Optimising the prescription and use of lower limb prosthetic technology: A mixed methods approach.

Elisabeth Manon Schaffalitzky  BA (Hons)
For receipt of PhD
Dublin City University
Supervised by Dr Pamela Gallagher
School of Nursing
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List of Acronyms

ADL – Activities of Daily Living
AT – Assistive Technology
CES-D – Center for Epidemiologic Studies Depression Scale
CID – Chronic Illness and Disability
ICF – International Classification of Functioning, Disability and Health
MPT - Matching Person with Technology model
NHS – National Health Service (UK)
OPUS - Orthotic Prosthetic User Survey
PEQ – Prosthesis Evaluation Questionnaire
PTSD – Post-Traumatic Stress Disorder
PVD – Peripheral Vascular Disease
QOL – Quality of Life
SI – Social Integration
SIGAM - Special Interest Group in Amputee Medicine
TAPES – Trinity Amputation and Prosthesis Experience Scale
TPB – Theory of Planned Behaviour
Elisabeth Schaffalitzky

Title: Optimising the prescription and use of lower limb prosthetic technology: A mixed methods approach.

Aim: Lower limb amputation is an increasingly prevalent surgical procedure in the Western world due to the increase of peripheral vascular disease. Not everyone who receives a prosthetic limb will benefit from its use and may abandon this expensive technology, a move which may negatively effect their adjustment to the amputation and also impact on their quality of life. There is currently no consensus on the most important outcomes to measure in lower limb prosthetic rehabilitation, or on the specific outcome measures to be consistently used in prosthetic rehabilitation. The aim of this research is to explore ways to optimise lower limb prosthetic prescription by identifying and gaining a consensus on 1) the most important outcomes of prescription, 2) the most important predictors of prosthetic use, and 3) the most important factors which have an effect on optimising use of the prosthesis.

Method: This is a mixed methods study. Repertory grid interviews were conducted with 2 lower limb prosthesis users to explore the values and preferences that prosthetic users have of their prosthetic devices; to investigate users’ perceptions of alternative prosthetic options and to demonstrate a novel method for exploring the values and preferences of lower limb prosthetic users. Semi-structured interviews were undertaken with 12 multidisciplinary service-providers within the amputation rehabilitation setting, and 6 focus groups were completed with 24 prosthesis users to identify the outcomes and predictors of prosthetic prescription from both the patient and professional perspective. This data was then used to create a Delphi survey of 23 experts within the amputation and prosthetic field, including users, service providers and academics, to develop a consensus on the most important factors to address within the prosthetic prescription process.

Findings: The repertory grid interviews highlighted the need to include patient choice and opinion in the prosthetic prescription process, while the focus groups and interviews identified the outcomes and predictors of prosthetic prescription while ascertaining what other factors affect optimal use of the prosthesis. These factors were physical, psychological and social in nature, and in particular, showed how service provision affects optimal use. A consensus on the most important factors to address in the fitting process and service was then established in the Delphi study.

Conclusion: By combining user and practitioner knowledge throughout the study, this research has developed a list of the essential elements to be monitored and improved in prosthetic prescription to improve outcomes, as well as highlighting the importance of patient inclusion and choice within the rehabilitation setting. This research indicates how fitting centres can potentially improve the service with the hope of improving fitting rates and user satisfaction and reducing the waste of medical resources.
**Study Overview**

The aim of this research is to identify and gain a consensus on 1) the most important outcomes of prescription, 2) the most important predictors of prosthetic use, and 3) the most important factors which have an effect on optimising use of the prosthesis. This will be done by using a number of different methods within a mixed methods framework.

Chapter 1 is a review of the amputation and prosthetic literature. The primary objective of this review is to clarify the state of knowledge in the outcomes of and factors associated with the prescribing and use of lower limb prosthetic technology, and to appropriately situate the rationale for the current research. The review examines the existing literature on amputation and prosthesis use. The purpose of these sections is to familiarise the reader with the circumstances leading to limb amputation, the physical challenges arising and the favourable physical rehabilitation associated with prosthetic use. The literature on non-use and under-use of the prosthesis, and the reasons behind them, are examined in order to understand why some people will not use their prosthesis to its optimum potential.

In order then to improve prosthetic prescription, the literature on outcomes and predictors of prosthetic prescription are outlined, with attention paid to the psychosocial, demographic and physical predictors of prosthetic prescription and use reported in previous research. A case is also made for the identification of factors which optimise the use of the prosthesis as different to predictors of prosthetic prescription. It is hoped that this review provides the rationale for the current study and the specific aims guiding the current research are presented.

Chapter 2 presents the methodology that will be followed for this research, in this case a Mixed Methods approach combining qualitative and quantitative methods. The philosophy behind Mixed Methods, specifically Pragmatism, is outlined as well as and the rationale for choosing Mixed Methods for this research. The research design is then stated and the specific research methods of inquiry put forth.
Chapter 3 comprises the first step of data collection: 2 case studies using the Repertory Grid. This aim of this section is to explore the values and preferences that prosthetic users have of their prosthetic devices; to investigate users’ perceptions of alternative prosthetic options and to demonstrate a novel method for exploring the values and preferences of lower limb prosthetic users. This study is conducted with a user of a high-tech prosthetic limb as well as a user of a more standard issue limb to gain two different perspectives on the technology available and offered to individuals who need prosthetic devices. It also highlights what may be important to certain individuals when it comes to using a prosthetic limb, including psychological and physical comfort with the device and the meanings that are attached to it. The procedure, analysis and results of the study are presented and the results discussed in terms of previous literature, current practice, and in relation to the current study.

Chapter 4 reports the second step of data collection, focus groups and interviews with prosthetic service users and providers. The aim of this section is to gain a better understanding of what individual users and service providers consider to be the important outcomes of having a prosthetic limb; factors which they think predict and affect the use of their limb and their experiences; and opinions of the service and prescription process. The procedure, analysis and results of this inquiry are put forward and a discussion carried out on how these results fit with previous findings and also contribute new knowledge in the field of prosthetics. The results of this study will also be the starting point for the Delphi study in Chapter 5.

The Delphi study, designed to create a consensus from a panel of experts on what are the most important outcomes of lower limb prosthetic prescription, the most important predictors in prosthetic prescription, and the most important factors in optimising the use of prosthetic limbs is described in Chapter 5. The procedure, analysis and results are described, with the discussion centring on the how the results contribute to knowledge about prostheses, fit with previous findings and potentially impact on the prosthetic prescription process.
The final study conclusions are then discussed in Chapter 6. This section looks at strengths of the study, how the findings on outcomes, predictors and factors optimising prosthetic use can be applied for use within the health care setting, the theoretical implications of the results of the research, and how future research can build on the results of this study to further optimise prosthetic prescription and use.

It should be noted that a concurrent study was conducted to optimise the prescription of upper limb prosthetic technology. Many of the same hospitals were contacted to provide participants for the above research inquiries and this is reflected in the research materials provided in the Appendices.
Chapter 1 - Literature Review

Multiple databases and individual journals (e.g. PsychInfo, PschyARTICLES, Medline, ScienceDirect, Academic Search Premier, BMJ, Prosthetics and Orthotics International, Cinahl Plus with full text, SpringerLink, Journal of Prosthetics and Orthotics, SAGE journals online, and Google Scholar) were searched using key words (e.g. amputation, prosthetics, lower limb, psychological, rehabilitation, disability, outcomes) to identify relevant publications for inclusion in this literature review. Relevant citations discovered from the initial database and journal searches, such as citations to book sections or conference proceedings, were also followed up and investigated. All sources were read, assessed and integrated into the final review if they were considered relevant for inclusion.

1.1: Lower Limb Amputation: Types, Causes, Prevalence and Costs

1.1.1 What is lower limb amputation?

Amputation is a surgical technique that has long been used to alleviate both congenital and acquired ailments of the extremities. It is often viewed as surgical failure but should instead be viewed as a means of returning a patient to a more functional level (Esquenazi and Meier, 1996). Major lower limb amputations generally include amputations that are transtibial (below-knee), through knee disarticulation, transfemoral (above knee), and hip disarticulation (toe amputation would not generally be considered major amputation). Below-knee amputation is performed more often than any other level of amputation (Esquenazi and Meier, 1996) due to the increased awareness of the benefits of a below-knee amputation over and above-knee amputation, decreased energy expenditure and improved rehabilitation potential (Tang et al., 2008). With a below-knee amputation, energy expenditure is believed to be raised 25-40% above normal, depending on cause and age (Tang et al., 2008) while with an above-knee amputation, energy expenditure is increased 68-100%, again depending on cause and age (Esquenazi and Meier, 1996).
Consequently energy expenditure for those with bilateral amputations can be up to 280% more than controls, depending on the level of amputation of each limb as well as the cause and age of the individual, though there is less available research to confirm this (Datta et al., 1992).

1.1.2 Causes and rates of amputation

The causes of lower limb amputation are varied, with amputation resulting from trauma (most usually motor vehicle accidents and warfare), vascular complications (usually from diabetes), tumour or cancer, infection (e.g. gangrene, again usually diabetes related), neurological disorders (e.g. polio, diabetic neuropathy) and congenital limb deformities. There is currently no epidemiological data available in Ireland on the number of people with amputations and their causes. The most relevant information available states that there are about 2000 outpatients at the main rehabilitation hospital in Ireland (Johnstone et al., 2008), though this obviously does not capture the full picture of those who have an amputation in Ireland. The Amputee Disability Federation of Ireland believes that there are over 6000 people living with amputations in Ireland, though there is no official data to support that claim. Indeed, the exact number of people who have amputation worldwide is difficult to determine as many countries do not keep records of the number of people with a limb amputation (Esquenazi, 2004).

The most up to date available evidence for amputation prevalence and incidence postulates that there are approximately 50,000 new amputations every year in the USA based on information from the National Center for Health Statistics (Esquenazi, 2004), yet Dillingham et al (2005) state that over 150,000 people a year are admitted to hospitals in the USA for amputation that are secondary to peripheral vascular disease (PVD) or diabetes alone, and another study reports that 185,000 undergo amputation yearly (Darnall et al., 2005). Disparity in numbers is caused by a variability of data collection methods within the medical arena (e.g. amputations are performed by vascular surgeons or orthopaedic surgeons, one person may also
undergo many amputations on the one limb). It is estimated though that 0.5% of all operations performed annually in the USA are amputations related to ischemia in the lower extremity (Jacobsen, 1998). In terms of the rest of the world, U.S. countries generally have higher amputation rates than non-US countries (in this case, the UK and Spain), and age adjusted amputation rates for men were 14.2 in every 100,000 and for women 6.7 in very 100,000 (Renzi et al., 2006). Schoppen et al have noted that 3000 primary amputation of the lower limb are performed annually in the Netherlands (Schoppen et al., 2003). From NHS Hospital Episode Statistics, there were 4574 lower limb amputation in the UK in 2006/2007, including minor amputations (NHS, 2006/2007) while in Germany there were 62,880 in 2006, which was actually a decrease in numbers from the previous year.

What is certain is that while in countries with recent civil unrest of warfare, trauma can account for 80% of all amputations (Esquenazi, 2004), and in most developed countries, the major cause for amputation is that of vascular complications, most likely resulting from diabetes mellitus, with 72% of lower limb amputation in the UK related to dysvascularity (NHS, 2006/2007), and 82% of all limb-loss related discharge diagnoses being accounted for by dysvascular amputations (Dillingham et al., 2002). These numbers are also increasing, with amputations arising from disease becoming more prevalent (Dillingham et al., 2002). The majority of patients who would present with amputation arising from vascular complications are older in age, usually over 60 years (Roberts et al., 2006), and may also present with a number of other comorbidities, such as cardiovascular disease. Individuals with PVD and diabetes can experience a progression of the underlying disease process that can result in amputation of the opposite lower limb, or higher-level amputation of the same limb. Furthermore, they also have a high rate of mortality. In a 12 month follow up study of 3565 persons with amputation (Dillingham et al., 2005), 26% of the sample required subsequent amputation within 12 months of their first amputation, and more than one third died within a year of their initial amputation. Those with diabetes were less likely than non-diabetic dysvascular patients to die
within 12 months of initial amputation (33% vs. 42% respectively), but they died at a significantly younger age than those without diabetes. Notably, the prevalence of amputations arising from disease is likely to increase due to the aging worldwide population and the associated increase in the number of people living with dysvascular conditions, especially diabetes (Wild et al., 2004). Further to this, given the increase in the prevalence of obesity and the relationship between obesity and diabetes, there is a likely projected increase in the incidence of amputation secondary to dysvascular conditions (Ziegler-Graham et al., 2008).

1.1.3 Costs of amputation

Amputations are predicted to cost approximately US$4 billion in the US in hospital expenditures alone. Dillingham et al (2005) conducted a study to examine the average health care costs for amputation patients over a 12 month period, including acute care hospital costs, inpatient rehabilitation, physician/outpatient care, home health care, durable medical equipment (e.g. assistive devices), and time spent in skilled nursing facilities by examining Medicare records. They found that the average cost for a non-diabetic transtibial amputation was US$74,937. This was significantly different to the $82,657 in costs for a diabetic transtibial amputation. Prosthetic rehabilitation can also be expensive with prosthetic technology ranging in price from $4000 for the more basic models of leg to $60,000 for a microprocessor controlled knee joint. A study on the average amount of prosthesis changes needed by persons with amputations in the US showed that those with transfemoral amputations needed 0.96 new protheses, 3.27 new sockets, 2.31 major repairs, 3.36 component changes and 21.85 minor repairs over a 10-year period. Those with transtibial amputations averaged 1.4 new protheses, 2.9 new sockets, 3.2 major repairs and 14.1 minor repairs over the same 10-year period (Nair et al., 2007). These costs, combined with the projected increase in prevalence of amputations due to the aging population and rising obesity rates, indicate how amputation is becoming a more visible issue for those working in healthcare and in the distribution of monetary resources and third party reimbursements.
1.2 Prosthesis Provision

Previous research has shown that, after the loss of a limb, there is a reduction in overall function within the community, including reduction in employment levels and social participation (Medhat et al., 1990). Rybarczyk et al (1997) theorise that when certain activities that are essential to an individual’s identity and self-worth are threatened, such as their employment status or recreation activities (social functioning), the individual will feel demoralised and may even eventually become depressed. One of the ways to help a person with an amputation regain their independence, prevent social isolation and help adjustment to the amputation is providing them with a prosthetic limb to improve their mobility. The hope is that restoring the function and form of the limb will help to optimise Quality Of Life (QOL) (Matsen et al., 2000). Indeed, for previous users of a prosthesis, to be forced to refrain entirely from using it (mostly due to residual limb complications) resulted in a reduction in QOL as measured by a tool created specifically for the study (Hagberg and Branemark, 2001).

Improved mobility also gives the user the chance to gain independence by doing the majority of their Activities of Daily Living (ADL) without the assistance of another person. This becomes important when considering that Verbrugge and Rennert (1997) have discovered equipment to be more efficacious than personal assistance for reducing disability. Those who use assistive technology as their primary source of assistance showed enhanced self-efficacy in comparison to those who had a personal carer, or even in comparison to those who used assistive technology and a personal carer. Self-efficacy beliefs enhance the functioning of the immune system, and lead to greater resilience in stressful situations, better general physical health, and better social and psychological adjustment (Carr, 2004). A study (Stineman et al., 2007) showed that achievement of even low levels of physical independence through rehabilitation compared with complete dependency markedly improved 1-year post-amputation survival rates of patients with amputations. Rates of survival also improved as physical independence improved, indicating that greater
independence could lead to a longer life. The hazard of death for prosthesis users after amputation, adjusting for functional status pre-amputation, presence of coronary artery disease, age, and diagnosis for amputation, was also found to be 80% less than for persons not using a prosthesis (Taylor et al., 2005).

Similarly, anything that increases mobility and enhances the patient’s confidence and self-esteem may help to facilitate the necessary physical and psychological transitions that take place after an amputation (Maguire and Parkes, 1998). Donovan-Hall et al (2002) found how the prosthesis, when changed to include a more aesthetically pleasing silicone cover, could improve engagement in more activities which revealed the body, and improved psychological comfort in situations which involved revealing the body, two factors which affect psychological adjustment and mental health (Rybarczyk et al., 1992, 1995).

This highlights that a prosthetic limb and its specific components can have positive effects, mentally, socially and even in relation to life-expectancy, other to its original mobility function, making it standard practice within lower limb amputation to provide a prosthesis to improve outcomes.

1.2.1 Prosthetic Prescription
The large varieties of prosthetic components available on the market make prosthetic prescribing and fitting a complicated process (Roberts et al., 2006), as prosthetists strive to achieve the optimal match between the different components and the patient’s need, functional levels and personal functional goals. They know that the “best” or most technologically advanced prosthesis will not be the most suitable for all patients. Firstly, due to economic constraints of the patient or medical provider, not everyone can afford to be fitted with the most advanced limbs. Secondly, what may be considered the “best” limb for one individual may actually be more of a hindrance to another individual (Gailey, 2006). For example, with the newly advanced energy storing feet, enough energy must initially enter the foot for it to
work, something that an older patient may be unable to supply. And even if there is the correct energy input, the spring mechanism in the foot may actually be too powerful for the individual to use, which would result in an imbalance, and most likely a fall. As such, when it comes to prescribing a prosthesis, professional efforts to deliver the right prosthesis can only be successful if attention is given to the specific needs of the individual (Brown-Triolo, 2002).

1.2.2 Prosthesis fitting rates

Fletcher et al. (2001) noted that several studies have reported successful prosthetic fit rates of 60-90% for transtibial amputation patients and 50-70% in older transfemoral amputation patients who have been referred for fitting. Retrospective studies also show that there appears to be no statistical improvement in the rate of prosthetic fitting in forty years, as seen in a comparison study of the years 1956-1973 and 1974-1995 (Fletcher et al., 2002). This is despite changes in surgical practice to have the residual limb more suited for fitting, and improved management of diabetes leading to an increase of below-knee over above-knee amputations which are more suited for prosthesis fitting (Lindholt et al., 1994, Alaranta et al., 1995) and are associated with better outcomes (Gauthier-Gagnon et al., 1999, Siriwardena and Bertrand, 1991). Suggested reasons for the lack of decrease are related to the increasing age of the population impacting on the age of first amputation, and the higher incidence of comorbidity in the latter group, most notably cerebrovascular disease which is associated with an inability to use a prosthesis (Fletcher et al., 2001). The overall fitting rates thus indicate that certain factors will preclude an individual being fitted for a prosthesis.

1.2.3 Prosthesis Use

Prosthesis use rates have been reported in a number of different studies, although there are difficulties in making comparisons due to differences in how prosthesis use is defined within the literature. Studies vary in how use is measured, be it in step
count (Klute et al., 2006), use of the prosthesis indoors and outdoors (Meatherall et al., 2005), how many hours used a day (Kauzlaric et al., 2007), or hours used per week (Pezzin et al., 2004) or whether it’s used daily (Bilodeau et al., 2000). Use can also be related to how the user uses the prosthesis, such as for a cosmesis, for transfers, for walking indoors or outdoors, or for ambulating on all surfaces at all times (Christensen et al., 1995). This makes it difficult to take a lot of the research findings on face value due to their incompatibility when trying to make comparisons (Bilodeau et al., 2000). It is also important to note that patients with amputation from trauma or tumour are usually younger and almost always do better in terms of rehabilitating than the older population associated with diseases-related amputations. Any study that includes both trauma-related and disease-related amputations when studying successful fit could bias results and overestimate the potential success rate in geriatric patients (Fletcher et al., 2001). Further to this, other studies which use homogenous groups are then not applicable to the wider amputation population (Pernot et al., 1997).

While these issues clearly play a role in analysing the data, it appears that there is a problem with non-use of the prosthesis. Use rates reported have varied as much as from 49% to 95% (Schoppen et al., 2003, Gauthier-Gagnon et al., 1998, Gauthier-Gagnon et al., 1999, Dolezal et al., 1998, Dillingham et al., 2001). In fact it has been found that 33% of non-users (n=63) had discarded their prosthesis during the first year and 16% had never worn it (Gauthier-Gagnon et al., 1998). Further to this, those that do get prescribed this technology may not be using it to its full potential. In a study on US war veterans, all persons with lower limb amputation who had identified themselves as primarily wheelchair users, were also in possession of micro-processor controlled knee joints. Essentially these individuals were using an expensive functional prosthesis as a cosmetic prosthesis, indicating a large waste of medical resources (Karmarker et al., 2009).
These findings then indicate that despite the advances in care and the efforts of the prosthetist, there are a number of patients who will have problems with the prosthesis and may even end up abandoning the prosthesis in the end. This then is a serious problem when considering the increasing rates of amputation, the increasing prescription of prosthetic limbs, and the increasing costs associated with the new technology and healthcare provided. The non-use of the prosthesis may also have a negative effect on the patient-healthcare team relationship (Verza et al., 2006). This is pertinent due to the long-term nature of the relationship between prosthetic user and prosthetic provider, especially prosthetists. It becomes important then to understand how prosthetic prescription can be improved to best serve the needs of the individual user so that the patient outcomes are improved, the patient-healthcare team relationship is maintained, and costs are not wasted on unused or under-utilised technology.

1.3. Reasons for Non-use of the Prosthesis

From the AT literature, researchers have postulated that practitioners “assume that rejection or abandonment of an assistive device is the fault of the abandoner” (Day and Jutai, 1996, p.159). This approach may overlook how prosthetic prescription can be better improved to address the specific needs of the individual physically, psychologically and socially. In order to optimise the use of the prosthesis, it is important to understand why individuals will not use, or under-use, a prosthesis and how this can be understood and applied in the healthcare setting.

One reason for non-use is that those who are dissatisfied with the comfort and look of the prosthesis, and are generally dissatisfied with the prosthesis as a whole, are more likely to not use the prosthesis. Certainly low levels of satisfaction with the prosthesis have been found to be related to the look of the prosthesis, the comfort of the prosthesis, the weight and even sounds made by the prosthesis (Pezzin et al., 2004, Dillingham et al., 2001, Gallagher and MacLachlan, 2000a, Legro et al., 1998).
However, research has shown that persons dissatisfied with a prosthesis still able to wear and use one (Dillingham et al., 2001, Pezzin et al., 2004) and persons will wear a prosthesis even when it results in pain and discomfort (Murray and Fox, 2002). This is not to indicate that satisfaction is unimportant in prosthetic prescription, but just that it is not indicative of non-use of the prosthesis.

Gauthier-Gagnon et al.(1998) reported that 28.5% of non-users will reject the prosthesis because it no longer fits, yet will not have returned it for repairs or adjustments, even when the prosthetist is nearby and appointments are readily available to the patient. This finding fits with the idea that if a patient rejects their prosthesis repeatedly saying that it does not fit, then they will continue to abandon the prosthesis regardless of any adjustments made (Ham and Cotton, 1991). This suggests that non-use is not related only to the fit of the prosthesis, but potentially to other factors that could be psychological in nature. Therefore ‘successful fitting’ of a prosthesis does not necessarily translate to successful use.

1.3.1 The impact of psychosocial factors
Gailey (2006) has noted that the most common argument against prediction of prosthetic ability would be the variable of compliance and points out that Mueller and Delitto (1985) found only compliance and medical problems after prescription showed a significant difference between successful and non-successful long-term transfemoral prosthetic users. In this instance, compliance was measured by whether a patient kept appointments and followed recommendations for treatment. Gailey argues that as these factors happen after the fact, a therapist would be unable to foresee the problem. Yet with psychosocial measures there could be a way to foresee these problems and accommodate for them.

1.3.1.1. Adaptation to the amputation
The way in which a person with an amputation experiences him or herself and how he or she constructs meaning out of his or her experience may also influence his or
her attitude towards prosthetic acceptance and use. The fact is that the technology needs to be integrated into a life that is deemed to be worth living and also a view of the self that is worth living for (MacLachlan and Gallagher, 2004). Unless the self after limb loss is accepted, there may be a difficulty in integrating and adapting the technology into the individual’s life, which could lead to non-use of the device. Heinemann and Bender-Pape (2002) state that device user rates are greater when the person has achieved a sufficient level of adaptation to the disability. As there is a renegotiation of ‘self’ that occurs following an amputation (Gow et al., 2004), the way in which a person with an amputation experiences him or herself and how they construct meaning out of their experience may influence their attitude towards prosthetic use. People who adapt to the loss of a limb may eventually make an effort to improve their function with the use of a prosthetic limb, while those who don’t may not be suitably motivated to do so. In their study on prosthesis use, Gauthier-Gagnon et al. (1998) found adaptation to amputation to be the best predictor of prosthetic use. However, it still remains uncertain why some individuals adjust and grow psychologically following amputation whereas others do not (Oaksford et al., 2005).

Research with Assistive Technology (AT) is more advanced in understanding how adaptation to Chronic Illness and Disability (CID) can affect device use. AT abandonment has been found to be related to people’s perception of themselves as disabled and broader issues related to identity (Hocking, 1999). In a study, users who were more accepting of their illness or disability were more likely to use their AT post-discharge from rehabilitation, and those with negative perceptions of disability and illness were less likely to use their assistive device (Wielandt et al., 2006). Similarly, the extent to which an individual has adapted to a newly acquired impairment rather than feeling embarrassed by their disability, has been identified as contributing to non-use of assistive devices (Schemm and Gitlin, 1988, Scherer and Galvin, 1994).
Livneh and Antonak (1997) view adjustment as the final stage in adapting to an amputation, and state that it is characterised by reaching and maintaining psychosocial equilibrium, achieving a state of reintegration, positively striving to reach life goals, demonstrating positive self-esteem, self-concept, and self-regard, and experiencing positive attitudes toward oneself, others and the disability. As such, in order to achieve optimal outcomes after amputation, it is important for the individual to adjust to the amputation. A failure to do so may lead to a number of psychological problems which could in turn lead to poor involvement in prosthetic rehabilitation affecting long-term outcomes (Engstrom and Van de Ven, 1999). Further to this, difficulties in adjustment and acceptance of the amputation are typically associated with reports of depression, low self-esteem, feelings of hopelessness, anxiety, fatigue, and in the extreme, suicidal ideation (Desmond and MacLachlan, 2002).

1.3.1.2 Mental Health Issues
Levels of depression within the amputation patient population have been well investigated, and many studies have reported rates of depression in excess of the community norms (Horgan and MacLachlan, 2004), with prevalence rates varying from 20.8-45% (Atherton and Robertson, 2006). Numerous studies have also indicated that those who do not adjust to their amputation are likely to suffer from depression and/or anxiety (Livneh et al., 2004), although the causal relationship is not completely defined.

This is relevant due to the associations between depression and rehabilitation. In other rehabilitation literature, depression has been associated with lower use of rehabilitation services (Gillen et al., 2001), and also to less success at functional recovery (Cully et al., 2005). Maguire and Parks (1998) state that those who suffer from depression cope less well and suffer more pain after amputation. Untreated depression may also increase the psychological impact of amputation, limit restoration of function and delay return to active lifestyle (Briggs, 2006). These
associations indicate how depression could impact on the use of the prosthesis due to its effect to rehabilitation process and adjustment to the amputation. The prevalence of depression within the population then means that that effect could be significant.

However, caution must be taken when examining the literature, as a number of different finding are available, with some studies finding no increases in levels of depression (Breakey, 1997), some saying depression may remain high for up to 10 years post-amputation (Bodenheimer et al., 2000), while others conclude that depression can be rapidly resolved within even a few weeks of the amputation (Singh et al., 2007). This may be due to the use of different methodologies across the different studies, the use of self-reporting measures like the Centre for Epidemiological Studies Depression Scale (CES-D) rather than clinical interviews, and the fact that many people with amputations would be likely to suffer from some of the physical symptoms of depression for medical reasons alone (e.g. fatigue, disturbed sleep). Therefore, depression may be over-reported due to the limitations that arise from the amputation itself (Horgan and MacLachlan, 2004) or indeed from the symptoms from the underlying disease which caused amputation.

Anxiety may also affect prosthetic rehabilitation. In rehabilitation research, patients with higher levels of anxiety had more difficulty in presenting their problems during consultations with medical staff compared to patients with lower levels of anxiety and thus relied on the questioning of doctors to elucidate their problems. Similarly, doctors gave less medical information to patients with high anxiety levels (Graugaard et al., 2003), something which may exacerbate the anxiety of those who are already anxious about their condition. Distressing thoughts, a symptom of anxiety disorders, have been found to influence activity limitations in lower limb amputees (Callaghan et al., 2008). In the AT literature, one study found that those who were not anxious were 4.3 times more likely to use their AT than those with mild to severe anxiety (Wielandt et al., 2006).
After conducting a literature review on anxiety within the patient population, Horgan and MacLachlan (2004) concluded that while anxiety is likely to be increased in the period immediately after and up to 1 year post-amputation, this level is likely to fall off afterwards to levels that are observed in the general population. However, there appears to be a number of studies that report levels of Post Traumatic Stress Disorder (PTSD) post-amputation that are higher than those found in the general population. Desmond and MacLachlan (2006a) conducted a study with 582 ex-servicemen in the UK to identify cases of PTSD. Of the sample, 32% met the criterion for possible clinical depression, and 34% met the criterion for possible clinical anxiety, although the majority of these were considered to meet “mild” symptoms. Similarly, almost a quarter (24.6%) of the sample reported significant post-traumatic psychological stress. As the average time since amputation of this group was approximately 53 years, with a range of 20-69 years approximately, it may seem unusual that mental health could still be affected by the amputation, but it is important to note that these were traumatic amputations, most of which came from active combat, and PTSD is more associated with traumatic amputations than amputations arising from other conditions (Cavanagh et al., 2006). However, this continuation of anxiety issues for a significant period after amputation indicates how mental health issues could impact on the acceptance of the amputation or acceptance of the prosthesis for longer periods of time if intervention is not provided. Similarly, Graham et al (2006) studied persons who had sustained limb loss as a result of terrorist activity in Northern Ireland and found that 67% of those studied (n= 75, of which 57 had lower limb amputations) had symptoms of PTSD. Importantly, those with symptoms of PTSD and psychiatric caseness were significantly associated with feeling that they had not made the best possible recovery.

The prevalence of mental health issues within the amputation population is obviously of concern to those working within the amputation rehabilitation setting. These conditions may affect rehabilitation progress, and in turn may arise as a result
of the rehabilitation process. If those with amputations are going to achieve optimal results through rehabilitation and optimal results with their prosthesis, then it is clear that mental health issues need to be appropriately addressed.

1.3.1.3 Psychological Comfort

When it comes to assistive devices, their use presents some dramatic compromises in self-identity and imposes many cognitive, behavioural and pragmatic adaptations, especially when it concerns the older population that is associated with lower limb loss (Aminzadeh and Edwards, 2000). With the rapid advance of prosthetic technology in both quantity and sophistication, there is a greater responsibility on those who develop and prescribe it to be aware of its impact on the ways in which people understand and construct their realities and attempt to cope with them (Gallagher and MacLachlan, 2004a). The fact is that the loss of the ability to relate psychologically, socially, sexually, vocationally and avocationally after amputation may have more impact on quality of life than the loss of the limb itself (Fitzpatrick, 1999). If rehabilitation professionals are to ensure the best possible match of prosthesis and user, it is imperative that they consider the persons psychological as well as physical comfort with the prosthesis.

As the prosthetic technology is effectively an interface between a person and the life they wish to lead, it could be argued that it is how people react to technology, and not the technology itself, that can decide just how ‘enabling’ it is (Gallagher and MacLachlan, 2004a). A given prosthesis may represent a restoration of independence and embody ability for one person because of what it enables them to do, while for another person, or the same person at another time, the same prosthesis may embody disability because it represents what they are unable to do (Gow et al., 2004).

A further review of the AT literature on the meanings assigned to assistive devices (Louise-Bender Pape et al., 2002) also stated that successful use of the device
involved users exploring the personal meaning they assign to the device; the anticipated social costs; and their expectations of the technology. Hocking (1999) also declares that the values and emotional responses to using assistive devices may be more potent factors in surviving, or even doing well with the device, than the opportunities that having the device enables. These findings further emphasise the role of individual feelings that persons attach to devices, as well as the large number of factors that need to be taken into account to ensure that the best possible match is made between user and device.

Marcia Scherer has created a model for Matching Person with Technology (MPT) (Scherer, 2000) for use with AT that takes into account the salient characteristics of the assistive technology itself; the characteristics of the environment and the situations in which the technology is to be used; and the relevant features of the individual’s personality, temperament, and preferences that may have an effect on the use of the technology. She argues that an individual may be an optimal user according to one or two of the factors, but may be a reluctant user on the other factor. For example, they may have the optimal personality and technology factors, but be reluctant to use their technology because of lack of support in their environment from family and friends. As such, the environment for use will need to be somewhat modified so the individual can gain optimal satisfaction and functional gain from the device. Assistive device use is also seen as interactive, with changes in one set of factors, such as temperament, having an effect on the other factors. For example, if an individual feels they have the best technology available and feel no discomfort or pain using it, they may become proud of using the device and improve their self-confidence, maybe in turn broadening their involvement in the community. This model obviously outlines some of the key factors that are needed for AT selection and could prove useful with prosthetic prescription due to the parallels that can be drawn between AT prescription and prostheses. However, this model is built on research with AT, which is still fundamentally different to prosthetics. Essentially prosthetics is a specialised area within AT, and as such needs specialised
measures. The specific difference even between upper limb and lower limb prosthetic prescription requires different approaches in research and when prescribing the limb, indicating that a catch-all prescription tool for AT will not delve into the specifics needed by prosthetists and other amputation specialists to improve non-use of the prosthesis.

What is clear from the above literature is that lower limb prosthesis prescription may not currently address some of the above issues in order to optimise prosthesis use. It therefore is important to look at the specific literature on prosthetic prescription and how it can be better improved to serve the needs of prosthesis users.

1.4 Improving Prosthetic Prescription

1.4.1 Outcomes of prosthetic prescription

Monitoring professional abilities through outcomes has become a necessary component of marketing rehabilitation services and ensuring ethical and professional work (Brown -Triolo, 2002). The goal of assessing health outcomes has been identified as improving the quality of life of patients by improving their quality of care and their quality of health (Szabo, 2001). Outcome assessment can also aid comparisons of different treatments, interventions and service delivery (Deathe et al., 2002) and contribute to cost effectiveness (Larner et al., 2003). Having standardised clinical guidelines closes the gap between what clinicians do and what scientific evidence supports and makes health care more consistent and efficient (Van der Linde et al., 2004b).

There is currently no consensus on the most important outcomes to measure in prosthetic rehabilitation, or concurrently, on the specific outcome measures to be consistently used in prosthetic rehabilitation. Much like comparing prosthesis use rates, there are a number of studies which look at outcomes of prosthesis use from different perspectives, placing importance on a number of different outcomes, and using a variety of outcome measures. Outcomes measured include:
- Level of disability with the Reintegration to Normal Living Scale (Davis et al., 1999),
- Independent living status (Taylor et al., 2005),
- Activities of daily living using the Barthel Index (Brunelli et al., 2006) and Functional Independence Measure (Bussmann et al., 2004),
- Level of self care (Nehler et al., 2003) and
- Activity restriction using the Trinity Amputation and Prosthesis Experience Scales (TAPES) (Deans et al., 2008).

Different mobility levels have been measured using the
- Special Interest Group in Amputee Medicine (SIGAM) mobility grades (O'Neill and Evans, 2009) (Graham et al., 2006),
- Locomotor Capability Index (O'Neill and Evans, 2009, Brunelli et al., 2006, Callaghan et al., 2008, Bussmann et al., 2004),
- Harold Wood/Stanmore mobility grades (Hanspal and Fisher, 1997),
- mobility grades created for the research (Schoppen et al., 2003),
- 6-minute walk test (Gailey et al., 2002),
- Timed Up and Go test (Schoppen et al., 2003),
- Step Activity Monitoring (Boone and Coleman, 2006, Klute et al., 2006) and the
- Physical Cost Index (Chin et al., 2007), along with a number of other biomechanical measure of gait and posture (Mouchnino et al., 2006).

Prosthesis use has been measured using the
- Functional Measure for Amputees (Callaghan et al., 2008) (Rau et al., 2007),
- The Houghton Scale (Leung et al., 1996, McNeill et al., 2008),
- Prosthetic Profile of the Amputee (Gauthier-Gagnon et al., 1998)
- The Orthotic Prosthetic User Survey (OPUS) (Karmarker et al., 2009) and
- Prosthesis satisfaction using the Prosthesis Evaluation Questionnaire (Asano
et al., 2008, Boone and Coleman, 2006) and the TAPES (Gallagher and MacLachlan, 2000a).

From a more psychosocial perspective, Quality of Life has been measured with

- The Visual Analogue Scale (Asano et al., 2008)
- Satisfaction with Life Scale (Wegener et al., 2009),
- Prosthesis Evaluation Questionnaire (PEQ) (Boone and Coleman, 2006, Legro et al., 1998),
- The Trinity Amputation and Prosthesis Evaluation Scale (Gallagher and MacLachlan, 2004b), and the
- Patient Generated Index (Callaghan and Condie, 2003)

Mental health outcomes have been assessed using

- The Centre of Epidemiologic Studies Depression (CES-D) scale to screen for depression (Asano et al., 2008, Wegener et al., 2009) and the
- General Health Questionnaire to screen for PTSD (Graham et al., 2006)

This extensive list indicates how prosthetic research has not defined the most important outcomes of prosthesis use, and unfortunately this is also the case in prosthetic practice. Deathe et al (2002) have described how centres of care in Canada evaluated programme and patient outcomes. Out of the 44 responses received from 61 centres contacted, a total of 31% of responders reported that they did not use any formal outcome measure to assess patient outcomes. Of those centres that did use formal measures, 67% did not use self-report measures, thus missing the patient’s own perspective on their rehabilitative outcomes. In fact, the majority of outcomes were concerned with only functional or physical aspects of rehabilitation. Heinemann et al (2006) have noted how this narrow focus on clinical indicators can tend to devalue and disregard important human and social outcomes.

The measurement of outcomes would provide an evidence base for the quality, value
and effectiveness of prosthetic practice (Hart, 1999) and responds to the need for accountability that is expected not only from funding sources, but also from the clients in receipt of the service (Miller et al., 2001a). If a prosthetic user is to receive the necessary payments from third party reimbursement for the best prosthesis for them, healthcare professionals must document the effectiveness of their interventions and ensure that resources and energies are not further wasted through prosthesis non-use.

There is currently an ongoing project which aims to develop an International Classification of Functioning, disability and health (ICF) core set for use in the prosthetic field (Kohler et al., 2009). ICF core sets are best described as combining the most relevant domains within the ICF for specific conditions or health-care situations so that the least number of domains is used to be practical, but with as many required to sufficiently and comprehensively cover the spectrum of limitations in functioning and health found with a specific condition (Stucki et al., 2002). They are developed to encourage the use of relevant outcome measures and interventions and have been developed for a number of different diseases and conditions (McIntyre and Tempest, 2007).

However, it appears that the ICF is not specialised enough to deal with the range of different function and body structures, such as walking with a prosthesis or considering the length of stump, which are essential to the prosthetic rehabilitation process (Kohler et al., 2009). The ICF also does not take into account temporal factors such as a persons stage in recovery and also does not acknowledge patient choice, an important factor in rehabilitation where pathology does not always predict limitation (Wade and Halligan, 2003). Certainly specific personal characteristics, such as self-efficacy or locus of control, attitudes and personality are not included within the ICF framework. Furthermore, while prostheses do offer a restoration of function, they do not necessarily result in increased activity of participation: many people with amputations choose to avoid situations where the amputation or
prosthesis may be visible to others (Rybarczyk et al., 1992, Williamson, 1995, Sjodahl et al., 2004, Donovan-Hall et al., 2002) despite having the functional ability to do so.

An ICF core set on amputation may prove useful for collating some functional information which is then easily transferable to different healthcare settings for further use. However, looking to the reasons for non-use stated previously, such as adaptation to the amputation and psychological comfort with the technology, there is clearly a need within prosthetic prescription to look at psychological outcomes deeper than activity and participation to understand why a person does or does not use a prosthesis and improve prescription accordingly. As such, it remains important to ascertain the most important outcomes of prosthetic prescription through other means which are not restricted by the ICF categories so that prescription and interventions are tailored to meet these outcomes.

1.4.2 Predictors in Prosthetic Prescription
Current prescription criteria in prosthetics are based mainly on subjective experiences of physicians, therapists and prosthetists. It is then argued that prosthetics as a field has fallen behind other professions in using evidence-based practice (Ramstrand and Brodtkorb, 2008). For example, The Medicare Functional Classification Levels (MFCL) (HCFA, 2001) were created to determine prosthetic prescription, with levels ranging from K0-K4 to classify various levels of lower limb amputation patients’ functional ability pre-prescription. However, this evaluation is still done subjectively by an evaluation by the physician and/or prosthetist on a number of different factors, such as current medical condition, history, and the desire to walk (Gailey et al., 2002). Also, there is the possibility that there can be difference in assessing the mobility and self-care in patients with an amputation by clinicians within the same rehabilitation team, as found by Stephen and Aitken (1987). MFCL assignments are also based on current functional levels rather than the ‘functional potential’ of amputation patients, which can lead to an individual
receiving prosthetic components that are below their functional level (Gailey, 2006). A number of functional assessment measures have been created, such as the Functional Ambulation Profile (Nelson, 1974), the Amputee Activity Survey (Day, 1981) and the Functional Independence Measure (Keith et al., 1987). However, none of these measures have been found to be reliably predictive of how a patient will do with a prosthesis in the long run (Leung et al., 1996, Gailey, 2006).

A research group in the Netherlands is currently developing national clinical guidelines for the prescription of lower-limb prostheses using the Delphi Technique (Van der Linde et al., 2005) based on previous research (Van der Linde et al., 2004a) with relation to specific choice of components. This study essentially created a list of guidelines that reflect the implicit processes used in prescription, such as ‘Weight of prosthesis is not essential criterion in prosthesis prescription for young transfemoral amputees’ (p.702). While this is an important first step in improving the prescription process, it could be argued that this study is just clarifying the current approach to prosthetic prescription, an approach which still needs to be improved.

Recently Gailey (2006) has also created the Amputee Mobility Predictor (AMP), and the AMPnoPRO for use without a prosthesis, to predict prosthetic mobility, and has found good inter-rater reliability and good prediction of the 6-minute walk test. It evaluates transfers, sitting and standing balance and various gait skills. However, while it can predict functional use of a prosthesis, it does not predict if an individual will continue to use the prosthesis after discharge from rehabilitation, or similarly use the prosthesis to the best of their abilities.

1.4.3 Literature on Factors Affecting Prosthetic Prescription and Use

It is clear then that prosthesis prescription in practice is not fully objective and furthermore is currently only predictive in terms of functional factors predicting functional outcome, rather than talking a more holistic approach to predict a greater
range of outcomes. As the important outcomes of prosthetic prescription are not yet known, it may be useful to look at the factors which have been identified in the literature as potentially predictive of prosthetic use and other outcomes.

1.4.3.1 Psychosocial Predictors of Prosthetic Use

From the previous review on research concerning the non-use of the prosthesis, it is clear that psychosocial factors can play a role in prosthetic prescription. Knowledge of the predictive relationships between psychosocial variables and rehabilitation and health outcomes would realise the prospect of being able to create facets of primary care and rehabilitation aimed at increasing the number of amputation patients making effective use of their prosthesis and/or achieving successful adjustment to their amputation (Callaghan et al., 2004). Arguably, if certain psychosocial variables are identified within rehabilitation such as poor adjustment or mental health issues, certain interventions may be set up to help the individual to adjust to the amputation and improve their outcomes. Furthermore, this knowledge could also prove useful in the prescribing of the appropriate prosthesis or assistive device for certain individuals to prevent non-use.

One study has tried to determine how specific psychological factors can predict prosthetic use. This study used the Common Sense Self-Regulation Model (CS-SRM) to determine the psychological predictors of prosthetic use and activity limitations (Callaghan et al., 2008). This approach states that inner and outer stimuli, such as the symptoms and diagnosis of an illness, trigger cognitive representations and emotional responses. These include:

- identity (number of symptoms the patient associates with the illness),
- timeline-acute/chronic (perceived duration of the condition),
- timeline-cyclical (perceptions of symptoms fluctuating),
- consequences (expected effects and outcomes of the condition),
- personal control (beliefs that one’s condition is self-controlled),
- treatment control (beliefs that one’s condition is controlled by treatment),
• illness coherence (how much the patient understands or comprehends their condition),
• causal attributions (personal ideas about the etiology of the condition) and environmental representations (emotional responses generated by the condition) (Leventhal et al., 1980).

Using this model, it was concluded that indoor prosthetic use at 6 months post-discharge could be predicted for persons who in rehabilitation perceived that their treatment would be effective in controlling their condition and that their physical symptoms fluctuated less. Outdoor prosthetic use at 6 months post-discharge was also found to be predicted for persons who perceived their treatment would be effective in controlling their condition, that their physical symptoms fluctuated less, and that their condition was caused by emotional/psychological factors (e.g. stress, personality and mental attitude). Hours per day of prosthesis use was also predicted by a CS-SRM model. Patients who in rehabilitation perceived that their physical symptoms fluctuated less, and that their condition was not caused by risk factors but was attributable to emotional or psychological factors, used their prosthesis more hours per day at 6-months post-discharge.

These findings indicate how specific beliefs and perceptions can be used to predict prosthesis use, though clearly from the last example on hours of use, while there is a relationship between the variables, we cannot be sure of the reasons behind the outcome. Further to this, the study admits to using a sample that may not be representative of the current amputation in terms of age and cognitive function, and they also lost over a quarter of their original sample of 166 persons at the 6-month follow up. However, the relationship found between psychological variables and prosthesis use reveals the importance of their inclusion in prosthetic prescription. Unfortunately not many other psychological or social variables have been examined to ascertain their direct effect on prosthesis use. However, due to their impact on mental health and adjustment to the amputation, these factors could potentially
impact on prosthesis use indirectly. As such, a number of psychosocial factors will now be examined to clarify their effect on prosthesis use.

1.4.3.1 Body Image Issues, Stigma and Social Isolation

Body image has been defined as ‘the combination of an individual’s psychological experiences, feelings and attitudes that related to the form, function, appearance and desirability of one’s own body which is influenced by individual and environmental factors’ (Taleporos and McCabe, 2002a, p.971). After the loss of a limb, the amputation patient needs to reconceptualise their body image to include the amputation. This reconceptualisation requires the patient to incorporate the loss of the limb, the likely phantom sensation of the limb, not to mention a prosthesis and any other mobility aids (Novotny, 1991). Patients who have an image of their bodies as a complete and undamaged entity, which may seem like a positive attribute resulting from positive self image, will in fact tend to suffer from phantom limb pain (Murray and Fox, 2002) and may have difficulties in adjustment.

Certain body parts carry conscious and unconscious symbolic meaning for an individual (Breakey, 1997) and bodily appearance also affects social identifications and self-definitions (Charmezi, 1995). Consequently, there appears to be a relationship in lower limb amputation patients between the perception of body image and psychological well-being, namely, the degree to which patients experience anxiety, depression, self-esteem and life-satisfaction after their amputation. Breakey (1997) has found a significant correlation between body image and life satisfaction, as well as anxiety, self-esteem, and the affective measures of depression on the Generalized Contentment Scale (Hudson, 1982). The more negative a person with an amputation feels about his or her body image, the less satisfied he or she will be with his or her life, and the more likely they are to have psychosocial difficulties. The effect on mental health issues indicates how body image can further disrupt prosthetic rehabilitation and prosthetic use. Body image can also have a more direct affect on prosthesis use, with higher levels of overall satisfaction and functional
satisfaction with a prosthesis, coupled with low levels of body image disturbance, correlated with higher levels of hourly prosthesis use per day (Murray and Fox, 2002). This study (n = 44) also split the results for genders, with lower levels of body image disturbance associated with higher functional satisfaction in males. Females however had higher levels of functional satisfaction, aesthetic satisfaction and weight satisfaction associated with lower levels of body image disturbance. However, due to the nature of correlations, these findings could either indicate the effect of body image on prosthesis use, or vice versa. However, the link between the two indicates the importance of body image within the prosthesis rehabilitation setting.

Body image is an important topic within the area of physical disability, especially when concerning visible disabilities and the stigmatisations that can arise from them. Goffman (1963) introduced the concept of stigma to refer to visible or distinguishing features in an individual or group, leading to negative perceptions and behaviours by others. Specifically he mentioned how stigma can arise from physical deviation that may be interpreted as deformity or disfigurement. According to this theory, people with visible disabilities, or even invisible disabilities, may be subject to stigmatisation from strangers due to their differences. The person becomes discounted socially, financially, and intellectually purely because of their physical appearance. The disability becomes the over-riding identity of that person which obscures all other personal characteristics, skills and abilities (Taleporos and McCabe, 2002a). There is also the danger that the individual themselves may also take this view as their physical form affects their self-perception of their capabilities as well as their acceptability to others (Breakey, 1997). This may be further antagonised by the use of a mobility aid, as in general, mobility aids are associated with the stigmas of aging and disability (Aminzadeh and Edwards, 1998).

Stigmatisations, as experienced by the self or others, may lead individuals with amputations to avoid certain social situations such as those revealing the body
(Donovan-Hall et al., 2002, Sjodahl et al., 2004) and lead to feelings of social discomfort (Rybarczyk et al., 1992). Rybarczyk et al. (1992) asked individuals with amputations whether they were bothered by public enquiries about their amputation or prosthesis, and if they avoided being in public because of their amputation or prosthesis. They found that having high levels of social discomfort (as interpreted from these questions) was a significant predictor of depression as measured by the CES-D, even after the effects of age, gender, social support, time since amputation, reason for amputation, and perceived health were controlled. In a separate focus group study, participants recounted awkward situations when they told people about having a prosthetic limb, expressed concern about the impression they made on others, and had the wish to appear ‘normal’ (Gallagher and MacLachlan, 2001b). Another study by Rybarczyk and colleagues (1995) found body image and perceived social stigma to be significant and independent predictors of depression after controlling for factors found to be linked to adjustment in previous studies (such as time since amputation, site of amputation and cause of amputation), with perceived social stigma found to be the best predictor of depression. Body image was also found to be an independent predictor of quality of life and an individual’s prosthetists’ rating of their psychological adjustment, indicating the importance of body image in adjustment to the amputation and in the overall outcomes of the individual. Again, these findings indicate how body image can affect the use of the prosthesis through its impact on mental health, adjustment to the amputation and rehabilitation.

1.4.3.1.2 Coping Strategies

Coping is defined as “the process of managing stressors that have been appraised as taxing or exceeding resources, and as the effort to manage environmental and internal demands” (Lazuras and Launier, 1978, p.311). Coping strategies are used in situations in which there is a perceived discrepancy between stressful demands and available resources for meeting these demands (Zeidner and Endler, 1996). Within the coping literature, there appears to be a number of differently effective coping
strategies available on a number of different coping dimensions. The most commonly mentioned are the approach versus avoidance coping and/or the cognitive versus behavioural coping (Beutler et al., 2003), but there are others that are also extensively studied, and indeed are similar in fashion, such as emotion-oriented (passive) and task-oriented (instrumental) coping styles (Endler et al., 2003). In fact, most coping styles can usually be fitted under the headings of “problem-focused coping”, such as confronting, planned problem solving, and seeking social support, or “emotion-focused coping” such as self regulation of emotions, distancing, positive reappraisal, accepting responsibility and avoidance.

Coping strategies have been examined in relation to amputation and how they affect adjustment. However, they have not been specifically looked at in terms of a direct effect on prosthesis use. That said, the literature that examines how coping strategies affect adjustment is still relevant due to the effect of adjustment on prosthesis use and participation in rehabilitation, and so will now be looked at in more detail.

Coping with a lower limb amputation is a process that involves multiple demands, both physical and psychological. Livneh et al (2000) found using cluster analysis on results of 61 people with amputations on the COPE Inventory that they utilised three different dimensions of coping. The first dimension consisted of cognitive and behavioural active coping contrasting with avoidance, the positive end of which consisted of direct plan- and action-taking efforts as an opposite to the avoiding, escaping and disengagement methods of the negative end of the pole.

The second dimension reflected a positive or optimistic attitude versus a fatalistic or pessimistic attitude, but could also be interpreted as using abstract or spiritual coping methods i.e. turning to God and religion in a stressful situation, versus concrete or substantive methods. These seem similar to the first dimension, in that actively
engaging in realistic problem solving is a more positive and constructive method of coping than the abstract and spiritual methods. Livneh et al (2000) argue that this dimension is especially relevant as an example of the changing nature of coping methods: Some individuals may at first use unrealistic solutions to their problems, which may present them with a more optimistic outlook for their future. However, in time they will feel the need to use more constructive solutions to their problems, offering a more realistic, and consequently more pessimistic, outlook. They also argue that this timeline can be reversed, so those using active responses to directly address problems may become disillusioned if this method is ineffective, and subsequently develop a fatalistic attitude. Folkman and Lazarus (1980) similarly argue that if problem focused strategies are perceived as successful, then a reduction of stressful symptoms will follow. But if not perceived as being successful, emotion-focused strategies are instead employed as a way of minimising the impact of prolonged stress, even though these strategies are not as effective in the long-term.

The third dimension identified was a distinction between social/emotional coping methods and cognitive methods of coping or alternatively, externally oriented and internally orientated coping. The first pole includes seeking social support and venting emotions through other people, while the opposing pole reflects accepting or denying the condition. They are referred to as externally or internally orientated as they require either others for help (external), or making personal and individual choices (internal).

Research specifically evaluating the role of coping strategies in amputation adjustment is consistent with the general coping literature, suggesting active and task orientated coping strategies, such as problem solving, are conducive to positive psychosocial adjustment, while emotion-focusing coping and cognitive disengagement are positively associated with anxiety, depression and externalized hostility, while negatively associated with acceptance of disability (Livneh et al., 1999). In a study with male war veterans with acquired lower limb amputations
(Desmond and MacLachlan, 2006b), higher levels of avoidance were associated with higher levels of reported anxiety symptoms. Problem solving had the opposite effect. Problem solving and avoidance were both associated with depressive symptomatology, but more extensive use of avoidance was associated with higher levels of reported depression while problem solving was associated with lower levels. Individuals who relied on an avoidant coping strategy also reported lower levels of general adjustment as measured by the Trinity Amputation and Prosthesis Experience Scales (TAPES), with avoidance the most consistent factor associated with poor psychosocial adaptation to the amputation. Individuals who extensively used avoidant coping strategies reported higher levels of intrusion symptoms, a defining feature of post-traumatic stress disorder. In terms of social adaptation, higher levels of seeking social support and lower levels of avoidance were associated with more favourable results.

Significantly in this research, time since amputation had a clinically significant relationship with both intrusion symptoms and adjustment to limitation. Longer time since amputation was associated with lower intrusion scores and more favourable levels of adjustment to limitation. One explanation to this could be that the longer time there is after amputation, the better the individual will have realised which coping strategies work best when dealing with their amputation. This indicates that an early intervention on coping strategies could prove useful in improving outcomes at a quicker rate. It also suggests that, for some, identifying coping strategies used in the earlier stages of rehabilitation may not be a good indicator of outcome in the long term due to the transient nature of coping. However, it is important to note that the conclusions drawn in this study were based on correlations that were low to moderate, indicating a need to further investigate the role of specific coping strategies on adjustment to amputation.

Dunn (1996) also investigated the influence of three different coping modes, namely finding positive meaning, dispositional optimism and perceiving control over
disability, on depression and self-esteem in adjustment to amputation. This sample consisted of 138 individuals from a golf association, most of whom were male and the majority of which (at least 65%) had a lower limb amputation, of which the majority arose from trauma. Finding positive meaning in one’s amputation was associated with lower levels of depressive symptomatology while perceiving greater control over one’s impairment and dispositional optimism were associated with lower levels of depressive symptomatology and higher levels of self esteem. Finding positive meaning after amputation has also been found to be associated with more favourable health and physical capabilities, higher adjustment to limitation and lower athletic activity restriction (Gallagher and MacLachlan, 2000b). Finding positive meaning was described in both studies as taking a variety of different forms, such as re-evaluating the event as positive, redefining the amputation in one’s life, finding side benefits such as meeting new people, imagining worse situations or making favourable social comparisons. Being positive about the amputation (positive cognitive processing) was also found to predict posttraumatic growth in persons with newly acquired amputations, that is, a shift in how individuals view themselves, their priorities and interactions with others (Phelps et al., 2008). This shift in thinking is similar the theories of adjustment to Chronic Illness and Disability (CID), which suggest that the view of the self has to change, along with the priorities in a person’s life, to adjust to CID and achieve better outcomes (Charmez, 1995, Bishop, 2005b).

The effects of problem solving, support seeking and avoidance on adjustment to prosthesis use were investigated by Gallagher & MacLachlan (1999), who reported greater use of social support seeking, together with low use of avoidance, were associated with better psychological adjustment to prosthesis use. This was an interesting finding as seeking social support would be considered an adaptive coping strategy and thus associated with better outcomes. They argue that by seeking the help of others and not relying on their own capabilities, an individual may be less successful in their adjustment by perceiving they have less control over their
situation, as corroborated by Dunn (1996). They also note that avoidant coping strategies were the predominant strategies employed by individuals with traumatic amputations, used significantly more often than by individuals who has disease-related amputations.

Hill et al (1995) have reported that coping strategies under the heading of ‘helplessness’ in the Coping Strategies Questionnaire, such as catastrophising, praying and hoping, were accountable for a significant proportion of the variance in both physical and psychosocial adaptation to amputation, with catastrophising predicting the largest proportion of psychosocial dysfunction, accounting for 22% of the variance. Catastrophising refers to the belief that things are awful and can only get worse (Janssen et al., 2002). It remains unclear whether this is due to having a pessimistic disposition (Sullivan et al., 2001) or is due to the impact of loss (Walker et al., 2006).

The specific coping strategy of catastrophising is also associated with higher levels of pain severity and poor adjustment to chronic pain, and was the single most important predictor of current pain, pain interference, depression and future pain interference in a longitudinal study looking at adjustment to phantom limb pain from 1 month to 6 months after amputation (Jensen et al., 2002). Notably, while high levels of catastrophising at one month post amputation was associated with higher levels of pain severity, interference and depressive symptoms, it was also positively associated with a subsequent decrease in pain interference and depression from after one to six months post amputation. This may be explained in a number of ways. Firstly, those with high levels of catastrophising and the comorbidities associated with it may be more likely to look for others for help and support, resulting in a decrease in negative outcomes. Secondly, logic dictates that if starting at the highest level, there is only room for a decrease than if starting at a moderate level of catastrophising. It is important then to realise that coping strategies that are adaptive
or maladaptive at one point in time may become less frequently used, or may even have different effects if adopted at different times (Oaksford et al., 2005).

‘Selective evaluation’ is such a coping strategy. A cognitive mechanism used to support the person by appraising themselves and/or their situation in comparison to chosen norms, there are five mechanisms of selective evaluation (Sjodahl et al., 2004):

1. to make comparison with more unfortunate persons (downward comparisons)
2. to selectively focus on dimensions to make your own situation more favourable
3. to create a hypothetically worse situation (what might have happened)
4. to invent benefits from the experience
5. to create norms as a standard which makes your own adjustments seem exceptional (Taylor et al., 1983).

Selective evaluation has strong links with Festinger’s Social Comparison Theory (1954): People compare themselves to others either by making upward comparisons to people better off than them, or downward comparisons to people worse off than themselves. These comparisons affect self-esteem, mental health and other aspects of behaviour, especially when considered in health and health care (Skevington, 2004). These comparisons can be made between people who are within the same illness group e.g. people with amputations, and also between people in different illness groups e.g. between a person with an amputation and a person in a burn unit. It has been found that making downward social comparisons can aid the adjustment to a range of negative events (Taylor and Lobel, 1989). However, social comparisons are a short-term rather than long-tem coping response as they only serve to improve mood and boost self-evaluations and thus do not provide information about successful adjustment (Dunn, 1996). Sjodahl et al (2004) found with a qualitative study on coping methods using interviews, that traumatic or tumour-related lower limb amputation patients used downward comparisons in
rehabilitation to strengthen their self-confidence, but that when they returned to their home environment this strategy was no longer useful as there was no one to compare themselves with. Furthermore, the comparisons they were then making were between the life they used to live in the house with full functioning, and the new one that they had returned to as a person with an amputation.

The coping responses of individuals with limb loss are seen to affect adjustment to the amputation, as well as potentially affecting the development of mental health problems. This information may then be useful in prosthetic prescription, as knowledge of an individual’s coping responses may aid in determining why they may encounter problems with their prosthesis indirectly: An individual may need extra support and counselling before they are ready to learn to use the prosthesis due to using an inappropriate coping method, or not having coped well with the amputation. Coping may also have a direct effect on the use of a prosthesis. Having a problem-solving approach to mobility training might be more beneficial rather than an emotion-focused one. Furthermore, resilient individuals are seen to adapt better to trauma and have a greater resolve for pursuing goals (Oaksford et al., 2005), indicating the potential for progress in rehabilitation. Recognising which coping responses an individual is using may help to a) predict whether they will use it and b) develop strategies to improve their adjustment to it. However, there is no literature specific to prosthesis use that can as yet be drawn upon to support this approach, indicating a gap in the knowledge that needs to be filled.

1.4.3.1.3 Control Beliefs, Self-Efficacy and Perceptions of Treatment

Control beliefs are linked to psychological and physical outcomes in numerous studies: having a sense of control, or perceived control, is positively related to both physical and psychological health (Gitlin, 2002). Perceived control refers to the belief that one can influence outcomes, either positive or negative, with a general motivation to obtain the former while avoiding the latter (Brehm, 1993). Perceiving
control over your life stressors is related to adaptive coping responses, whereas believing that you do not have control over you life, that is, attributing stressors to external factors, is associated with maladaptive coping responses such as alcohol abuse, and waiting for pain problems to solve themselves (Folkman, 1984). In the literature on control beliefs and life stressors, a sense of personal control is linked with lower levels of depression and higher levels of self-esteem (Dunn, 1996). For instance, persons with a greater sense of control over pain use more active coping strategies to deal with pain (Crisson and Keefe, 1988, Hill et al., 1995, Jamison and Verts, 1990) which are more effective than passive strategies. Those who rated their ability to control and decrease pain as poor exhibited greater psychological distress, with depression, anxiety, and obsessive compulsive disorder symptoms more frequently reported than by those who felt they could control their pain (Crisson and Keefe, 1988).

There are similar results with self-efficacy, that is, the confidence an individual has that they can perform a desired action. Studies specifically related to illness adjustments show that high perceptions of self-efficacy are associated with higher levels of motivation (de Ridder, 2004) and as mentioned before, better general physical health and better social and psychological adjustment (Carr, 2004). Self-efficacy is related to personal control, and it is important to note that perceived control and self-efficacy can have more of an effect on an individual than actual control and self-efficacy, and still achieves positive outcomes (Taylor et al., 1991). Within the disability literature, emphasis has been placed on the person’s perception of their disability, rather than the disability itself, and this appraisal process is argued to have considerable influence on subsequent adjustment to the disability (Elliott et al., 2002b). For one thing, individuals with an amputation who have compensable injuries have a higher perceived level of disability than those who do not receive compensation (Davidson, 2004). This effect of compensation would indicate that traumatic injuries, which have a greater chance of being compensable, would be seen as a greater disability than non-traumatic amputations where no compensation
is offered. However, traumatic amputations usually affect younger and thus pre-operatively more able-bodied patients, and may be perceived as more disabling due to the previous physical condition of the person.

Heightened levels of perceived control over one's amputation as a disabling event has been linked with higher levels of self-esteem, and also negatively correlated with depressive symptomatology (Dunn, 1996). This finding was also replicated in Desmond and MacLachlan’s (2006b) study with elderly war veterans. Beliefs and attitudes have also been addressed in relation to prosthesis use by Callaghan et al (2004), who posit that the Theory of Planned Behaviour (TPB) can be used to improve prosthetic prescription. TPB which states that behaviour is determined by a combination of behavioural intention, which is influenced by attitude towards the behaviour and subjective norms, and perceived behavioural control. By identifying in rehabilitation patients a number of behavioural outcome expectancies (attitudes), such attitude to regaining mobility and independence; normative influences (subjective norm), such as family and other patients; and items which affect perceived control, such as walking on slippery surfaces or people helping; they hope to be able to predict prosthetic use. This study unfortunately only concerned the initial creation of the measure for use in rehabilitation, and there is currently no further publications available on how the measure has worked in the prosthetic provision setting. However, this use of the TPB as a potential useful predictor of prosthetic provision further emphasises how beliefs and attitudes can impact on prosthetic outcomes.

While the above studies are encouraging it is important to note that pain control beliefs were not found to be statistically associated with future functioning, or indeed concurrent functioning in a pain study (Jensen et al., 2002), and locus of control was also found to be unrelated to prosthesis use in another study (Larner et al., 2003). Consequently caution should be taken on how much of an impact control beliefs can make. Potentially, the combination of a number of factors upon a belief
system, such as with the TPB, will be more effective than simply determining locus of control. Certainly a model which takes a similar approach as TBP (looking at attitude towards AT use, subjective norms regarding AT use, self-efficacy concerning AT use, awareness of ATs and socio-demographic characteristics) has been found to be associated with AT device use (Roelands et al., 2002) and as such indicates how attitudes and beliefs can affect prosthesis use.

1.4.3.1.4 Social Support

The quantity and quality of our social relationships strongly affects our health. People with larger social networks and stronger social bonds within their networks have better physical and mental health, with fewer illnesses, quicker recovery from physical and psychological problems, and less depression (Saranson et al., 1990). Social support may take many forms, such as easing the stressor with companionship, offering ideas for coping, or even just giving reassurance that you are cared about and valued as a person and that everything will be all right (Saranson et al., 1997). These have been definitively defined as a) esteem support, whereby other people increase one’s own self-esteem, b) informational support, whereby other people are available to offer advice, c) companionship, which involves support through activities and d) instrumental support, which involves giving physical help, which also include the provision of resource (Ogden, 2004). Because of the many forms it takes, social support and its enhancement of well-being has tended to be based on two different theories. The first is that social support has a “buffer effect” by mediating the relationship between stressful life events and psychological distress, social support influences the individual’s appraisal of the potential stressor. The second is that social support has a “direct effect” also known as the main effect hypothesis, in that it will have an effect on well-being regardless of the stressor involved and that its absence itself can act as a stressor (Schwarzer et al., 2004).

Social support is usually measured in studies as perceived social support, that is, how the individual sees the support network available to them. It has been
hypothesised that perceived support will have more of a main effect on psychological well-being than received support, which would have the buffering effect mentioned above (Cohen and Willis, 1985). Rook (1990) maintains that health and well-being are not merely the result of actual support provision, but are the outcomes of participation in a meaningful social context. Essentially, being embedded in a positive social world that involves receiving and giving support and companionship might be more influential than just receiving help.

Thus social support is increasingly recognised as a predictor of outcomes in the amputation patient population. However, like the coping literature, there is no specific literature that focuses on the relationship between social support and prosthesis use, but rather on how social support affects mental health and other similar outcomes. For instance, a person with an amputation who is divorced or separated has an increased risk of depressive symptoms by almost 100% compared to a person who is married or partnered (Darnall et al., 2005). In another study married amputation patients also reported significantly higher levels of life satisfaction than unmarried patients (Nielson, 1991). The quality of support within the marriage relationship may shield the individual to the vulnerability usually experienced after amputation, and result in less psychological distress (Carr, 2004). However, both studies were conducted predominantly with males with a lower limb loss, so may not be extrapolated to the entire amputation population, in particular women, who have reported receiving higher levels of social support and having larger social networks than men and rely less on their spouses for social support (Antonucci and Akiyama, 1987).

That said, other quantitative studies have also found increased social isolation and lower levels of perceived social support to be associated with a lower quality of life in amputation patients (Rybarczyk et al., 1995). Perceived social support is also linked with a decrease in levels of depressions and future improvement in phantom limb pain interference (Jensen et al., 2002). Gallagher et al (2001) also highlight the
importance of perceived social support as a predictor of phantom limb pain. In their study, 55% of those reporting that they received social support prior to their amputation did not experience phantom limb pain, whereas of those who reported not receiving social support, 77% experienced phantom pain.

Another way of measuring social support is looking at a person’s Social Integration (SI). This is defined as the extent to which an individual participates in a broad range of social relationships, and includes behavioural (actively engaging in activities with others) and cognitive (sense of place within the community) components (Williams et al., 2004). Much like perceived social support, people who are more socially integrated benefit with longer lives (Berkman, 1995), and less susceptibility to illnesses (Cohen et al., 1997).

Williams et al (2004) discovered, using the Craig Handicap Assessment and Reporting Technique (CHART) Social Integration subscale (Whiteneck et al., 1992), that while overall SI did not change significantly over the first year post amputation and was not related to gender, partner/living status or amputation aetiology, at 24 months post amputation, persons who were married or living with a romantic partner reported more SI than those unmarried or living alone. Williams et al furthered their study by including perceived social support and the relationship of the two measures of social support on various amputation patient outcomes (Williams et al., 2004). SI one month after amputation was significantly related to occupational status, but otherwise was not seen to be as important as perceived social support in predicting outcomes such as quality of life, depression, pain interference and mobility. It was thus concluded that quality of relationships, rather than the quantity of social network interactions were better determinants of how an individual will cope with the loss of a limb.

Interestingly, social support can also have a negative effect on coping. If a person has family and friends who are overprotective, they may put less effort into their own coping strategies, or may develop negative feelings towards their caregivers. In
a study of people with physical disabilities (Newsom and Schulz, 1998), 50% of the 276 respondents reported their spouses providing help they did not need, and 39% reported emotional distress resulting from the care giving of others. This distress also predicted concurrent depressive symptoms and depressive symptoms reported a year later. In the amputation literature it was found that, in addition to coping responses, solicitous spouse responses, (i.e. helping behaviour which is over-attentive and over-concerned) were associated with increased levels of depression and phantom limb pain at one month post-amputation (Jensen et al., 2002).

Seemingly, seeking social support is a positive coping strategy to amputation, with the presence of social support having ameliorating effects on mental health. This improvement of mental health status may improve participation in rehabilitation and positively influence prosthetic prescription. Having the support of others when using a prosthesis may prove useful in avoiding abandonment as encouragement from others may motivate an individual to reach their optimum functional potential. Furthermore, social support in the form of support groups or peer support may also aid in the use of a prosthesis as users can interact with each other on how they find living with an amputation, how they previously overcame certain problems or even how they have found psychological growth after receiving their prosthetic limb. A positive peer influence and information obtained from support groups may help an individual to adjust to using their prosthesis for optimum gain.

However, if a social support response is solicitous, or not of a significant quality, it may end up having negative outcomes for the patient. For example, an individual may experience feelings of self-worthlessness from relying on the help of others, or even emotional distress from receiving help they do not want. Similarly, if a person with an amputation is found to receive more help than they need from family and friends they may be less likely to follow their rehabilitation programme to gain optimal functional level, which could lead to abandonment of a prescribed prosthesis.
These contrasting findings indicate that there are positives and negatives to social support, and it is thus not enough to garner whether someone has social support by tick boxes (Are they married? Do they have a close family?). Rehabilitation practitioners need to understand how a person operates within their support network before making conclusions on how it might affect their outcomes.

1.4.3.1.5 Motivation

Motivation is an important factor in the rehabilitation of amputation patients as motivation to walk will lead to better participation in the rehabilitation programme and generally better outcomes. As noted by Young,

“Meaning and purpose for continuing life in what could be a vastly altered state of health and general ability must become a strong motivating force if ‘living’ rather than ‘existing’ is to be the goal. The will to overcome difficulties and work towards finding alternative strategies to accomplish a task is as important as being provided with the means to do so” (Young, 2004, p.23).

Thus it is not only the physical means that play a part in reaching optimum potential (that is ‘living’), but also the psychological.

Motivation can be described as ‘a global dynamic structure responsible for action or to a specific tendency toward some specific actions’ (Quoniam and Bungener, 2004, p.7) and has been found to be the best psychological determinant of exercise adherences and the performance of other health behaviours (Sabin, 2005). Studies with different illness groups have shown how important motivation is in the older adult’s ability to recover from a disabling event and to regain functional activities (Resnick, 1998a, Resnick, 1998b, Resnick, 1999). Motivation has also been named as one of the personal factors that should be considered when prescribing AT in the Matching Person and Technology model mentioned previously (Scherer et al., 2005), showing its potential relevance for prosthesis prescription.
General literature on motivation with older patients, who make up the large majority of those with lower limb amputations, highlights a number of different factors that can influence motivation such as self-efficacy beliefs (Resnick, 2002), treatment-efficacy beliefs (Grindley and Zizzi, 2005) and depression (Sabin, 2005). In a study by Resnick (1999) which interviewed 44 adults who were institutionalised to discover their motivations to perform ADLs, many believed that personality, whether they were a ‘determined’ person or a ‘lazy’ person, was central to whether they would perform ADLs themselves. Goal-setting was also identified as key to increased activity, with individuals using goals such as maintaining independence and mobility to fuel their behaviour. Goal-setting has also be found to work well with returning older amputation patients to some form of mobility, especially when gradually progressed as the patient regains more function (Edelstein, 2005).

The Motivation Equation (Phillips et al., 2004b) was used to explain a number of individual case-studies of difficulty in dealing with amputation (Edelstein, 2005). These were older patients with amputations as a result of trauma and arteriosclerosis. Reasons for being unmotivated to partake in rehabilitation included having never engaged in intensive exercise before, being caught up in searching for punitive damages from the accident resulting in limb loss, and having been previously failed by medical care. The equation states that:

\[
\text{Motivation} = \frac{\text{Perceived Chance of Success}}{x} \times \frac{\text{Perceived Importance of Goal}}{\text{Perceived Cost}} \times \frac{\text{Inclination to Remain sedentary}}{}
\]

This equation fits well with explaining why certain individuals have difficulty with rehabilitation and adhering to an exercise plan after leaving the rehabilitation unit. Furthermore, this approach also fits with the previously mentioned study which found beliefs about treatment efficacy affected prosthesis use at a 6-month follow-up after fitting (Callaghan et al., 2008).
It is important to recognise that while motivation is considered an important aspect of rehabilitation, there is as yet no clear concept of how to identify it and measure it, and as such a patient may be treated differently if labelled as ‘unmotivated’. Maclean et al (2001) studied the concept of motivation as used by a group of professionals working in stroke rehabilitation. Interviews were conducted to examine the concept without informing the participants of the aim of the study. ‘Motivated’ patients were those that were proactive but were also compliant to therapy. However, if too compliant it was believed that they had too little intrinsic motivation, or motivation that comes from their own selves rather than the encouragement of others. By being too compliant or not proactive enough, a patient could be labelled as ‘unmotivated’, with associations with laziness, and led many professionals to treat their patients differently, generally in a more negative fashion. The professionals were aware of the damage caused by labelling an individual, but yet continued to do so within the multidisciplinary team setting when observed in team meetings.

It is also important to note that some individuals may be incompliant to rehabilitation as part of the process of adjusting to the amputation. Some people may feel that they are losing control of their situation as they follow rehabilitation recommendations without any form of choice. Being non-compliant is a way of exerting control and finding a sense of self in a situation where the self is changed dramatically (Charmez, 1983). As such, motivation as a concept needs to be clarified and a standardised form of measurement established before motivation can be used as a predictive evaluator within the rehabilitation setting.

Motivation has been recognised as an important factor is rehabilitating the amputation patient, yet it is still difficult to understand what exactly is meant by motivation and how it could possibly be measured for use in terms of prosthesis prescription. Certainly it can be argued that a patient that is not motivated to learn to use a prosthesis will not benefit from receiving one, but this can not be decided by
any individual, other than the person themselves, unless a validated tool for motivation is created. Until then, it remains an important factor for prosthesis use, but one that needs to be approached with caution.

1.4.3.1.6 Learning Ability and Cognitive Ability

When it comes to rehabilitating older amputation patients, Adult Learning Theory states that older people learn new skills most effectively within the context or situation in which the skill is actually used, as well as with repeated practice opportunities, so learning within a proper context and with repeated actions is very important (Gitlin, 2002). This is especially pertinent when considering the number of factors needed, such as physical ability and coordination, which are often impaired in the older population, when learning to use a prosthetic limb.

Larner et al’s study (2003) found that poor learning skills and level of amputation had an 81% chance of predicting mobility within an inpatient rehabilitation unit. 70% of the variance in predicting mobility could be accounted for by poor learning skills alone. This study found that the Kendrick Object Learning Test (KOLT), a simple picture recall test that is used to test for dementia, was the best predictor of prosthetic outcome, and thus indicates why older amputation patients who may be suffering from memory failure or dementia will have significant problems when learning to use a prosthesis. Anxiety, depression and recovery of locus of control were also measured but found to not be significant predictors of functional prosthetic use. The effect of level of amputation may also be related to the learning process as it becomes more difficult the higher the level of amputation. Walking with an above-knee prosthesis requires a significant cognitive effort; the normal system of proprioceptive clues as to the position of the limb in space are lost, and loss of motor control at the ankle and knee prevents some of the normal balance defence strategies from working (Williams et al., 2006). Walking may also require even greater cognitive attention in challenging conditions, such as walking on
uneven terrain or simultaneously engaging in a cognitively demanding task (Pellecchia, 2003). To walk effectively and prevent knee falls, individuals with an amputation must often rely on information such as visual clues to monitor the position of their prosthetic knee (Fernie and Holliday, 1978). The constant monitoring of the prosthesis is hypothesised to interfere with an individual’s ability to attend to other tasks and is therefore an additional cognitive burden (Heller et al., 2000).

Further support for the importance of cognitive abilities is in the findings of Schoppen et al (2003). They discovered memory to be the most important mental predictor for functioning with a leg amputation 2 weeks after amputation (n=46). Combined with age and balance, the 15 word memory test predicted functional outcome, as measured by an activity restriction scale, in 64% of the sample. This seems very possible as age would have an important effect on memory ability as well as balance ability.

O’Neill and Evans (2009) found that ratings on the Locomotor Capability Index at 6 months after limb fitting were predicted by measuring visual memory, hours of use were predicted by a verbal fluency test, and Special Interest Group in Amputee Medicine (SIGAM) mobility grades, which range from not using the limb to walking anywhere in any weather without a walking aid, were predicted by a combination of immediate verbal memory, age, level of amputation and presence of pain. They concluded that cognitive factors play a large role in predicting outcome, but stress that interventions should be established to ameliorate the effect of cognitive factors rather than affect the provision of a prosthesis.

This resonates with the work of Diamond et al (1996), who found that functional improvements in cognitively impaired patients in a geriatric rehabilitation unit were comparable with cognitively intact patients at the time of discharge. Their length of stay was slightly longer but was not statistically significant. Cognitive impairment
was associated with lower functional status on admission, so as they were less capable on admission, they were less capable at discharge. Therefore cognitive impairment did not significantly limit a response to rehabilitation.

Similarly, Barnes et al (2004) found that patients admitted to skilled nursing facilities (with a number of different illnesses) with the greatest cognitive impairments needed significantly more therapy hours than independent patients or those who only required supervision, but many were still able to be discharged into the community. However, the study had mixed outcomes, with different rehabilitation settings and a small sample size. And it should be noted that the two former studies were general older rehabilitation patients, rather than specific amputation patients. The extra pressure of learning to use a prosthetic limb, how to doff and don it, look after it, and other important factors, may actually be too much for some cognitively impaired patients. However, while it is important to keep health care costs low and prevent issuing prostheses that may not be used, cognitive impairment alone is not enough to preclude anyone receiving a prosthesis, and should instead be assessed for increased intervention to improve outcomes rather than preventing use.

1.4.3.1.7 Vulnerability and Balance Confidence
Clinicians have noted that amputation patients will often express concerns about their safety as well as their fear of criminal victimisation. In one survey, out of 94 patients, 72% perceived that they were less able to defend themselves after their amputation (Nicholas et al., 1993). These concerns seem to also parallel closely with feelings of social discomfort, perceived stigma and body image, and there is preliminary findings to support the theory that adjustment problems can arise from experiencing feelings of vulnerability (Behal et al., 2002). In this study, high levels of vulnerability were associated with higher levels of depression, lower quality of life and poor overall adjustment. In fact, vulnerability accounted for 12% of the variance in depression scores as rated on the Center for Epidemiologic Studies-
Depression Scale (CES-D). Similarly, high public self-consciousness can predict feeling more vulnerable and less able to defend oneself, which in turn increased levels of activity restriction (Williamson, 1995).

Of course, with vulnerability it is important to realise that social realities do underpin its existence. There may be connections to the patients’ past experiences with victimisation or abuse which may increase the likelihood of feeling vulnerable. They may also live in an area which is associated with high levels of criminality. These two factors would increase the patient’s concerns and most likely increase their perception of themselves as vulnerable to attacks. However, vulnerability, regardless of its source, may potentially impact on mental health and adjustment, suggesting it may also effect prosthetic rehabilitation.

Vulnerability may also increase when a patient has a low level of balance confidence. Most cases that have a low level of balance confidence are older adults who suffer from multiple comorbidities, so the prevalence of reduced balance confidence among lower-limb, disease-related amputation patients appears to be very high (Miller et al., 2002, Miller and Deathe, 2004). Balance confidence was also found to be independently related to limitations of daily activity and also to symptoms of depression in a study by Miller and Deathe (2004). This relationship between balance confidence and social activity, due to the debilitating cycle of further reduction of balance confidence brought on by self-imposed restriction, will obviously have an effect on quality of life, and consequently, acceptance of the amputation. Furthermore, a decreased level of balance confidence in lower limb amputation patients is associated with a decrease in perceived prosthetic capability that is, what the individual believes the prosthesis can do, and prosthetic performance, that is, what the individual actually achieves with their prosthetic limb (Miller et al., 2001b), indicating the importance of creating balance confidence in the early days of prosthetic training in order to increase perceived prosthetic capability and prosthetic performance.
1.4.3.1.8 Environmental Barriers

One social barrier that effects rehabilitation with a prosthetic limb, especially a lower limb, is the obstacle of environmental barriers within the home and the community. When a recent amputation patient returns home after rehabilitation, there is a realisation that what was once an easily navigable and a comforting setting has since become a place where barriers exist to safe and independent living (Gitlin, 2002). This may result in negative psychological and social consequences, such as feelings of anxiety, depression, social isolation, loss of personal control and a diminished quality of life.

In a recent study, environmental factors were measured in relation to the characteristics of the amputation, prosthetic use, and the sociodemographic characteristics of the individual (Ephraim et al., 2006) using the Craig Hospital Inventory of Environmental Factors on community-dwelling persons with amputations. The younger a person was, the more likely they were to perceive barriers in physical/structural, attitudes/support and services/attitudes environments. Older individuals did not seem to perceive as many barriers which may be related to their expectations of what is achievable with old age; making them less likely to engage in activities where environmental barriers could be encountered. Similarly, persons with two or more comorbid conditions were 2-3.6 times more likely to perceive barriers in their environment to normal functioning with a prosthesis than those with no comorbidities. This seems a logical conclusion, as those with more illnesses would have more functional limitations leading to greater impairment. Comorbidities are also negatively associated with satisfaction with ease of use of the prosthesis, as well as the weight of the device, which again, would be a logical conclusion (Pezzin et al., 2004). Indeed it appears that comorbidities have an inverse relationship with hours of use for a prosthesis: As comorbidities increase, the hours of weekly use of the prosthesis decrease.
Those who wore their prosthesis for 9 hours of more a day were 50% less likely to perceive barriers in the area of attitudes and support, and were even 70% less likely to perceive barriers in the area of services and assistance than those who wore their prostheses for less hours a day. This finding highlights the important positive effect that wearing a prosthesis can have on the life of a person with an amputation as if less barriers are perceived to gaining service and assistance, and even in receiving support, an individual may be more likely to continue living without much worry towards the impairment and continue to use the services that have been made available to them.

1.4.3.1.9 Conclusion of Literature on Psychosocial Predictors.
There are a number of different psychosocial factors that can have an effect on prosthesis prescription, some of which have been found to affect prosthesis use directly, while others may have an indirect effect due to their effect on adjustment to the amputation or on mental health, which may in turn effect prescription of the prosthesis. Generally assessment of personality and psychological adjustment are evaluated both informally and formally when an individual attends a prosthetic rehabilitation centre. However, this may not be the case with all fitting centres, and if testing does take place, difference in qualifications and training can result in differential use of these instruments and subsequent interpretation of results (Elliott et al., 2002a). This highlights the need to identify and streamline within services what psychosocial factors are likely to have an effect, how to best identify these factors in rehabilitation, and how interventions can be introduced to achieve the optimum results for each individual. If these psychosocial factors are known to service providers in prosthetic fitting as potential predictors of prosthesis use, there presence may help to make the case for patients who may not have a high functional potential for prosthetic use to be allowed to rehabilitate with a prosthesis. Psychosocial interventions could also potentially optimise use of the prosthesis to ensure that expensive technology is not wasted on under-use.
1.4.3.2 Literature on Demographic Predictors of Prosthesis Use

While there are clearly a number of psychosocial factors that can have an effect on prosthesis use, there are also a number of demographic factors that can have an effect. Similarly, these factors may also have an effect on adjusting to the amputation. The current available literature on these factors will now be outlined.

1.4.3.2.1 Amputation Aetiology

There is mixed evidence as to whether the cause of amputation has any effect on amputation outcomes. It is however widely believed that the rehabilitation of individuals with traumatic amputations results in more favourable functional outcomes than is the case for those with disease-related amputations (Mac Whinnie et al., 1994). Certainly those with traumatic amputations tend not to have underlying illnesses which may affect rehabilitation or healing time of the residual limb.

When comparing amputation patient groups, those with amputations due to surgery had a greater prevalence of depression in comparison to the group with traumatic amputation (51.4% compared to 34.7%) (Canserver et al., 2003) though this was not found to be statistically significant. This finding contrasts with Darnall et al’s (2005) study who found that persons with trauma-related amputation reported the highest levels of depressive symptoms in comparison to other types of amputation.

In their study on social integration, Williams et al (2004) found persons with traumatic amputation reported greater social integration than persons with non-traumatic limb-loss, with those with chronic-illness related amputation experiencing a decrease in social integration over the first year post-amputation. This may be linked to the majority of chronic illness patients being of an older age and thus less likely to participate in the social community, and also due to the comorbidities that arise with chronic illness amputation, which could further impede social contact.
Similar to this finding, balance confidence has also been found to be higher in patients who had amputations for non-vascular reasons (listed as trauma, cancer, infection secondary to trauma, and congenital malformation) than those who were vascular patients (Miller et al., 2002) which was also attributed to age and comorbidities.

Regarding coping strategies, Gallagher and MacLachlan (1999) have noted that patients with a traumatic amputation are more likely to use avoidance and denial as coping strategies, coping strategies known to limit recovery, in comparison with patients with a disease-related amputation. However, having a disease-related amputation was associated with lower levels of general adjustment in a sample of veterans (Desmond and MacLachlan, 2006a). Similarly, Ham and Cotton (1991) believe that patients having an elective amputation to improve their life are more likely to adjust than those who have an amputation due to an accident or trauma.

This mix of findings indicates that amputation aetiology does appear to have an effect on adjustment to amputation as significant differences between groups have been found, but that it is difficult to predict with amputation aetiology alone how an individual will adjust. Many studies take the approach that there should be differences between the two, and report findings that may not be particularly strong or significant to emphasise this, when in reality most studies in this area use small samples which are not representative of the amputation population as a whole. However, it should be noted that outcomes from amputation aetiology tend to show that in the long run, those with trauma-related amputations tend to have better social integration and, due to being more associated with young age and less comorbidities, would generally be expected to achieve higher levels of function and mobility with a prosthetic device than someone who may be older with significant comorbidities with an amputation of vascular origin. This however, may be more to do with age and physical status rather than amputation aetiology.
1.4.3.2.2 Education, Employment and Socioeconomic Status

Education status and socioeconomic status are strong predictors of prosthesis outcomes in the lower-limb amputation population. Educational status was found by Pezzin (2004) in a large study with 935 persons with major amputations, to influence prosthesis prescription. As the education level of the person increased, so did their likelihood of being satisfied with the prosthetist. Having private health insurance was also linked to significantly longer hours of prosthetic use per week than those patients that were on public health care. In an interview study with 21 amputation patients, the data collected suggested that those with higher levels of education are better able to negotiate their interests with the prosthetist: participants with more years of education were likely to have seen more prosthetists, to have longer appointments with the prosthetist, and to have had a greater number of prostheses (Nielson et al., 1989). Those who also did not have an adequate income to meet their needs reported more restriction to their routine activities as a result of their amputation.

Those who have an income that is near the poverty line were 2 to 3.5 times more likely to perceive environmental barriers to normal functioning with a prosthesis than those who were not as financially poor (Ephraim et al., 2006). The important thing to note here is that while these are ‘perceived barriers’ that might not even exist, it is well known that socioeconomic status is inversely related to the risk of disability (Pope and Tarlov, 1991). Further studies have also found that those who have private health care will have significantly longer hours of prosthetic use per week than those who are relying on public health care alone (Pezzin et al., 2004). Those on low-income were also found to wear their prosthesis for shorter periods of time and to be less active users indoors (Gauthier-Gagnon et al., 1998). Similar findings have been reflected in studies with lower extremity injury outcomes, with those living in poorer households significantly associated with poorer outcomes at both 2 and 7 years follow-up to their injury no matter what their treatment plan (Cannada and Jones, 2006). Educational status has also been linked to depressive...
symptomatology, with greater education levels theorised to have a buffering effect, with patients with 12 or more years of education being less at risk for depressive symptoms on the CES-D (Darnall et al., 2005) after suffering from limb loss. Lower education status was also found to be related to shorter periods of prosthesis use and less active users outdoors (Gauthier-Gagnon et al., 1998).

Frequent prosthetic use and satisfaction with its comfort in particular are shown to significantly improve the prognosis of a return to work (Pezzin et al., 2004) and this would indeed be more likely with those who can afford proper health care in the first place, and secondly, are in a job that requires limited mobility and physicality, such as most white-collar jobs. Users that have limited use of their prosthetic limb because they find it cumbersome and it causes sweating that leads to discomfort and pain, will obviously find it difficult to work at manual labour (Jones and Davidson, 1995). It then is also unsurprising that those with below-knee amputations are more likely to have the same jobs after amputation as they did before, than those with above-knee amputations (Nicholas et al., 1993). Interestingly, there appears to be a link between how income is earned. Self-employed people, who strongly depend on a successful rehabilitation, have better health-related quality of life amputation outcomes than war veterans, who are guaranteed a financial basis without having to return to work (Demet et al., 2003). Furthermore, war veterans may also have access to a greater selection of high-tech prosthetic options, yet would still have lesser outcomes than those who are self-employed.

It is most likely that after amputation there will be a change in occupational status for the patient, the impact of which needs to be considered in the wider context of day-to-day living post-amputation. This is especially true if this change in occupation is seen as a step down, rather than up, by the patient. Full-time employment has been found to have beneficial health effects for both men and women (Ross and Mirowsky, 1995) such as enhancing self-esteem and reducing social isolation (Robinson, 2000), and a survey of individuals with amputations
found that respondents who were employed full-time reported higher levels of life satisfaction than those who were employed part-time or unemployed (Nielson, 1991). Vocational status was also found to be favourably related to prosthetic wear and active use of the prosthesis outdoors(Gauthier-Gagnon et al., 1998). Although if you have better health you are more likely to have full-time employment so it is difficult to separate the two concepts.

While educational status is seen to have an effect on prosthesis satisfaction and use, it could also be argued that only social economic status has an effect on prosthesis satisfaction and use, as these two concepts are so closely related. What is definite is that the presence of money to meet the needs of the person with the amputation means that they are more likely to use and be satisfied with their prosthesis, a finding that is unsurprising. More surprising findings in terms of socioeconomic status are related to work status, with those in work more satisfied with life than those who are unemployed. This indicated that in some cases it may be more beneficial for an individual to return to work rather than receive disability benefits from the state. However, the fact is that as age increases, so does the rate of unemployment and also the need for assistance with activities of daily living (Whyte and Carroll, 2002). This means that the majority of lower limb patients, as they are over the age of 65, are more likely to be retired and thus less likely to experience the benefits that employment can provide.

1.4.3.2.3 Age
Age is a potential influencing factor on prosthetic use, due mainly to the fact that those who suffer limb loss at a later age may have more difficulty in managing the energy expenditure that is associated with using a prosthetic limb (Cutson and Bongiorni, 1996). Persons who are also older at the time of amputation are usually undergoing amputation for disease-related reasons, and may therefore have a lower health status than those who would be younger and undergoing amputation due to trauma or tumour. Being older also puts a person with an amputation more at risk of
suffering from a number of comorbidities which may affect prosthesis use, such as cardiovascular disease and respiratory problems, and also more at risk of having cognitive limitations regarding learning to use the prosthesis.

A population study on rehabilitation of persons with amputations over 65 years of age found that of those who had undergone surgery, only 36% of the whole population was successfully fitted compared with 74% of those who were referred for fitting being successful (Fletcher et al., 2001). All persons in this study were patients with disease-related amputations, so underlying illness may have further limited their prosthetic options. Indeed general weakness and incapacity was one of the factors that contributed to unsuccessful fitting, along with re-amputation, cerebrovascular disease, cognitive deficits, skin integrity of the amputated limb and fixed flexion contracture, the majority of which can be attributed to illness. In another study on older amputation patients (Kurichi et al., 2007), 2375 older veteran healthcare administration records were studied to see what clinical factors (i.e. sociodemographic contexts, aetiologies for limb loss, anatomical level of the remaining limb, comorbidities less directly associated with limb loss, medical acuity according to hospital procedures, and functional status on basic physical and cognitive activities of daily living) predicted limb prescription. Patients who were younger than 76 years were more than 4 times more likely to receive a prosthetic prescription than those over 86 years after controlling for gender, marital status, living circumstances before hospitalisation, anatomical level, aetiologies, comorbidities, medical acuity, and initial functional status.

In another study looking at postoperative functional status in relation to a number of preoperative factors (Taylor et al., 2005), advancing age was found to be a predictor of prosthesis wearing rates, survival one year post-amputation, maintaining preoperative ambulation status, failure to ambulate, maintaining preoperative independent status and failing to maintain independent living statues, with older age associated with the more negative outcomes. Those who were aged 70 years and
over were 3 times less likely to wear a prosthesis, had a 3.1 greater chance of death, were 2.3 times more likely to be non-ambulatory and were 4 times more likely to lose functional independence when compared to the other individuals in the study. Age was also found in another study to be negatively correlated with active use of the prosthesis for ambulation indoors and outdoors (Gauthier-Gagnon et al., 1998).

In terms of adjusting to an amputation, in a study on 78 persons with lower limb amputations arising from trauma, persons who were older at the time of injury were significantly more likely than their younger counterparts to be satisfied with the comfort of the prosthesis and its ease of use (Dillingham et al., 2001), although it is unclear why. It also should be noted that the majority of older amputation patients would have amputation as a result of disease rather than trauma so these results may not be applicable to the wider older amputation patient population.

While the research into age an prosthesis use tends to be more negative in relation to older amputation patients, it should be noted that a large number of older patients may still be fitted with a prosthetic limb, and Bilodeau et al (2000) noted in their study on older amputation patients that 81% of their participants (n=65) wore their prosthesis every day and 89% wore it for 6 hours or more per day. Of those who did not wear their prosthesis, deteriorating health was the main reason cited. This did not include patients with severe cognitive problems but it still offers interesting information with regards prescribing prosthetic technology for older patients: there are a number of individuals who will use a limb, even for limited hours a day, if they are given the opportunity to wear the limb, indicating a need to explore a number of different factors, not just the physical.

1.4.3.2.4 Gender

Women have been found to be on average 8 years older than men when undergoing amputation for disease-related amputation, and amputation incidence is higher in
men compared to women in all subgroups except tumour, with the biggest difference in amputations due to trauma (Heikkinen et al., 2007). These differences in demographics alone may indicate that there would be gender differences in terms of rehabilitation and prosthetic prescription after an amputation. For example, older men were found to be more likely than older women to use their prosthesis (Bilodeau et al., 2000). However, this finding was not independent; suggesting that age or even other factors measured such as wheelchair possession may have affected the results. In another study, men were found to be more likely than women to be satisfied with the prosthesis fit, comfort and appearance, although there was no gender difference in frequency of prosthesis use (Pezzin et al., 2004). Again, caution needs to be exercised with these findings as age and health at the time of amputation could have an effect. Singh et al (2008) found more men that women were successfully fitted with a prosthesis in a rehabilitation centre, and with further analysis found that only gender and social isolation were significant factors contributing to the success of limb fitting. This finding would need to be replicated in other centres and studies before gender could be taken alone as a factor affecting limb fitting.

There also appears to be some factors that are affected by gender and gender roles when it comes to adjustment to an amputation. A study on environmental barriers looked at the role that masculinity plays in their perception. It appears that overall, masculine role conflict and conformity to masculine norms explained 28% of variance in perception of environmental barriers to their successful functioning within the environment, with greater masculine role conflict perceiving less environmental barriers to successful functioning within their community (Good et al., 2006). Traits typically associated with masculinity such as physical strength, sexual performance, independence and vocational achievement are often the qualities compromised as a result of amputation. Yet men who display these traditional conceptions of masculinity may display greater determination, goal orientation, and ability to focus on the challenges of rehabilitation tasks, all of which are potentially
relevant to favourable outcomes in the rehabilitation process. However, these positive aspects to masculine roles are confounded by the fact that conformity to masculine norms and masculine role conflict combined to account for 24% of the variance in the participants’ attitudes towards seeking psychological assistance. Those who believed it was appropriate to restrict expression of emotions, to be self-reliant and to have power over women reported less favourable views of seeking psychological assistance, and also less life satisfaction. This is similar to the theory of Gerschick and Miller (1995) who believed that men with disabilities vary in their ways of coping with the pressures of masculine roles, with some men seeking to maintain their original masculine ideals by trying to function independently. They may refuse help, or requesting help, despite needing assistance.

When it comes to body image and prosthesis satisfaction, studies tend to show a gender difference. In Murray and Fox’s study (2002), they found that only higher levels of functional satisfaction with their prosthesis were correlated with lower levels of body image disturbance in men. However, when it came to women, higher levels of all of the subscales used in the study; functional satisfaction, aesthetic satisfaction, and weight satisfaction were associated with lower levels of body image disturbance. In the whole sample in this study, higher levels of overall satisfaction and functional satisfaction with a prosthesis, coupled with low levels of body image disturbance, showed correlations with higher levels of hourly prosthesis use per day. But when these were split into genders, it appeared that only functional satisfaction was needed for more hours of use a day in males, while females again needed to meet all measures of satisfaction with the prosthesis.

Explaining the findings for the male participants, it has generally been thought that functionality is important. For instance, males perceived more structural and physical barriers when using a prosthesis than females did in the same study. One possible explanation for this is the traditional social role for males of continuing to provide financially and to be active. Similarly, the number of hours of use in men
was correlated to positive body image, which in many ways could be a bi-directional finding. That is, as males used the prosthesis more, they had a more positive body image of themselves, or it could be said that having a more positive body image led the male participants to use their limb for more hours a day.

For the female participants, it appears that the aesthetics are important as they help to sustain a sense of femininity as they can continue to wear feminine clothes, such as skirts and high heels. This is similar to findings that young people and women, but not older men, are more likely to feel their choice or apparel is affected by the use of a prosthesis (Nicholas et al., 1993). But functionality in women is also related to a positive body image, so it appears that the aesthetics of the prosthesis are not the only important factor, but one that may need to be taken into consideration when prescribing prosthetics with females. However, the findings in this study have to be looked at critically. The sample was small, so higher correlations were needed, but the authors dismissed this need as they believed important relationships may then be ignored. Analysis of the data show that many of the correlations observed are small and clinically not significant for the population sampled.

1.4.3.2.5 Cultural Context

It is important to look at culture as having an effect on prosthesis use and prescription if we are to take the viewpoint that disability is created by society’s impact on individual impairment rather than by impairment alone (Swain et al., 2003). As such it is important to understand a person with a prosthesis in the context of their wider society and cultural situation if we are to understand how the prosthesis is viewed. However, there is very little research on broader sociocultural or contextual aspects of prosthetic use (Schaffalitzky et al., 2009), especially when it comes to lower limb prostheses. Murray (2008) looked at how the context of gender in society could affect the use of certain prostheses: In Western cultures, the loss of the right hand prevents and individual from shaking hands in the conventional way, so the use of a prosthesis restores this convention. He also cites the case of one
woman who felt that wearing a prosthetic hook was less socially acceptable for women that it was for men. This may relate to the functionality need ascribed to males and the aesthetic need ascribed to females in society. In relation to lower limb prostheses, he notes two cases which indicate the importance of understanding culture in prosthesis prescription: a woman who was angry because she was prescribed a man’s foot (the only available), and a black woman in the UK who was offered a pink, rather than a black, prosthetic foot, and the consequent distress this caused her.

Wider social context is also important when considering how amputation is viewed in society. French (1994) did a study on persons with amputations in Cambodia. Cambodia has a higher level than average of amputations per population due to large proliferation of landmines within the country. It was then supposed that the general population would be more understanding of those with amputation. However, it was instead found that persons with amputations evoked anxiety about personal safety in others and in particular, young males with amputations were avoided due to a reputation for violence and theft. Individuals with amputation themselves felt degraded and abandoned by their families and society in general. This finding indicates how society, especially one which does not view amputation compassionately, can affect the acceptance and adjustment to an amputation.

1.4.3.2.6 Conclusion of Literature on Demographic Predictors of Prosthetic Prescription

In all, these findings indicate that demographic variables can play a role in prosthesis prescription, though it is unclear of how much of a reliable predictor they are in terms of providing specific components or in terms of how well an individual will adjust and rehabilitate due to the contrasting findings and weak evidence in some of the studies. Demographic variables may therefore be used as a guideline for how an individual will do with rehabilitation and the prosthesis, or be used to tailor which prosthesis components may be best used for an individual. This may involve
taking into account how a person’s financial situation will affect choice of components, how their gender or culture may affect the aesthetics of the prosthesis, or how their age may affect the potential weight of the prosthesis. It is clear though that they cannot be the over-arching predictor of an individual’s outcomes; there are a number of other factors which need to be taken into account such as the psychosocial, but also physical health status.

1.4.3.3. Literature on Physical Factors Predicting Prosthetic Prescription
As seen from the subsection on age, physical health status can have an effect on the ability of an individual to use a prosthetic device. A number of the important physical factors in relation to prosthetic prescription will now be outlined to clarify their effect on prosthetic use.

1.4.3.3.1 Level of amputation
There are a number of different levels of major lower limb amputation: transtibial, through-knee, transfemoral and hip disarticulation. A person may also have bilateral amputations and different levels or the same level on both legs. In terms of research, groups tend to be made up of people with either above-knee or below-knee amputations rather than separating people out into more distinct groups. All levels of amputation have a different effect on the individual undergoing the surgery, but the general rule is: the higher the amputation the more energy expenditure that is needed to walk with a prosthesis. With a transtibial amputation, energy expenditure is believed to be raised 25-40% above normal, depending on cause and age (Tang et al., 2008). The person is also more likely to be able to ambulate without an assistive device, and perform more activities than those with higher level amputations (Esquenazi and Meier, 1996). With a transfemoral amputation, energy expenditure is increased 68-100%, again depending on cause and age (Esquenazi and Meier, 1996). Individuals may be able to ambulate, but with maybe more difficulty than those with transtibial amputations.
It should also be noted that many individuals who undergo amputation for disease-related reasons may start off with a below-knee amputation, but then may need to get a reamputation at some point as their disease or illness progresses. Levels of amputation have been found to be a significant factor predisposing to prolonged prosthetic wear and active use of the prosthesis indoors, with a greater proportion of transfemoral compared to transtibial amputation patients discarding their prosthesis in the 5 years following discharge from a rehabilitation programme (Gauthier-Gagnon et al., 1998).

Similarly, amputation level has been found to be an independent predictor of prosthesis wear rates, survival at 1 year post-amputation, and maintaining independent living status, with a higher amputation level associated with poorer outcomes (Taylor et al., 2005). In a study with older veterans with amputations, those with transtibial amputation had a higher likelihood or prosthetic prescription than those with transfemoral amputations (Kurichi et al., 2007). Those with below knee amputation were also found to have better Walking Ability Index scores at 3, 6, 9 and 12 months after prosthesis fitting than those with either through-knee or above knee amputation (Siriwardena and Bertrand, 1991). Generally speaking for many older patients the comorbidity and the increased energy expenditure associated with the use of an above knee prosthesis make prosthetic fitting unlikely (Fletcher et al., 2002).

1.4.3.3.2 Pain
Pain is experienced by a large majority of amputation patients, and manifests itself as residual limb pain, that is, pain that occurs in the remaining limb that was amputated; phantom limb pain, that is, pain that feels like it occurs where the amputated limb should be; or pain in the rest of the body as a result of the amputation e.g. back pain or pain in the remaining lower limb. Psychosocial factors have been found to be associated with the prediction of current pain intensity, pain interference, and depression, and have also been found to lead to subsequent
changes in pain interference and depression (Jensen et al., 2002). This is important when we consider how much of an impact pain can have on the adjustment to the amputation. For example, health-related quality of life is substantially lower among those reporting phantom limb pain than those who are pain free (Van der Schans et al., 2002) and in some cases pain can lead to greater disability, limitation, and suffering (Desmond and MacLachlan, 2004). For example, decreased functioning and activity is associated with amputation specific pain (Marshall et al., 2002).

The danger is that an individual with an amputation may blame their prosthesis for the pain they experience and lead them to discard it. Phantom pain has been found to be negatively associated with ease of use of a prosthesis as well as satisfaction with prosthetic appearance with trauma-related amputations (Dillingham et al., 2001). The relationship between daily prosthesis use and phantom limb pain has shown that those who use their limb for upwards of nine hours per day have less phantom limb pain than individuals who use their prosthesis less (Whyte and Carroll, 2002), suggesting a relationship between prosthesis use and phantom limb pain. This group also appears more likely to remain in employment due to the benefits of both mobility and less pain.

However, despite the ameliorating affect of the prosthesis on phantom limb pain, it should be noted that residual limb pain can cause a number of problems for individuals who use a prosthesis, as they may find that the residual limb too painful for wearing the prosthesis, thus disrupting their lives. Gallagher et al (2001) found that of a sample of 104 persons with lower limb amputations, 34% of those who experienced residual limb pain were experiencing daily occurrences that they classified as ‘distressing’, and which interfered ‘moderately’ to ‘a lot’ in their daily lives, although it wasn’t concluded if this was due to not being able to wear the prosthesis or purely because of the pain experience itself. This study also found residual limb pain to be a more intense, longer lasting and interfering experience than phantom limb pain for those studied. Being somewhat, or extremely bothered
by residual limb pain was a risk factor for depressive symptoms in those under the age of 55 years (Darnall et al., 2005), suggesting that older persons may be more conditioned to cope positively, although being bothered by either phantom limb pain or back pain was a significant risk factor for depressive symptoms for all age groups in the same study, so age may not be a strong mediator.

In terms of psychological affects of pain, Rudy et al (2003) also found on physical tests of strength and endurance, disabled individuals with chronic pain had decreased endurance for both tasks, and that 90% of the variance in this performance was predicted by psychosocial factors such as self-efficacy, perceived emotional and physical functioning and pain intensity. They then concluded that chronic pain significantly reduced performance in subjects with amputations due to its effect on psychosocial functioning.

Pain can have a direct affect on prosthesis use in that an individual may be unable to wear their prosthetic limb because they are experiencing residual limb pain. However, pain may also have an indirect effect on prosthesis use as pain may create problems in psychosocial functioning, which may impact they way a person performs in rehabilitation, as well as how he or she regards their prosthetic limb. The apparent effect of psychosocial functioning and pain experience also indicates how psychological factors can further impact on rehabilitation and physical experiences.

1.4.3.3 Comorbidities

One common underlying cause of lower limb amputation is that of diabetes which causes a number of different comorbidities which effect rehabilitation, such as: limited activity tolerance because of underlying atherosclerotic heart disease (with symptomatic of silent ischemia); peripheral vascular disease and diabetic neuropathy; unstable residual limb volume because of fluctuating weight; renal disease or congestive heart failure; impaired cognition or other neurological deficits because of
cerebrovascular disease; sensorimotor deficits caused by peripheral nerve dysfunction; and visual impairment as a result of diabetic retinopathy or other ophthalmic disorders (Roberts et al., 2006). As a diabetic patient becomes older they may also have higher risks of contralateral limb loss, functional disability, persistent pain, depression, urinary incontinence, polypharmacy, injurious falls, cardiovascular disease, organ damage, and premature death. All of these things may complicate post-amputation recovery, slowing wound healing or delaying the start of rehabilitation training. These comorbidities may also inhibit the achievement of optimal functional independence, especially in terms of energy expenditure with regards ambulation (Roth et al., 1998).

Hemiparesis as a result of stroke is another comorbidity associated with amputation. Even a mild residual hemiparesis in conjunction with amputation presents challenges to rehabilitation, and until the 1970’s, neurologic weakness after hemiparesis usually contraindicated prosthetic rehabilitation (Varghese et al., 1978). Patients with a below-knee amputation and coexisting hemiparesis are more likely to walk after the amputation if they were ambulatory before the onset of the concurrent condition. O’Connell and Gnatz (1989) found that patients with moderate hemiparesis had difficulty transferring with one leg, and this limited their ADL performance. A more recent study on transfemoral amputation (Brunelli et al., 2006) indicated that while ADLs were limited by hemiparesis, it was still possible for some patients to recover the ability to walk. However, the severity of hemiparesis and the side of the hemiparesis affected this outcome. This finding then indicates the importance of examining individual factors in relation to comorbidities rather than using them as a reason not to rehabilitate.

Cardiac, respiratory and neurological problems have been found to be significantly related to limited prosthetic limb wearing (Gauthier-Gagnon et al., 1998). Vascular disease, the condition of the contralateral limb, and the use of prescription medications were correlated with walking distance in a retrospective questionnaire
study of 148 lower limb amputation patients (Matsen et al., 2000). The condition of the contralateral limb was also correlated with ratings of quality of life and general satisfaction. Also, patients with peripheral vascular disease, renal failure, congestive heart failure, psychoses, paralysis or other neurological disorders were less likely to receive a prosthesis prescription (Kurichi et al., 2007). Patients with ischemic heart disease had poorer walking ability index scores at 6 + months post prosthesis fitting than those without, patients with hemiplegia were worse at 12 months on walking ability index scores than those without, and patients with bronchitis were worse at 12 months on walking ability index scores than those without (Siriwardena and Bertrand, 1991).

Essentially, comorbidities have an effect on rehabilitation outcomes with a prosthetic limb because they affect the functional status of the patient. This can be physically, mentally and even emotionally, and so it is important to make sure that the individual is at optimum health before being evaluated for prosthesis prescription. This is especially true in terms of cognitive functioning which may be affected by illness unbeknownst to rehabilitation staff and the individual themselves. However, as shown from the hemiparesis literature, the presence of comorbidities does not necessarily predict functional outcome but rather informs the healthcare team of issues which may need to be addressed by the rehabilitation programme or the componentry of the prosthesis.

1.4.3.3.4 Conclusion on Literature of Physical Factors Predicting Prosthetic Prescription

Physical factors are an important influence on restoring functional mobility due to their influence on energy expenditure and general physical condition for using the prosthesis. Furthermore, some physical factors may also affect prosthesis use indirectly due to their effect on psychological adjustment (e.g. pain) and cognitive ability (e.g. comorbidity). That said, caution is still needed in interpreting just how predictive these factors are as it may be a case of tailoring rehabilitation or
componentry to overcome physical problems rather than letting them prevent prosthesis prescription. The available literature indicates that a number of these factors have a negative effect on prosthesis prescription, but their presence does not always signify an inability to use a prosthesis.

1.4.3.4 Service Provision
Apart from psychosocial, demographic and physical condition factors, service provision may have an effect on how an individual rehabilitates with their prosthetic limb, as well as also directly affecting how the prescription process operates. For example, the speed of the fitting service affects prosthesis use. Pezzin et al (2004) found that timing to the first prosthesis fitting had the most consistent pattern of significant effects on frequency of prosthesis use and satisfaction with the device. They conclude that receiving your first prosthesis more than 60 days post amputation significantly decreases the number of weekly hours of prosthesis use. This negative effect was larger the longer the wait from amputation to the first prosthesis fitting. Furthermore, the patient was less likely to be satisfied with the prosthesis fit, comfort, appearance and overall performance. Delays in time between amputation and fitting were also found to be negatively correlated with prosthetic wear and with active use outdoors (Gauthier-Gagnon et al., 1998). While these findings are indicative that time to fit affects use, it should be noted that often a delayed fitting time is due to the physical condition of the individual being fitted. It is likely that their residual limb may not be healing well, possibly indicating underlying comorbid diabetes, which would in turn affect the use of the prosthesis.

Studies have found that failure to consider user opinions and preferences is often associated with abandonment and rejection of assistive technology (Phillips and Zhao, 1993, Wielandt et al., 2006, Scherer et al., 2005). This may become most apparent when a patient is fitted with their first prosthesis and subsequently discovers that it doesn’t function as effectively as they had hoped, or may have been lead to believe by a health care professional (Rybarczyk et al., 1997). Patients
should have realistic expectations of what to expect from their prosthesis and also to be properly prepared for the rehabilitation process (Maguire and Parkes, 1998). In a study that looked at the experiences of amputation patients with information sharing with healthcare providers, Van der Linde et al (2007) discovered from the administration of a survey on patients from an outpatient clinic in rehabilitation that patients wish for more information on: the existence of patient associations; the aspects concerning costs of the prosthesis; the cosmetic aspects of the prosthesis, especially shoes; the possibility to return to their old job; and the maintenance of the prosthesis. Of course, these findings were specific to this rehabilitation centre, but help to indicate which areas covered by health care practitioners were of importance to the client-group. In another study on information needs of amputation patients (Nielson, 1991), 44% of 109 people surveyed reported that not enough information was available for them to make informed decisions about their care. It was also noted that much of the current information available to patients is provided by manufacturers, and it may be useful for prosthetists to provide more objective materials to be discussed with patients.

Offering emotional, informational, and practical support within the service setting was cited by patients in a qualitative study as leading to decreased levels of depression and also improving a trusting relationship between staff and patient (Liu et al., 2006). Healthcare research in a variety of different areas also indicates that patients who feel prepared and informed are more likely to comply with treatment and have an improved health outcome (Nielson, 1991).

Sjodahl et al (2008) conducted a qualitative study to understand the amputation rehabilitation experience from the point of view of the patient. Again, a need for information, most notably clarification of information and increased communication, was mentioned as a number of the participants felt that they were unprepared for their situation. Participants also requested information and care that was tailored directly for their needs and that didn’t lose sight of the fact that they were human
beings who needed emotional support and to be treated with respect. They also needed help in taking the next steps of their rehabilitation, in gaining control back in their lives and ‘finding themselves’ as people again. This research again draws attention to the need to provide patients with information, but also the need to tailor rehabilitation needs individually. The requests for emotional support also shows how awareness of the mental and emotional difficulties facing an individual with an amputation, not just the physical ones, can help the rehabilitation team to overcome them.

In another interview investigation with amputation patients, individuals reported being happy with the technical competence of the prosthetist, but tended to be dissatisfied with the quality of the patient-prosthetist relationship (Nielson et al., 1989). It seemed that if the healthcare provider expressed interest in the whole person rather than just the amputation, the quality of the interaction tended to improve, which could lead to better comfort and fit with the prosthesis. Certainly, it was found in another study that of those who wear a prosthesis, 57% reported moderate to severe pain most of the time while wearing it, suggesting that they not only expect this pain, but do not report it to their prosthetist (Nielson, 1991). This finding indicates the need to increase the amount of information given to those with an amputation on what is to be expected and how making their concerns known to their prosthetist will improve their comfort and walking ability.

Service provision has an effect on prosthetic rehabilitation which can be related not only to the staff that work within the area, but also the running of the service and how it appears to the client. Certainly it seems that in healthcare, the majority of quality problems are traceable to faults with the systems, processes structure and practices of the organisation rather than to a person who was not conscientious enough (Ford et al., 1997). Geertzen et al (2002) in their study of consumer satisfaction with prosthetic and orthotic services used a modified version of the SERVQUAL instrument, which assesses priorities and experiences on a 5-point
Likert scale. In their study they measured: Tangibles (appearance of physical facilities, accessibility etc), Reliability (ability to perform the promised service dependably and accurately), Responsiveness (willingness to help consumers and provide prompt service), Assurance (with regard to competence, courtesy, credibility and security) and Empathy (with regard to access, communication and understanding the consumer). This variety of different domains indicates how a number of different factors within the clinic setting may affect the rehabilitation experience and potential of an individual. The results found that the less satisfying items included availability of parking space, privacy for consumers, respect for the consumer, and attention and time for the consumer. While again related to specific services available in the North of the Netherlands, this study indicates how satisfaction with a service is related to a number of different factors.

Service may affect how an individual responds to their prosthesis. If they are not happy with the care they received or believe their opinion was not sought on prescription, they may be less inclined to use the prosthesis. Furthermore, a lack of information may lead them to believe they are not functioning well with the prosthesis, or lead them to think that pain and discomfort is inevitable. In order to optimise prosthesis prescription it then is important to look at service factors and how they can be improved to increase consumer satisfaction and increase prosthesis use.

1.4.3.3 Conclusions from Literature on Predictors of Prosthetic Prescription and Use

It is clear from this review that there are a number of factors which are potentially predictive of whether prosthetic prescription will occur. Due to the large number of factors considered as predictive, it is important to ascertain exactly which factors are the most important predictors in prosthetic practice: the most useful to consider as affecting prosthetic prescription and guiding the prescription process.
However, much of the research above indicates that there are factors which will affect the use and satisfaction with the limb, but may not be necessarily predictive of prescription. Similarly, some of these factors may become more apparent after prescription has taken place. For example, pain will affect how satisfied an individual is with a prosthesis, and how much they might use a prosthesis, but will not decide if the individual will receive the prosthesis, and may not even occur till after prosthesis prescription (or even as a result of prosthesis prescription).

Due then to these factors’ association with prosthesis use and satisfaction, it is clear that they are useful to consider in the prescription process. This may involve identifying factors which will have a positive effect on optimising prosthesis use and using them as a justification for providing a higher level of technology, or identifying factors which will have a negative effect on prosthetic prescription, and setting up suitable interventions to overcome them. Either way, their identification in the prosthetic rehabilitation process, either pre- or post prosthesis provision, will prove useful in optimising the use of the prosthesis and optimising the outcomes of the prosthesis user.

1.5 Literature Review Conclusion & Aims of Research

As can be seen from the review of the literature, lower limb amputation is a growing area of concern for healthcare due to the increasing prevalence within the population and the costs associated with rehabilitation. In order for persons to reach their full potential after amputation, providing an appropriate prosthesis to achieve functional and psychological gains is the best option. However, non-use and under-use of the prosthetic technology is a growing concern as technological advances have increased the functionality of lower limb prosthetics and also the costs associated with their provision. In order to decrease the non-use or under-use of this technology it is then important to understand exactly why they occur and how they can be ameliorated.
The literature review has indicated that non-use may be addressed by improving the prescription of lower limb prosthetics. In order to optimise the use of a prosthesis, it is clear that the current approach to prosthetic prescription needs to establish its most important outcomes. Current practice, using a number of different outcomes and measures, means that research studies are difficult to compare, and differences in the best interventions or approach with a patient can occur even within the same fitting centre. Having recognised, established, important outcomes would make it easier to compare different interventions, easier for accountability to be established in prosthetic care, easier to know which outcome measures to use, and easier to justify the provision of expensive prosthetic technology for third-party reimbursements from insurance providers or public-expenses. This literature review has also shown that to optimise use of the prosthesis, it is not enough to analyse functional outcomes. It is important to identify the important psychological and the social outcomes of prosthesis use in order to fully address the needs of the individuals user.

Apart from establishing the important outcomes of prosthetic prescription, this literature review has also indicated that in order to improve prosthesis prescription and use, it is also important to establish the important predictors of prosthetic prescription. Doing so would move prosthetics away from its subjective nature and create more objectivity, a crucial component in modern healthcare. As there are currently a large number of factors seen to affect prosthetic use and prescription, which are physical, psychosocial and demographic in nature, ascertaining the most important predictors is essential if progress is to be made. Establishing the most important predictors would provide support for using certain interventions, providing certain componentry, and even justifying providing prosthetic rehabilitation to some individuals. As modern healthcare is concerned with delivering the best outcomes with the least waste of resources, the standardisation of prosthetic prescription through identifying the most important outcomes and predictors is both relevant and essential.
However, it is clear from the literature on predicting prosthetic prescription that some factors may affect prosthetic prescription, but may not be wholly predictive of certain outcomes. This means that in order to optimise the use of the prosthesis, it would prove useful to understand how other factors, which may not be ascertained in and previous to prosthetic prescription, or may not directly affect the most important outcomes, will affect the use of the prosthesis to its full capabilities. For example, if an individual is given expensive prosthetic technology, it is important that they then use the technology to the best of its, and the users abilities. If a high-tech prosthesis is only used for transfers or indoor walking, this represents a large waste of medical resources. Factors which affect the optimisation of prosthetic use are then also important to identify as they are concerned with improving rates of satisfaction and range of use. Identification of these factors could further ensure that prosthetic technology will be used effectively. It could also further indicate interventions which need to be applied to ensure the optimal outcome for the prosthetic user.

The aim of this research is to explore ways to optimise lower limb prosthetic prescription and use by identifying and gaining a consensus on 1) the most important outcomes of prescription, 2) the most important predictors of prosthetic use, and 3) the most important factors which have an effect on optimising use of the prosthesis. It is not the aim of this study to design a single intervention that is applicable to everyone, but instead creating the best, standardised way of identifying which interventions or components a person needs depending on their individual evaluations.
Chapter 2 - Methodology

2.1. Introduction

Psychology has been known as an empirical science within the positivist, and indeed post-positivist stance, and as such would tend to be associated with mostly quantitative research and supporting and refuting various hypotheses (Ye, 2007). However, in more recent years there has been an emergence of different theoretical perspectives behind psychological research as different methods of qualitative research from the other social sciences have become more acceptable within psychological inquiry. It became clear that psychology does not only deal with finding explanations for different phenomena, but also in describing, characterising, and understanding the content of these phenomena and the meaning they have for the individual (Moller and Nyman, 2005) and needed to adapt to new methods of data collection and analysis which were available within other fields of scientific inquiry.

Qualitative methods of data collection are sensitive to the unique personal experiences, perceptions beliefs and meanings of individuals (Meatherall et al., 2005), and as such can be invaluable when trying to capture the essence of the experience of health-service users. They give the opportunity to understand a phenomenon in a holisitic way by getting to the genuine experiences of those involved, be it through self-report, interviews, or observations. The data generated is context-driven, and offers richer and more detailed descriptions of the experience being studied (Polkinghorne, 2005). Using qualitative methods also ensures that the factors and areas that are important to the participant are highlighted to the researcher. Furthermore, qualitative research can clarify the language and meanings attributed to the participants of the research, allowing people to speak in their own voice, rather than being confined to categories imposed on them by others (Walker et al., 2006). Especially when developing a patient or consumer survey, it is valuable to begin by identifying the issues that are most meaningful to the
consumers and patients as well as the language they use in talking about these issues (Morgan, 1997) which can lead to the development of reliable and valid survey instruments (Walker et al., 2006).

That is not to say that quantitative methods are no longer useful to psychological research. Quantitative research has a number of advantages: it is generally easier to administer to large groups of people; results can be generalised to a larger population; specific hypotheses can be objectively tested to support theory; greater control can be held over the research process by the researcher; and the data generated is numerical in nature, and therefore potentially quicker to analyse and manipulate (Holton and Burnett, 2005). Quantitative methods therefore remain popular, especially within the area of health care. Certainly within medicine there exists a hierarchy of evidence, that is, an ordering of different methods in terms of which provide the most valuable evidence, and within this systematic reviews of Randomised Controlled Trials (RCTs), are considered the most valuable forms of evidence (Kennedy et al., 2003), showing how this hierarchy prioritises experimental quantitative methods over others.

While this is a valid way to approach evidence in health care, it is becoming increasingly understood that the understanding of health and illness behaviour and health interventions is incomplete unless the subjective reality of how health and ill-health affect the individual can be comprehended (Meatherall et al., 2005). For example, as people create their new identities incorporating illness, they may draw on medical, non-medical or even anti-medical knowledge to do so (Fox and Ward, 2006), indicating that health outcomes are not determined by empirical evidence alone. As rehabilitation outcomes are dependent on people’s thoughts, attitudes and motivation regarding the rehabilitation process, and as the rehabilitation process itself builds on social interaction, it is clear that studies with a qualitative design are useful tools in the development and improvement of rehabilitation due to their
ability to explore these factors and their effects (Ohman, 2005). Therefore in order to improve the outcomes of rehabilitation, the collection of both quantitative and qualitative data is necessary to develop interventions but also to understand how factors, like attitudes and beliefs, influence the effect of interventions, or how these interventions affect the individual psychologically.

2.2 Mixed Methods Research Design
A mixed methods approach to data collection and analysis indicates that the research is collecting, analysing and mixing both quantitative and qualitative data within a single study or series of studies. Its central premise is that the use of both quantitative and qualitative approaches in combination provides a better understanding of research problems than either approach alone (Creswell and Plano Clark, 2007). In the last twenty years, the concept of mixed methods has grown and changed (Creswell et al., 2003). Originally used mostly for triangulation purposes, combining quantitative and qualitative methods are now used to: develop the method of one by using the results of the other; to complement one another; to recast results from one method as questions or results in another; or to expand the range of inquiry by using different methods for different routes of inquiry (Kortte et al., 2007).

Further to this, mixed methods have also been used to:

- better understand a research problem by combining numeric trends from quantitative data and specific details from qualitative data
- identify variables/constructs that may be measured through the use of existing instruments or the development of new ones
- get statistical, quantitative data and results from a sample of a population and use them to identify individuals who may further expand on the results through qualitative data
- save another method when it is struggling or failing to answer the question and
• communicate the needs of individuals or groups of individuals who are marginalized or under-represented (Punch, 1998, Mertens, 2003, O'Cathain et al., 2007b, O'Cathain et al., 2007a).

Mixed methods have therefore increasingly become a popular choice within health and health services research. This is due to the complexity of research questions within the health care setting, with the need to continue quantitative, objective, measurable research for evaluating interventions, but also to understand the different important phenomena within health care which affect why interventions are effective or not (O'Cathain et al., 2007b).

2.2.1 The Philosophy of a Mixed Methods Approach

Epistemologically speaking, there has been a long debate on whether the mixed methods approach can exist as both quantitative and qualitative research are rooted in different paradigms and they are thus incompatible (Tashakkori and Teddlie, 2003). Quantitative research is based in the positivistic paradigm, that ontologically speaking believes that there is a ‘real’ reality that can be apprehended, and epistemologically believes that knowledge is objective and that there is a universal truth to findings in empirical studies (Lincoln and Guba, 1985). Qualitative research is based in a new paradigm of science, sometimes referred to as the ‘metaphysical paradigm’ as it combines a number of different ontologies and epistemologies (Morgan, 2007), which tends to be constructionist in nature, believing reality is relativistic that is, individuals create reality from different ideological, social and personal positions (Cornish and Gillespie, 2009), and that knowledge is subjective and transactional, and co-created by both participants and researchers in qualitative inquiries.

Both of these viewpoints have been criticised. Positivism for prioritising a single form of knowledge as ‘true’ and therefore ignoring other alternative forms of knowledge (Cornish and Gillespie, 2009), and constructivism for refusing to accept
that knowledge that is constructed from ideological, social and personal position can be simply wrong or even oppressive (Prior, 2003) and as such is not morally defensible when considering the responsibilities of science and research to provide the best solutions to problems.

2.2.1.1 Pragmatism
Recently, however, the concept of pragmatism has been proposed to bridge the gap between the two methods and their paradigms (Bryman, 2006). Morgan (2007) argues that qualitative researchers became focused on assumptions on the nature of reality as guiding research, which imposed limits on assumptions about the nature of knowledge and what could be known. This then in turn limited the range of methodological assumptions about generating knowledge and restricted the methods available to answer research questions. This ‘top-down’ approach to research led to an emphasis on metaphysical questions about the nature of reality and the possibility of truth rather than practical answers to research questions. Pragmatism instead presents a very practical and applied research philosophy, where researchers consider the research question to be more important than either the method they use or the beliefs of reality and nature of knowledge that underlie the method (Tashakkori and Teddlie, 2003), taking a ‘bottom-up’ perspective to approaching the question (Teddlie and Tashakkori, 2006). Pragmatism places human activity as the most important indicator of what is ‘real’, with assumptions about ‘reality’ and ‘truth’ considered speculative and vague. Good knowledge is then judged by whether it works to solve the problems of everyday action (Cornish and Gillespie, 2009).

Erzberger and Kelle (2003) argue that ‘the selection of adequate methods should not be made mainly on the basis of sympathies toward a certain methodological camp or school. Methods are tools for the answering of research questions and not vice versa.’ (p.482) By putting epistemology and ontology to the side, pragmatism leaves research able to use whatever methods needed to answer the research
question regardless of the underlying beliefs associated with certain methods. This becomes especially pertinent when mixed methods are needed for research purposes in applied fields (e.g. education, evaluation and the health sciences), to research complex phenomena (Teddle and Tashakkori, 2003), such as coping styles (Kartolova-O'Doherty and Doherty, 2008), terminal illness care-giver grief (Waldrop, 2007) and medical interventions (Protheroe et al., 2007), where there is a responsibility to offer solutions that are both acceptable and applicable in solving problems and improving lives.

There are some critiques to mixing methods within the pragmatic paradigm, mainly related to knowledge generated from different methodologies being ‘incommensurable’, meaning that knowledge from one methodology cannot be combined, accepted or even understood by another paradigm due to the underlying assumptions of knowledge and reality of each being incompatible. This however, is not the case within the real world of research practice, with those working in the same field, but with different ontological backgrounds informing different methodologies, often combining their research findings and using the same methods, with the incommensurability of methodologies only relevant in debates about the nature of reality and truth (Morgan, 2007). So while the belief systems of researchers create separate paradigms, they actually have little bearing on the practical decisions made in research. Pragmatism is also criticised for not offering access to ‘absolute truth’, but only to a ‘truth’ that is currently useful, a criticism that is reasonable, but also irrelevant as it is inherent in the type of knowledge claims that are made in science (Scott and Briggs, 2009). There is always the possibility that new findings will replace old truths.

### 2.2.2 Why a mixed methods approach was chosen

This research study used a mixed methods approach to data collection and analysis, and as such, a pragmatic approach was taken to this research. A mixed method approach was chosen as it was believed that its methods are most suited in
answering the research question and providing a more comprehensive and valid result than if only qualitative or quantitative methods were used in isolation.

Specific definitions of mixed methods are varied, but this research will follow the definition of Creswell et al (2004), specifically “integrating quantitative and qualitative data collection and analysis in a single study or program of inquiry” (p.7). This definition best describes this research study, making clear reference to the integration of separate stages of inquiry.

A mixed methods approach was also chosen for this study as it has strengths that offset the weaknesses of both quantitative and qualitative research (Teddlie and Tashakkori, 2003). This is the main argument for the use of mixed methods. Quantitative research does not take into account context or setting, and people’s voices are generally not heard in the research. Researcher bias and interpretations are also rarely discussed. Qualitative research makes up for these weakness, but unfortunately also creates its own, such as difficulty in generalising data to a large group and the interpretations and bias that are created by the researcher (Creswell and Plano Clark, 2007). Quantitative research arguably does not have these weaknesses. By using appropriate quantitative and qualitative methods within the study to answer the research question, mixed methods can reduce the weaknesses associated with each approach while also emphasising their strengths.

Furthermore mixed methods provide more comprehensive evidence for studying a research problem than either quantitative or qualitative research can alone by the simple fact that many different types of methods are available by combining both research types (Creswell and Plano Clark, 2007), and more forms of inquiry within one study will offer a wider variety of evidence.
2.3 The Research Design and Methods

2.3.1 Sequential Exploratory Design

While there are a number of different research designs available in mixed methods, this research followed a Sequential Exploratory Design as described by Creswell et al (2003). This research design consists of two distinct phases: a qualitative stage followed by a quantitative stage. In the Sequential Exploratory design a researcher first collects and analyses the qualitative data. The quantitative data are collected and analysed second in the sequence and help explain or elaborate on the qualitative results obtained in the first phase of the study. The second quantitative phase builds on the first qualitative phase and the two phases are integrated in the intermediate stage in the study. The rationale for this approach is that the qualitative data and their subsequent analysis provide an in depth view into the research problem. The quantitative data and their analysis is informed by the first qualitative phases and aids in refining the findings generated by qualitative data (Creswell and Plano Clark, 2007).

2.3.2 Methods

As discussed previously, mixed methods research is practical in that it provides the researcher with all the methods possible to address a research problem rather than being constricted to either quantitative or qualitative methods only (Creswell and Plano Clark, 2007). The overall aim of this study was to explore the outcomes of and factors associated with the prescribing and use of lower limb prosthetic technology and to reach a consensus on the important predictors of lower limb prosthetic technology outcomes and optimal prosthetic prescription and use.

This study involved three sections of data collection: (1) Repertory grid interview case studies, (2) patient focus groups and service provider interviews, and (3) a Delphi study consensus procedure. The Repertory Grid interview and the focus
group and interview section made up the qualitative phase of the Sequential Exploratory Design, and the Delphi study the quantitative phase.

The first section of the research involved Repertory Grid interview case studies to explore the values and preferences that prosthetic users have of their prosthetic devices, to investigate users’ perceptions of alternative prosthetic options and to investigate an idiographic method for exploring the values and preferences of lower limb prosthetic users. Using a qualitative inquiry at this stage helped to get an in depth view into exploring the values and preference of prosthetic users that could not have been achieved with quantitative methods such as a survey. Furthermore, this approach produced ways of evaluating prosthetic technology which could not have been done using another qualitative approach due to their subjective and deeply personal nature.

The second section of the research involved patient focus groups and interviews with service providers to identify what service users and providers consider to be the most important outcomes of lower limb prosthetic use, the most important predictors of lower limb prosthetic prescription and use, and also to identify any other factors which may impact on the optimal use of the prosthesis. The phase also offered the potential to gain a perspective on the issues involved in prosthetic use and prescription and how the process can be improved. Moreover, this phase was intended to assist in identifying topics for inclusion in the Delphi study that hadn’t arisen from the review of existing literature. Therefore the use of qualitative research was essential to ensure that the Delphi study reflected accurately the experience of prosthetic limb prescription and prosthesis use.

Finally the Delphi study gave the opportunity to gain a consensus among a group of experts on what exactly the most important factors are in prosthetic prescription and use by identifying the most important outcomes of prosthetic prescription, the most important predictors of prosthetic prescription, and the most importance factors that
effect optimal use of the prosthesis. This phase built on the findings in the qualitative stage by refining the data generated in the qualitative stages to create a definitive list for informing providers in the clinical setting of which factors need the most attention in terms of improving outcomes, and which outcomes are the most important to measure to evaluate improvement. Doing this quantitatively helped to reduce any researcher bias or influence what could have arisen in the previous rounds and also helped to confirm that the analysis of the qualitative data had been accurate. This sequence of methods is represented graphically in Figure 2.1 below, which is based on Ivankova et al.’s (2006) guidelines for visual models of mixed methods studies.

For the initial stage of data-collection for the study, it was agreed that qualitative research methods would provide the most useful insights into the thoughts and feelings of the prosthetic user and would produce more informed data than quantitative methods. It would help to clarify the issues with prosthetic prescription that both users and providers have that need to be overcome, give insights into the people who use and work with prosthetic services, and give informed suggestions from the stakeholders in prosthetic services as to what could improve and optimise prosthetic prescription. Qualitative research offers a variety of methods for identifying what really matters to patients, detecting obstacles to changes, and explaining why improvement does or does not occur (Pope and Tarlov, 1991). Through the use of the Repertory Grid Interview, focus groups, and semi-structured interviews, we can garner more complex details on the prosthetic prescription process from those who partake in it, understanding not only how it affects both the user and the service provider, but also how the prosthetic provision service system works and how the research findings might fit into that system. The Delphi study will utilize these findings to make sure that the most important outcomes, predictors and factors which have an effect on optimal use in lower limb prescription are identified.
Figure 2.1: Visual Diagram of the Research Design

Phase one

qual Data Collection  →  qual Data Analysis and Results  →  qual Data Collection  →  qual Data Analysis and Findings

Procedures: Repertory Grid Case Studies establishing the importance of patient inclusion in prosthetic prescription, highlight how psychological comfort can affect opinion on prosthetic, technology. (n = 2)

Products: Repertory Grids

Phase Two

Integration of data to create Delphi Study

Procedures: Combine focus group and interview data with literature review data to create list of outcomes, predictors and factors which optimise prosthetic use to create first round of Delphi study.

Products: First round survey for Delphi study.

Results of the study

Procedures: Delphi survey sent to experts to find the most important outcomes predictors and factors which affect optimal use of the prosthesis for use in the prosthetic prescription process, (n=23). Results analysed and survey reformulated in 2 further rounds to reach consensus.

Products: List of factors to be taken into account in prosthesis prescription.

Products: Conclusions and recommendations
Integration between the quantitative and qualitative methods is a key part to conducting mixed methods research. Quantitative and qualitative components can be considered “integrated” when these components are explicitly related to each other within a single study so that they are mutually illuminating, producing findings that are greater than the sum of parts (Wooley, 2009). If the methods are not somehow integrated then the study is not really mixed methods, but just multiple studies. Integration in this study took place between the qualitative data collection and the quantitative data collection, as put forward in the Sequential Exploratory Design (Creswell et al., 2003). The data from the focus groups and interviews were used to create the first survey of the Delphi study. Without the initial qualitative enquiry, the Delphi study would not have been as comprehensive or related to everyday situations within prosthetic prescription practice. The qualitative data made sure the quantitative enquiry was correctly constructed to reflect service user and provider opinion as well as comprehensively covering the topic of prosthetic prescription. Without it, data for the Delphi would have been drawn from a literature review, a process which could have left out many of the important factors identified in the qualitative studies, as well as neglecting to comprehend the experience of the prosthetic prescription process.

Mixed methods research can answer research questions that other methodologies cannot (Teddlie and Tashakkori, 2003). It can be argued that quantitative research tends to be related to confirmatory research questions while qualitative research tends to be related to exploratory research questions. By combining both methods, it was possible to explore the research question (focus groups and interviews) and confirm and condense the data (Delphi study) in the same study.
Chapter 3 - The Repertory Grid Study

Aim: The aims of this part of the study are to explore the values and preferences that prosthetic users have of their prosthetic devices; to investigate users’ perceptions of alternative prosthetic options and to demonstrate a novel method for exploring the values and preferences of lower limb prosthetic users. This study was conducted with a user of a high-tech prosthetic limb as well as a user of a more standard issue limb to gain two different perspectives on the technology available and offered to individuals who need prosthetic devices. It also highlights what may be important to certain individuals when it comes to using a prosthetic limb, including psychological and physical comfort with the device and the meanings that are attached to it.

3.1 Introduction

Using a variety of commercial components, prosthetists strive to achieve the optimal match between the device and the patient’s need, functional level and personal goals. The ‘best’ or most technologically advanced prosthesis will not always be the most suitable for all patients. Firstly, due to the economic constraints of the patient or service provider, not everyone can afford to be fitted with the most advanced limbs (e.g. C-Leg ®). Secondly, what may be considered the ‘best’ limb for one individual may actually be more of a hindrance to another (Gaily, 2006). Furthermore, when it comes to assistive devices, their use presents some dramatic compromises in self-identity and imposes many cognitive, behavioural and pragmatic adaptations, especially when it concerns the older population that is associated with lower limb loss (Aminzadeh and Edwards, 2000). While a number of factors including equipment, functional utility, and individual variables have been associated with non-use (Heinemann and Pape, 2002, Dillingham et al., 2001, Nielson et al., 1989) there has been a growing recognition within the assistive technology literature of the importance of consumer preferences and values in understanding non-use (Scherer, 2002).
The social role of the prosthesis, and the psychosocial meanings attached to it can have an effect on the use of the prosthetic limb. Pape and Weiner (2002) believe that the successful integration of devices into the user’s life involves exploring the meanings they assign to the device that they are using, the expectations of the devices and the anticipated social costs. A study by Murray and Fox (2002) found that becoming skilled in impression management, such as using the prosthesis as well as clothing to hide their disability, helped people to avoid social stigma, and enable social integration, thus lessening social withdrawal. Users sometimes choose to wear their prosthesis even when they are not functional or comfortable, indicating that in some cases the role of the prosthesis that helps the user become accepted in society plays a greater role than function in acceptance and use.

Amputation can have an effect on an individual both physically and psychologically and benefits in both of these areas can be achieved with advanced prosthetic technology combined with an understanding of client priorities for function (Swanson et al., 2005). According to Scherer (2002), a good match between person and technology is achieved if the prosthetic device meets the user’s performance expectations and is easy and comfortable to use. As prosthetic technology continues to advance, it is important to understand how the experience of using a high-tech leg affects the perception of self within an individual and social context, and also how the prosthesis is viewed in relation to alternative prosthetic options so that resources are not wasted on prosthetic components that do not fit into an individual’s perception of themselves, or components that are not requested by the individual. It has been recommended that when selecting a prosthesis for an individual, attention should be directed at the specific needs of the individual (Brown -Triolo, 2002), that prosthetic users should be provided with a choice of available options (Scherer, 2002), and should also be involved in prosthesis selection (Wielandt et al., 2006, Phillips and Zhao, 1993). The individual values, preferences and meanings assigned to the device need to be explored to successfully integrate devices into the user’s life (Louise-Bender Pape et al., 2002). This allows for a greater match between the
technology and the needs of the person, and may result in an increase of satisfaction for the user, and an increased use of expensive technology.

Therefore it is essential to develop methodological approaches to elicit and assess these meanings. Approaches such as the Patient Generated Index (Callaghan and Condie, 2003) and Goal Attainment Scaling (Rushton and Miller, 2002) have been used to assess the individual preferences, values and meanings of prosthesis users in prosthetic rehabilitation. Although these individualised assessment approaches have the advantage of consulting the consumer to determine which dimensions are most important to them for evaluation in rehabilitation, they have not been used to determine preferences of alternative prosthetic options amongst users.

3.1.1 The Repertory Grid

This individual approach to preferences, values and meanings in rehabilitation is reflected in the basic theoretical assumptions of Personal Construct Psychology (PCP). George Kelly’s Personal Construct Psychology attempts to understand the way in which each of us experiences the world, how we express ourselves in our behaviour, and how each of us negotiate our view of the world with others (Bannister and Fransella, 1986). The basic theoretical assertion of Kelly is Constructive Alternativism (Kelly, 1955). It states that all our present interpretations of the world around us are subject to revision (Landfield and Leitmer, 1980). This implies that a situation may be viewed differently by different people, or even differently by the same person at another time, as there are always alternative constructs available to choose from (Kelly, 1955). Kelly used the concept of a Construct System to explain the process. The Construct System is made up of 3 parts: Elements, Constructs, and a scale that links the two. Elements are the objects of peoples’ thoughts and constructs are the qualities that people attribute to those objects (Smith, 1978). Constructs are evaluative representations or interpretations of the universe that are created by a human being and then tested against the reality of the universe (Kelly, 1955). Each construct is double-ended, made up of pairs of
characteristics that are opposite, not necessarily in a logical sense or a semantic sense, but in terms of the individual’s own terminology. Construing is a purposeful process whereby an individual seeks to anticipate and interpret events (Bannister, 1962). It is also the means by which an individual categorises and discriminates the event with which he comes in contact, and involves thoughts, feelings and moral judgments (Ravenette, 1980). The whole essence of personal constructs is that they are created in the individual’s language (Phillips, 1989) and using their personal judgments and feelings.

After a review of the literature on the personal factors that can affect the use of assistive devices, Pape et al (2002) concluded that to successfully integrate assistive technology into daily activities, the user of the device needs to explore the meanings they assign to devices, their expectations of assistive technology, the anticipated social costs, and also come to terms with disability as part of, but the not the defining feature, of the self. By discovering a prosthetic user’s constructs regarding different prosthetic options and their effect on the self, we are able to understand and explore the different dimensions along which the participant evaluates not only themselves but also the prosthetic technology. These dimensions may include the different feelings, attitudes, opinions, and maybe the hidden judgements that are involved in prosthetic choice and use and if discovered, could be taken into account during prosthetic prescription.

The technique developed to discover an individual’s constructs, and used in this study to provide an understanding of the way an individual views various prosthetic options and also interprets their experiences, is the repertory grid (Bannister, 1985). Kelly argued that in order to understand someone, we must do so in their own terms; which means identifying their personal constructs, otherwise we run the risk of simply projecting our own thinking on to them (Jankowicz, 2004). Constructing a repertory grid involves the use of a set of elements either supplied or elicited from the participant (e.g. different prosthetic options), the use of a set of constructs (either
supplied or elicited) and instructions which indicate how participants are to rank or order the elements along the constructs’ dimension (Neimeyer et al., 2005). The information garnered from a participant is then displayed in the form of a grid (as shown in Figure 3.1).

The repertory grid method offers a variety and wealth of information for the researcher that may not be acquired from a simple face-to-face interview in that it provides easily retrievable data in the form of the ratings of constructs on the grid, as well as uncovering new ideas for both the interviewer and the participant that may not be discovered using conventionally constructed questions by making them think about certain elements under headings they may not have used before (Jankowicz, 2004). Indeed, the repertory grid has been found to be a useful tool within the health sector, and has been used to evaluate certain treatments (Lambert et al., 2004, Frewer et al., 2001) or services (Melrose and Shapiro, 1999), understand patient perspectives (Ni Mhurchadha et al., 2008), (Dixon and Johnston, 2007) and understand medical decision making (MacCormick et al., 2004).

The aim of the present study is to explore the values and preferences that lower limb prosthetic users have of their prosthetic devices; to investigate how the user views alternative prosthetic options and to demonstrate a novel idiographic method for exploring these values and preferences.

3.2 Method

3.2.1 Participants
The participants in this study consisted of two individuals with lower limb amputation(s) who had been fitted with a lower limb prosthesis. Both participants were over 18 years of age and had a fluent understanding of English. One of the participants was fitted with an Otto Bock C-Leg ® (the high-tech microprocessor controlled, prosthetic knee joint), and the other, as a bilateral amputation patient,
with two below-knee titanium prosthetic legs with a fibre-glass socket, which are considered the standard issue. These two users were chosen to highlight the different reactions to prosthetic options that exist from the viewpoint of those who have experience of high-tech options and those who do not.

3.2.2. Procedure
Ethical approval was sought and obtained from the IRB at Johns Hopkins, Baltimore, MD. Each participant was contacted by the Director of Rehabilitation Psychology at Johns Hopkins (Appendix A) who informed them about the study, and invited their participation. The interviews were conducted in Johns Hopkins Hospital, Baltimore, MD as there are currently no C-Leg ® users in Ireland. Access to a C-Leg ® user in Johns Hopkins arose from research connections and the opportunity was therefore taken. After each participant had given informed consent (Appendix B), and filled out a demographic questionnaire (Appendix C), the tape-recorder was switched on and the participant was shown the grid to fill in. As the focus of the study was to elicit the values and preferences of users of prostheses, the participants were presented with a pre-determined list of elements. Presenting a list of elements ensured that potential prosthetic options and critical aspects of self-perception were rated. The list of elements was constructed by a number of individuals working in prosthetic rehabilitation and also a user of prosthetic technology with a pilot study on an individual with an externally powered prosthetic arm (Ni Mhurchadha et al., 2008). These elements were then changed by the research team to be suitable for a person with a lower limb amputation (e.g. Electric arm became High tech prosthetic leg). This list of elements is in Box 3.1. Not all prosthetic options chosen were available to each user due to financial, physical or technological reasons. However, these options were still included to gain further insight into how they are perceived.

Each element was explained to the participant, as well as pictures provided, so that the participant was aware of what each element was and meant. The elements were grouped together randomly (using a random number generator at
http://www.randomizer.org) into sets consisting of three different elements so that construct elicitation could take place. These sets are displayed in Table 3.1.

For this particular study, the repertory grid was constructed using the ‘Contrast Method’ of triadic elicitation of constructs as outlined in Neimeyer et al (2005). This method was chosen as it is believed to overcome the pitfalls that are associated with the Difference and Opposite methods of triadic elicitation. Most notably it creates constructs that are more genuinely bipolar, unlike those created with the Difference method, but also does not incur the greater negativity associated with the contrast poles of constructs elicited by the Opposite method (Aminzadeh and Edwards, 2000). Participants were presented with each set of three elements above at a time and asked to identify ‘how any two of these are alike’ in some way. This characterization (e.g., ‘functional’) formed one pole of the construct and was written in on the left-hand side of the grid. After recording the first pole of the first construct, participants were then given the second set of elements and the instructions were repeated, again forming a characterization that served as the first (i.e., emergent) pole of the second construct. This process continued until all 12 emergent construct poles were formulated. This number was chosen as it was typical of other studies repertory grid studied and it was believed it would provide a good overview of the different elements selected, with each element represented at least once, while keeping the time frame of the study at a minimum.

Following the elicitation of these 12 construct poles, participants were then directed back to the first construct pole. In order to form the contrast poles participants were presented with the emergent pole of the first construct and instructed as follows: ‘To you, being [emergent pole] would contrast with being __________? If, for example, the emergent pole of the first construct were ‘functional,’ the participant would be asked, ‘To you, being ‘functional’ would contrast with being __________?’ This then formed the contrast pole for the first construct. This phrase was written in on the right hand side of the grid, opposite the corresponding emergent pole.
Box 3.1: List of Elements

1. My Ideal Self
2. Self as I am now
3. Self as others see me
4. Intact leg
5. Own body
6. Single-axis hinge leg
7. Cosmetic leg (i.e. a leg that is purely cosmetic with little or no function).
8. High tech prosthetic leg
9. Self before amputation
10. Self after first prosthesis
11. Osseointegration (the fusing of a metal implant with the residual bone of the amputated limb to provide a steady structure for attaching a prosthesis).

Table 3.1: List of the sets of elements generated for construct elicitation

<table>
<thead>
<tr>
<th>Set Number</th>
<th>Numbers Generated</th>
<th>Corresponding elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>1, 3, 4</td>
<td>My ideal self, Self as others see me, Intact leg</td>
</tr>
<tr>
<td>2</td>
<td>7, 9, 10</td>
<td>Cosmetic leg, Self before amputation, Self after first prosthesis</td>
</tr>
<tr>
<td>3</td>
<td>4, 10, 11</td>
<td>Intact leg, Self after first prosthesis, Osseointegration</td>
</tr>
<tr>
<td>4</td>
<td>2, 3, 4</td>
<td>Self as I am now, Self as others see me, Intact leg</td>
</tr>
<tr>
<td>5</td>
<td>1, 6, 11</td>
<td>My ideal self, Single-axis hinge leg, Osseointegration</td>
</tr>
<tr>
<td>6</td>
<td>4, 7, 10</td>
<td>Intact leg, Cosmetic leg, Self after first prosthesis</td>
</tr>
<tr>
<td>7</td>
<td>1, 3, 11</td>
<td>My ideal self, Self as others see me, Osseointegration</td>
</tr>
<tr>
<td>8</td>
<td>3, 6, 9</td>
<td>Self as others see me, Single-axis hinge leg, self before amputation</td>
</tr>
<tr>
<td>9</td>
<td>2, 8, 10</td>
<td>Self as I am now, High tech prosthetic leg, Self after first prosthesis</td>
</tr>
<tr>
<td>10</td>
<td>3, 9, 10</td>
<td>Self as others see me, self before amputation, Osseointegration</td>
</tr>
<tr>
<td>11</td>
<td>3, 5, 8</td>
<td>Self as others see me, Own Body, High tech prosthetic leg</td>
</tr>
<tr>
<td>12</td>
<td>1, 6, 7</td>
<td>My ideal self, Single-axis hinge leg, Cosmetic leg</td>
</tr>
</tbody>
</table>
This process was repeated until contrast poles for each separate construct were elicited and written on the right hand side of the grid.

Following completion of the construct elicitation phase above, participants were instructed to rate each of the elements along each of the constructs in a stepwise fashion, using a 10 point rating scale. The phrase on the left of the grid stands for the ‘1’ end of the scale, and phrase on the right of the grid for the ‘10’. The participant rated all the elements on the scale giving each of them a rating from 1 to 10 to say which end of the scale they were nearest to. Participants were told the phrase on the left of the grid stands for ‘1’ end of the scale and the phrase on the right of the grid for ‘10’. The participant was allowed to use the same number as many times as he liked. The participant was then asked to repeat this process through each of the remaining constructs i.e. rating each element from 1-10 on each of the 12 constructs. Once completed, the interviewer discussed with the participant the ratings on the grid as well as the constructs created to clarifying their meanings. During this process it was ascertained which end of the construct was considered positive and which end was considered negative. A number of constructs were reverse scored so that a positive and negative end of the grid could be established for ease of analysis, meaning that 1 is considered positive, and 10 considered negative. The interview also provided additional information regarding the thoughts of the participant at that time. The whole of the interview process including the construction of the grid was audio-recorded and later transcribed.

3.2.3 Ethical Considerations

Ethical approval for this research was sought and obtained from the IRB at Johns Hopkins Hospital Baltimore, MD.

Safeguards were introduced to minimize risk to participants and to deal with situations that might cause harm or distress to participants. Given the topic of the interview, there was a possibility of causing harm by bringing up vulnerabilities and
uncertainties, as well as distressing memories that an individual may not want to discuss (Hyde et al., 2005). In the event that a participant becomes upset during the interview, the option of withdrawing was immediately offered to them. The participant was also supported in accessing suitable support systems, if required.

Ethics were also an issue in terms of confidentiality. Case studies using qualitative methods contain a level of detail and specificity that can make it difficult to offer confidentiality, especially when dealing with a minority group (Haverkamp, 2005). This made it important to change names on all data collected, as well as details which may have indicated who the individual was to any third parties. The only personal data taken were participant’s names on consent forms and their email addresses/phone numbers if they wished to be informed study’s results. These were stored in a locked filing cabinet designated for project use only. These contain no corresponding codes to connect participants’ details with data provided in any part of the study. All data has been kept confidential and secure. All computers that have project information on them are password protected. Audio recordings were kept private, confidential and secure and were destroyed after transcription.

Informed consent was also needed for this study. It was necessary that all participants were aware they could potentially become upset during the research procedure, they would be tape-recorded, and that information from the study would be published at a later date. All participants were given an information sheet before agreeing to take part in the study (Appendix D), detailing problems that could arise from the research study. This was presented again before the beginning of data collection so adequate time was given to read and understand the form, as well as pose questions to the researcher if needed. They were also offered the right to leave the study at any time and withdraw consent without reason.
3.2.4 Analysis
The aim of analysis of repertory grid data is to elucidate underlying patterns and note any exceptions to these particular patterns (Leach et al., 2001). Although it is possible to carry out statistical analyses and make graphical representations using multidimensional scaling, Burr and Butt (1992) have suggested there has been a tendency to overemphasize mathematical interpretation of the grid. They caution that subtle nuances of meaning could be extracted from the figures that could be justified mathematically, but not in any other sense. As the aim of part of this research was to study the patterning of individual’s constructs and beliefs and not to make comparisons of a large number of different grids, we chose to use a content analysis, idiographic approach. This allows for careful analyses of the original grid data which enables the investigator to focus on the participant’s original words and meanings. A summary of the different forms of analyses can be found in Leach et al (2001).

A content analysis, ideographic approach can be particularly appropriate with individual case studies (Beaumont, 2006) and involves examining each individual’s data and comparing how elements and constructs are similar or dissimilar (Borrell et al., 2003). This involves exploring how elements were rated on all of the constructs, as well as looking at what constructs were elicited in the first place. Similar elements (in this case, different prosthetic options) were looked at in terms of how they were rated on the same constructs, as well as how they compared overall on all constructs. Ratings were also examined to determine how significant an element or construct was to the participant.

3.3 Results

3.3.1 Case Study 1 - John
John is a 78 year old, white male, with a right transfemoral amputation that occurred following complications of knee surgery. It has been over 4 years since his
amputation and he has had his current prosthesis, an Otto Bock C-Leg ®, for just over 3 years. Previous to the C-Leg ® he used a hinge-leg with a locked knee. He wears this prosthesis everyday for an average of 9 hours each day. He uses two canes as mobility aids. He would not be considered a typical C-Leg ® user due to his age. A copy of his completed repertory grid is in Figure 3.1.

3.3.1.1 Analysis of elements
Examination of John’s grid shows that he viewed his intact leg positively. The ratings of his intact leg provided a baseline comparison for his view of alternative prosthetic options. John had a negative attitude toward cosmetic limbs as evidenced by his ratings of 10 on each of the constructs for this prosthetic option. Similarly, his view of osseointegration is very negative on all constructs. He viewed his current high tech limb only slightly more positively on average than his previous single axis hinge leg.

With regards to the cosmetic leg and osseointegration, the concepts appear to not have much in common, especially in terms of functionality and aesthetics, yet are rated exactly the same. However, it is important to consider these elements from the individual’s perspective, and from the data collected in the interview after the completion of the grid. The participant stated that he was unable to relate to these concepts, and it was observed during the completing of the grid that he rated both negatively each time without paying much attention to the construct he was rating them on. So these ratings do not necessarily show the individual’s careful, thought-out opinion on each element, but rather a lack of interest for each. In terms of osseointegration, he could not relate to the idea because, as he explained in the interview, he knew that it was not a prosthetic option that was available to him as a 78 year old with limited mobility. With the cosmetic leg, he explained he was unable to relate to the concept as he felt there was no reason to hide his prosthetic leg for what it is, and had a definite issue with the use of a cosmesis.
For the other elements, it is notable that he rated the single-axis hinge leg and the high-tech prosthetic leg similarly on each construct, indicating that there is, in his eye, not much of an improvement between the high-tech leg and the more standard prosthetic, and certainly highlights that to him the C-Leg® is no better than what would have been normally offered to him. For example, both have the same rating on the ‘ability to take care of myself’ construct, and the ‘advancement’ construct, suggesting that, from his perspective, the use of the C-Leg® has not really improved his life better than a standard issue prosthesis. This raises a question for both him as a consumer and society as the payer as to why this individual was offered this expensive prosthesis rather than a less expensive standard issue prosthesis in the first place. Certainly he feels he had a slightly higher ability to take care of himself (4 vs. 5) in his ‘self after first prosthesis’ in relation to the high-tech leg.

In looking at the constructs ‘self as I am now’ and ‘self as others see me’, the latter is rated more negatively than the ‘self as I am now’ on every construct except one, suggesting he feels others see him less positively than he sees himself. Certainly, the ‘self as others see me’ element is informative as it is the most negatively rated of all the self-referent elements, and thus may be seen as something that is of concern to him. Indeed, while he accepts unsolicited help and understands that people are only trying to be nice, it emerged in the interview and is reflected in the rest of the repertory grid that he would prefer to be left alone to be independent.

The grid reflects that John has coped well with his amputation and while he recognizes that it has affected his life, he still rates the ‘self as I am now’ as positive, and even with his first prosthesis he was considerably satisfied. Indeed the positivity of the participant is further highlighted by the fact that, excluding the cosmetic leg and osseointegration, the negative ends of the construct scales (in these case, ratings were only used 3 times.
Figure 3.1: John’s completed repertory grid

<table>
<thead>
<tr>
<th>Positive end of construct</th>
<th>My Ideal Self</th>
<th>Self as I am now</th>
<th>Self as others see me</th>
<th>Intact leg</th>
<th>Own body</th>
<th>Single-axis hinge leg</th>
<th>Cosmetic Leg</th>
<th>High-tech prosthesis leg</th>
<th>Self before amputation</th>
<th>Self after first prosthesis</th>
<th>Osseo-integration</th>
<th>Negative end construct</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consideration</td>
<td>2</td>
<td>6</td>
<td>6</td>
<td>2</td>
<td>2</td>
<td>7</td>
<td>10</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>10</td>
<td>Lack of consideration</td>
</tr>
<tr>
<td>Losing and gaining independence</td>
<td>1</td>
<td>3</td>
<td>5</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>10</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>10</td>
<td>Losing independence</td>
</tr>
<tr>
<td>Concern</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>10</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>10</td>
<td>Not caring</td>
</tr>
<tr>
<td>More communication</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>10</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>10</td>
<td>Too little communication</td>
</tr>
<tr>
<td>Improvement within myself</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>10</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>10</td>
<td>Giving up</td>
</tr>
<tr>
<td>Ability to take care of myself</td>
<td>1</td>
<td>3</td>
<td>5</td>
<td>3</td>
<td>3</td>
<td>5</td>
<td>10</td>
<td>5</td>
<td>2</td>
<td>4</td>
<td>10</td>
<td>Not caring</td>
</tr>
<tr>
<td>Closer to reality</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>10</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>Refusing to accept reality</td>
</tr>
<tr>
<td>A beginning</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>10</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>10</td>
<td>Lack of positivity</td>
</tr>
<tr>
<td>Advancement</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>10</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>10</td>
<td>Stagnantism</td>
</tr>
<tr>
<td>Increased honesty in myself</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>10</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>Failure to strive honestly</td>
</tr>
<tr>
<td>Wishing I could improve</td>
<td>1</td>
<td>3</td>
<td>5</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>10</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>Not recognising need to improve</td>
</tr>
<tr>
<td>Realism</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>10</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>10</td>
<td>Dishonesty (w not)</td>
</tr>
</tbody>
</table>
3.3.1.2 Construct Analysis

To gain a better understanding of what is important to the participant, it is also essential to look at the constructs that were elicited to rate the elements. The idea of improvement is evident in the constructs ‘improvement within myself’, ‘advancement’, and ‘wishing I could improve’. The opposite meanings given for each of these, ‘giving up’, ‘stagnantism’, and ‘not recognising the need to improve’, suggest that those who do not see the need to improve their lives, in his opinion, have given up and do not realise that they have the ability to improve their lives. This was also reflected in the construct of ‘ability to take care of myself’ and its negative construct of ‘not caring’, again indicating that those who don’t try to take care of themselves do not care about improving. Certainly we can see from his rating of elements, such as ‘self as I am now’, that he believes that he has put in the effort to make his life the best that it can be, and this theme highlights the importance of this in his life.

Another theme that is evident within the grid is that of honesty and reality. The constructs of ‘closer to reality’, ‘increased honesty in myself’, and ‘realism’ and their given opposites, ‘refusing to accept reality’, ‘failure to strive for honesty’ and ‘dishonesty (wilful or not)’ show a link between being honest with the self and in accepting the reality of the amputation. This concept relates to the negative ratings of the cosmetic leg element, arguably a device that somewhat negates the reality of an amputation by making the prosthetic look more real. The importance of honesty and reality for this participant therefore demonstrates his high level of acceptance of his amputation that he has no need to hide from this reality.

A third theme identified within the constructs was that of looking after the self and the independence needed to do that. This emerged from the constructs ‘losing and gaining independence’ and ‘ability to take care of myself’ and their contrasting poles of ‘losing independence’ and ‘not caring’. The ‘consideration’ and ‘lack of consideration’ construct was related to the concept of how others treat him. The
construct was developed during the interview when he described how people had become more considerate to him since his surgery, and he revealed that sometimes he does not want people to be more considerate and to help him all the time, as he values his independence and the ability to take care of himself. This construct was the only one which received ratings that were nearer to the negative end of the construct dimensions (over 5), showing that consideration of his abilities may not always be taken into account. It also links back to his ratings of the elements and his belief that others do not view him as positively as he sees himself, and as such offer unwanted help.

It should be noted that of all the constructs generated, they were all predominantly positive and reflect the positive outlook the participant has.

3.3.1.3 Summary of Case Study 1
The grid reflects that this person has coped well with his amputation and while he recognizes that it has affected his life, he still rates the life he has now as positive. However, he feels others see him less positively than he sees himself and have since become more considerate to him since his surgery. Yet he prefers to be independent and believes that he has put in the effort to make his life the best that it can be. He has a high level of importance for honesty and reality, indicating a high level of acceptance of his amputation, in that he has no need to hide from this reality. He has not found much of an improvement between the high-tech leg and the standard issue prosthesis.

3.3.2 Case Study 2 -Phil
Phil is a 64 year old, African American male with bilateral transtibial amputations and a history of diabetes and peripheral vascular disease (PVD). He originally had a unilateral amputation. Subsequently he had a series of amputations with a higher level each time culminating 5 years ago in a second transtibial amputation. The prostheses that he is currently using are 5 years old (despite having a newer one
which he does not wear). His prostheses are standard issue below knee prostheses which he wears everyday for about 10 hours. He was fitted with a more cosmetic and less functional limb after his first amputation, but since then has been fitted with similar models to the type he currently wears. He uses a scooter mobility aid for increased mobility but is able to walk short distances. A copy of his completed grid is in Figure 3.2. It should be noted that as a below knee amputee, the C-Leg® prosthesis is not available to him to use, nor the single-axis hinge joint (they both contain knee joints) but were included for further insights into how these options are perceived.

3.3.2.1 Analysis of Elements
Phil rated the element ‘intact leg’ positively. The only negative score referred to it as being considered not an option for him. Phil viewed cosmetic limbs as his least desirable prosthetic option, rating it high in terms of ‘dislike’ and ‘unimportant’. Similarly, Phil did not view the single axis hinge leg favourably, rating it as ‘not an option’ for him, and also rating it negatively in terms of dislike and unimportance. Phil rated osseointegration as his second most favourable prosthetic option behind a high tech prosthetic limb. Phil’s most favourable ratings for osseointegration referred to this being a potentially ‘convenient’, ‘comfortable’, and ‘functional’ option, indicating that he might consider having the procedure if it was an option available to him. Despite a high tech leg requiring a higher amputation, Phil chose this as his most desirable prosthetic option, rating it highly on most constructs. If given the opportunity, this participant would like to use the high tech prosthesis, and certainly from the interview, he believes that if he had an above knee amputation he would be favourably inclined to get a C-Leg® due to the improved walking ability that is associated with the leg. He rated it more favourably on selected constructs compared to his second favourite option, osseointegration. He bases this belief on the research he has done himself into the number of prosthetic options that are currently available on the market.
The ‘self after first prosthesis’ provides some of the most remarkable information, as it is rated the most negatively of all the elements and contrasts well with the positively rated ‘self as I am now’ element. The former receives a score of 3 on the ‘liked-disliked’ construct in contrast to the 8 for the ‘the self as I am now’. The ‘self after first prosthesis’ also rates low on the ‘myself-it wasn’t me’ construct, the ‘normalcy-irregular’ construct and the ‘mobility-stationary’ construct.

Certainly, Phil noted that he was unhappy after his first amputation, noting it as ‘traumatic’ and this may have affected his acceptance of his first prosthesis. Furthermore, he indicated that his first prosthesis was predominantly cosmetic, and as we can see from his ratings of the cosmetic leg, this is not rated favourably. However, it is important to note that these ratings are harder to interpret as there was a number of similar constructs that produced different ratings on the ‘self after first prosthesis’ element. For example, this element was rated 4 on the first ‘normal-irregular’ construct, but then rated 8 in the ‘normalcy-irregular’ construct. This difference in ratings, however, may indicate differences in the apparently similar constructs, or differences in how the constructs were interpreted when the ratings were being made. The repertory grid reflects how people feel at a given period in time, and it is possible that by the end of rating the elements on the grid more thought was put into how the self was after the first prosthesis. It is also possible that the 4 on the ‘normal-irregular’ construct means Phil felt he was mentally and psychologically like a normal person after his first prosthesis, while the 8 on the ‘normalcy-irregular’ construct means Phil felt he was functionally ‘irregular’ after his first prosthesis. This is certainly reflective of the way Phil discussed his experiences within the Repertory Grid process and is a more likely explanation than a change in opinion during the interview.
Figure 3.2: Phil’s completed repertory grid.

<table>
<thead>
<tr>
<th>Positive end of construct</th>
<th>My Ideal Self</th>
<th>Self as I am now</th>
<th>Self as others see me</th>
<th>Intact leg</th>
<th>Own body</th>
<th>Single-axis Hinge leg</th>
<th>Cosmetic Leg</th>
<th>High-tech prosthetic leg</th>
<th>Self before amputation</th>
<th>Self after first prosthesis</th>
<th>Ossiointegration</th>
<th>Negative end of construct</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>4</td>
<td>3</td>
<td>Irregular</td>
</tr>
<tr>
<td>Myself</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>6</td>
<td>6</td>
<td>3</td>
<td>2</td>
<td>8</td>
<td>4</td>
<td>It wasn’t me</td>
</tr>
<tr>
<td>Convenience</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>7</td>
<td>2</td>
<td>Inconvenience</td>
</tr>
<tr>
<td>Comfortable</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>5</td>
<td>5</td>
<td>3</td>
<td>2</td>
<td>6</td>
<td>3</td>
<td>Uncomfortable</td>
</tr>
<tr>
<td>Functional</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>5</td>
<td>3</td>
<td>3</td>
<td>6</td>
<td>3</td>
<td>Dysfunctional</td>
</tr>
<tr>
<td>Liked</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>7</td>
<td>8</td>
<td>2</td>
<td>3</td>
<td>8</td>
<td>3</td>
<td>Disliked</td>
</tr>
<tr>
<td>Important</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>7</td>
<td>8</td>
<td>4</td>
<td>3</td>
<td>8</td>
<td>3</td>
<td>Unimportant</td>
</tr>
<tr>
<td>The same person</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>5</td>
<td>7</td>
<td>3</td>
<td>3</td>
<td>6</td>
<td>3</td>
<td>Not me</td>
</tr>
<tr>
<td>My choice</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>9</td>
<td>6</td>
<td>10</td>
<td>7</td>
<td>2</td>
<td>1</td>
<td>8</td>
<td>3</td>
<td>Not an option for me</td>
</tr>
<tr>
<td>Normalcy</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>5</td>
<td>7</td>
<td>3</td>
<td>1</td>
<td>8</td>
<td>3</td>
<td>Irregular</td>
</tr>
<tr>
<td>Mobility</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>7</td>
<td>3</td>
<td>Stationary</td>
</tr>
<tr>
<td>Like</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>7</td>
<td>7</td>
<td>3</td>
<td>2</td>
<td>4</td>
<td>4</td>
<td>Don’t like</td>
</tr>
</tbody>
</table>
Other elements that produce quite different ratings when compared are the ‘self before amputation’ and the ‘self after first prosthesis’ elements. These two elements vary as the ‘self before amputation’ is consistently rated positively and the ‘self after first prosthesis’, as mentioned above, is generally seen in a negative light. Even though Phil suffered from diabetes and vascular problems, and would have had some problems with mobility and pain before his amputation, ‘self before amputation’ is still seen as better than after the amputation, and as something of an ideal. The ‘self after first prosthesis’ highlights how much the prosthesis was not liked, and is rated poorly on comfort and functionality.

‘My ideal self,’ ‘the self as I am now’, and the ‘self as others see me’ had similar positive ratings and reflect Phil’s positive outlook on life. His rating of his ‘self as he is now’ as almost the same to his ‘ideal self’ shows how well he has adapted to his situation, and how well he has accepted his amputations. That ‘the self after first prosthesis’ is not rated as favourably show that this process was not an instant one, and that the first prosthesis he had was too disliked to be truly accepted. His “self as he is now” has almost identical ratings to his “ideal self”, and in turn has almost identical ratings to the ‘self as others see me’ element. Phil also described himself as a content person within the interview. The ratings suggest that he feels that he is still the same person that he has always been, and believes that those who know him do not see him as changed from the person he was, indicated by similar ratings on the ‘self as I am now’ and the ‘self before amputation’. His high level of acceptance of the amputation may also be related to his dislike of the cosmetic leg. This user sees no need in hiding his amputation and disability and so believes the cosmetic leg to be somewhat useless due to its limited functions.

3.3.2.2 Construct Analysis

There was significant overlap between a number of constructs. For example, the dimension of ‘liked-disliked’ and ‘don’t like-like’; ‘normal-irregular’ and ‘normalcy-irregular’; and ‘myself-it wasn’t me’ and ‘the same person-not me’. This
may indicate undifferentiated thinking or the salience of a single theme along various dimensions. However, it is important to note that different ratings of the same elements appeared on these constructs, which indicates that these apparently similar constructs may have different meanings for the individual. For example, on the ‘normal-irregular’ dimension, the ‘cosmetic leg’ was rated as 4, but then rated as 7 on the ‘normalcy-irregular’ dimension. So the cosmetic leg can be rated as more normal in one sense, for example aesthetics, but more irregular in another, for example functionality. Similarly, the ‘self after first prosthesis’ element was rated 3 on the ‘dislike-liked’ dimension, but 8 on the ‘Don’t like-like’ dimension. It could be argued that the self that was liked after the first prosthesis was the one that was continuing on with life and regaining mobility, while the self that was disliked was the one that was having difficult adjusting to walking differently and with less ease. Certainly, the interview data suggests that the participant did not dislike who he was as a person after his first prosthesis. He considers himself to be the same person that he always was, but he also noted that he disliked the lack of functionality that came with his first cosmetic leg, which may explain the negative rating on this element with a similar construct.

Together the constructs provide a picture of the importance of being normal, of still being the same person, and liking who you are and the prosthesis you have been given. Furthermore, useful constructs in terms of rating prosthetics such as functionality, convenience, comfort and mobility were identified. The ‘not an option for me- my choice’ construct indicated which prostheses Phil would have if he was given the choice, but also taking into consideration his physical limitations. In this case, as he had a below knee amputation, there is no option of the C-Leg ® for him, yet he would choose to use it if his situation was different as he believes it to be the best option available for those with lower limb amputations in terms of improving mobility and regaining normality.
In a relevant coincidence to this study, in the interview after the repertory grid it emerged that Phil had recently decided not to use a new prosthesis and returned to one he had previously owned. He had found that his new prosthetic was not as comfortable, that he was experiencing sores and knots in his leg muscles, so he returned to using his original prosthesis without returning to a prosthetist. He had originally gone to get a new prosthetic for one of his legs and was instead fitted for two new prosthesis for both legs which he felt was unnecessary.

3.3.2.3 Summary of Case Study 2
This participant is well adapted to his situation and has accepted his amputations. He sees no need to hide his amputation and disability and feels that he is still the same person that he has always been. He also believes that those who know him do not see him as changed from the person he was. However, this process was not an instant one: he was unhappy after his first amputation and the first prosthesis he had was too disliked to be truly accepted. He highlights the importance of being normal, of being the same person, and liking who you are now and the prosthesis you have been given. If the situation arose, this participant would like to use the high tech prosthesis and believes that if he had an above knee amputation he would be favourably inclined to get a C-Leg ® due to the improved walking ability that he perceives to be associated with it.

3.3.3 Conclusions from the Repertory Grids
As we can see from the grids, both of the participants were prosthetic users who appeared to have adapted to their amputations and were generally content with their lives as prosthetic users. However, we can also see that both individuals were not completely satisfied with the protheses they were using. John, while given the most high-tech prosthesis available, had concerns particularly with whether his health insurance money was being appropriately spent. He recognises that the C-Leg ® is not really made for use with older patients, and points out that while it is made to aid stair-walking, he has no stairs in his house. Although Phil had recently received a
new prosthesis, he had returned to use his old one which he felt fit better and was more comfortable. He also felt that his range of prosthetic choices were limited as a person with a below knee amputation, as the more high-tech advances in prosthetics relate to the knee joint.

Both participants had little regard for the cosmetic limb, and while John did wear long trousers, Phil was comfortable enough to wear shorts and show off both his prosthetic limbs. Although John also stated in the interview that he didn’t really like to show off the prosthetic limb by wearing shorts he also stated that he felt no need to try and make it look more realistic. The lack of regard for the cosmetic leg may also be related to their level of adjustment and adaptation. As both men appeared to have adapted well to their amputation, and were accepting of who they were, they were less likely to feel a need to hide their amputation with a cosmetic limb as they were not afraid if people knew about it. However, given the importance of functionality for both participants, it is possible that the reaction to the cosmetic limb could also arise from its lack of functionality rather than the fact that it conceals the amputation.

3.4 Discussion
The aim of the present study was to explore the values and preferences that lower limb prosthetic users have of their prosthetic devices; and to investigate how the user views alternative prosthetic options and to demonstrate a novel method for exploring these values and preferences. We can observe from the two grids that individuals who are somewhat similar (both male, over 60 years old, with amputations later in life, and both well adjusted to their amputations and involved in the amputee community) can have very different views on existing prosthetic options, and that a number of different features are important to individual prosthetic users when selecting a prosthetic option. This observation is to be expected based on the theory of Constructive Alternativism, central to Personal Construct Psychology, which states that individuals construct different realities even when presented with similar
situations. While numerous papers suggest that individual’s may vary in their prosthetic preferences, these case studies using a standardized assessment process provide evidence to support this notion. These results also suggest that the factors individuals use to evaluate a prosthetic option can be highly individualized, and that different prosthetic options are not held in the same regard among different prosthetic users.

The repertory grid is a tool to explore the thoughts and feelings of the individual without imposing researcher bias or opinions on the participant. Using this participant-led interview it is possible to identify what is important to the individual as a prosthetic user and consumer. Both participants, while adapting well to their amputation, were not completely satisfied with the prosthetic options prescribed, and did not have much involvement in their initial choice of prosthesis nor in their choices of prosthesis at further fittings. Furthermore, the preference and choice of prosthesis may not reflect what providers see as the most up-to-date and cutting edge available. Even when the most high-tech prosthetic option is offered, there is no guarantee of satisfaction for the user, highlighting the need for personal choice and involvement for the user in the fitting stages of the prosthesis. These findings suggest that the rapid increases in the functionality of the technology available to prosthetic users have not always taken into account the feelings and emotions individuals attach to devices, and that some technological advances may not be appreciated by users of that technology. Sullivan states that ‘facts known only by physicians need to be supplemented by values known only by patients’ (2003, p.1595), and the repertory grid provides an opportunity to allow individuals to express their views and feelings that may not usually be been taken into account when prescribed protheses. Both of these case studies also show that individual choice is not only relevant for patient satisfaction, but also when considering the costs and resources that are involved in fitting an individual for a prosthetic limb. If the patient is not comfortable using the limb, and decides not to use it, this represents a waste of medical resources. These cases therefore support the growing
concern over the lack of attention to patient preferences in prescription of prosthetic limbs and other Assistive Technology. As Scherer notes, ‘It is no longer acceptable to point to technological solutions before the prospective user’s goals are fully defined. A particular technology should never become the place to start; the needs, desires and goals of the user should be the beginning point.’ (Scherer, 2002, p.3). As such, these cases also raise the issue of understanding the needs of the user, and whether follow-up care is necessary to ascertain whether they are using their prosthesis or not.

The structured approach to the interview was advantageous in that it is easy to do, with a highly standardised method that leads the participant to greater awareness of their often tacit values. It also gives service providers an insight into what is important to the consumer. The Repertory Grid process created individually meaningful scales for each person to rate the different prosthetic options. By rating the technology on these scales, we are essentially rating the technology under headings that are personally important to the prosthetic user. The unique perspective of each completed repertory grid provided a number of headings for rating prostheses and the self, such as ‘normal –irregular’ and ‘improving – giving up’ that may not have been identified using conventional questionnaire or interview techniques, and were exclusive to each individual. The Repertory Grid therefore goes a step further than other prescription methods such as the MPT (Scherer, 2002) as it indicates what an individual’s preferences are with technology by offering ratings on different prosthetic options, while also showing why and how they have arrived at these preferences. The finished grid also offers a wealth of ideographic information to the researcher or service provider that is easily accessible and understandable, without the need of laborious transcriptions and thematic or content analysis.

There are some limitations to this study. The two case studies were chosen to include a person with a lower limb amputation and also a person with a bilateral
amputation. Both individuals were very active in the amputee community, and both were involved in providing peer support to other people with an amputation. As volunteers there may be selection bias leading to differences in the grids than may be obtained from individuals who do not volunteer for advocacy or research activity. Another limitation was that through the chance of randomly generated triads, each triad contained a self-referent element. This meant that there was less opportunity for the participant to generate a personal construct from the triads that was not self-referent. However, the inclusion of these elements meant that the constructs created were less related to the physical attributes of the prosthetic options and therefore gave us a better insight into the individuals taking part and their deeper feelings and emotions regarding the prosthetic options, as well as providing unique constructs for rating the technology. Further to this, both participants did not find any difficulty in rating prosthetic options on the constructs created. Finally, as in other qualitative research, the researcher may influence the observations drawn from the data. Thus other investigators may draw additional or different conclusions from the data. However, by elucidating the data collected on the grid with each participant as part of the Repertory Grid process, there was less scope to misinterpret the data

While the repertory grid remains to be established as an effective and efficient method for matching user with technology, the underlying theory and approach has potential for advancing the field. These case studies confirm the growing concern over the lack of attention to patient preferences in prescription of prosthetic limbs and other devices. This study highlights the need to move away from the path of thinking of patients in general, but specifically prosthetic users, as just recipients of health care and rehabilitation. They need to be thought of as persons who have preferences and expectations of the product or device they wish to use. Even when choice of components is slim for users due to financial constraints, it is important that choice is offered when possible and recognised as an important factor in optimising use rates. Discovering the values and preferences of the patient and assessing them early in the treatment process is increasingly recognised as an
important factor in the delivery of healthcare (Quill and Brody, 1996). In particular, client participation and client-centred focus are central features in the International Classification of Functioning, Disability and Health (ICF) (WHO, 2001), and are highlighted in the widely accepted Matching Person and Technology (MPT) model used for prescribing assistive technology (Scherer, 2002).

The repertory grid study looks into the different experiences that prosthetic users have with the prosthesis, and how the different technology impacts on their life. This study further emphasises how patient reactions to different technologies are individualised and how different prostheses types may contain different meanings for different people. This highlights that patient perspectives are an important knowledge base within the prescription process, as by including the patient there may be a greater chance of matching the user with the technology. Given that there are currently no standardised methods in which to measure patient preferences within the prosthetic prescription setting, this study recommends further research in this area to aid the necessary change in practice. Including individuals’ choices and opinions within the prescription process will increase patient satisfaction and decrease the likelihood of prosthetic abandonment. It is also recognised that due to the time constraints in clinical practice, a modified Repertory Grid process would be more suitable for use within prosthetic prescription. Consequently, this study recommends a standardized method be created for clinical use which uses a similar approach. With some training a modified Repertory Grid could potentially be administered by any health care provider, though would be of most use to either a clinical psychologist or a prosthetist due to the information it generates. Importantly, those administering the interview should be aware of not offering prosthetic devices which are not available to the user due to potential disappointment, and also of how the Repertory Grid process could potentially upset individuals (see Ethical Considerations, Section 3.2.3).
The information from this part of the research shall now be built on in the next section. As the importance of the individual was emphasised in the repertory grid study, user perspectives will be investigated as part of gaining information about improving the prosthetic prescription process. This process will be more explicit as it will involve specific questions about how the prosthesis itself is viewed. It follows on from the data collected in the first part of this research by finding out what users feel are important factors to optimise their prosthesis use, the important outcomes to measure, and the important predictors of prescription. Interviews with service providers will also be conducted to maximise the knowledge base in ascertaining the key factors in prosthetic prescription and which of these are vital to optimise prosthesis use.
Chapter 4 - Focus Group and Interview Study

**Aim:** To gain a better understanding of what individual users and service providers consider to be the important outcomes of having a prosthetic limb; factors which they think predict and affect the use of their limb and their experiences; and opinions of the service and prescription process.

### 4.1 Introduction

Qualitative research offers a variety of methods for identifying what really matters to patients and carers, detecting obstacles to changes, and explaining why improvement does or does not occur (Pope and Tarlov, 1991). For this stage of data collection, it was agreed that qualitative research methods would provide necessary and useful insights into the thought and feelings of the prosthetic user and service provider about important outcomes and factors associated with prosthetic prescription and use, and would produce more informed data that could later be used in the Delphi Study.

#### 4.1.1 Focus Groups with Users

A focus group is defined as “a carefully planned series of discussions designed to obtain perceptions on a defined area of interest in a permissive, non-threatening environment” (Kreuger and Casey, 2000, p.5). Most simply put, it is a gathering of relevant persons to discuss and comment on, from personal experiences, the topic that is the subject of the research (Powell and Myers, 1995). The facilitator leads the group so that it remains focused on the topic being explored, though group interaction is encouraged as it is explicitly part of the method (Kitzinger, 1995). There is no pressure by the moderator to have the group reach consensus. Instead attention is placed on understanding the feelings, comments and thought processes of participants as they discuss the issues (Kreuger and Casey, 2000).
Focus groups are best used instead of individual interviews when it is clear that the interactions among group members will be as illuminating as the statements of any individual but it is also hoped that the group processes will help people explore and clarify their views in ways that would be less effective and accessible in a one-on-one interview (Kitzinger, 1995, Walker et al., 2006), or may even elicit richer or more sensitive data than an interview (Morrison-Beedy et al., 2001). Focus groups can also aid research by encouraging participation from those reluctant to be interviewed on their own, or from people who feel they may not have a contribution to make, as they provide as 'safe' forum for the expression of views e.g. it is not obligatory to respond to every question (Vaughn et al., 1996). They also provide a forum for the exchange of views and opinions in a collegial, supportive atmosphere, especially for people from otherwise socially marginalised groups (Kroll et al., 2007). Furthermore, when aiming to improve health services, this method can prove extremely useful as, within the group dynamic, a range of different solutions to problems are generated and criticisms are expressed from patients who might be reluctant to give negative feedback, or feel that any problems result from their own inadequacies (Kitzinger, 1995, Syron and Shelley, 2001). This may be true in the prosthetic setting where users may feel that problems with the use of their prosthesis arise from their own inadequacies rather than a fault in the technology or prescription. By talking to others, individuals may get the sense that they are not alone in the difficulties they experience and feel happy to share them.

The focus group method has been used within a number of different studies to explore different aspects of rehabilitation and psychology, such as the bereavement model in stroke rehabilitation (Alaszewski et al., 2004), the client perspectives of different types of rehabilitation (Ham and Cotton, 1991, Crosbie et al., 2006), the impact of physical disability on body esteem (Taleporos and McCabe, 2002a), the characteristics of assistive technology service delivery models (Ripat and Booth, 2005) and patient information on phantom limb pain (Mortimer et al., 2004). Gallagher and MacLachlan (2001a) conducted focus group research into the
adjustment to an artificial limb, where thematic analysis indicated that self-image, social, physical and practical concerns such as revealing the impairment to strangers, support among others and the meaning attributed to and the acceptance of the amputation were important in the adjustment process. Focus groups were also used in a multi-stakeholder (users, researchers, clinicians and manufacturers) study on assessing the needs of lower limb prosthetic users, seeing if differences in needs existed between traumatic and illness-related amputation groups, and to identify and describe future research and development to address these needs (Klute et al., 2009). The focus groups only made up the first half of this study, and identified no difference in needs between the traumatic and illness-related amputation groups, but identified areas which needed to be addressed to improve prosthetics prescription, notably changes in socket fit and alignment. There were also issues highlighted about how measuring prosthetic use needs to be improved and standardised, as well as the need to identify meaningful outcome measures.

This study hopes to build on this by identifying the important outcomes and predictors of prosthetic prescription. By using a focus group approach with users of prosthetic services, it was anticipated that the information generated would reflect accurately the experience of prosthetic fitting from the point of view of the prosthesis user, while also identifying the important outcomes and predictors of prosthetic prescription as viewed by users. A cross-national approach was also used in this study to ensure a sufficiently large enough sample to get a comprehensive view of prosthesis use. This approach also enabled the inclusion of an extensive perspective of views. As the similarities between different prosthetic services and in the knowledge needed to prescribe prostheses are greater than the differences that separate them, the inclusion of a cross-national sample was deemed appropriate. A description of the prosthetic service in the UK can be found in Engtrom and Van de Ven (1999, p.98), while a description of Irish services can be found at www.apos.ie. Service providers within the field of prosthetics also have a history of working
together, despite being in different countries, to further the field and as such most services are operated on similar principles.

4.1.2 Interviews with Service Providers

To get comprehensive data on the prosthetic prescription process, it was also necessary to collect qualitative information from service providers within the field to supplement the data obtained from the service users. Information garnered from service providers would reflect their individual clinical expertise and would thus be valuable in identifying the most important outcomes and predictors from a clinical specialist point of view. It would also offer another insight into the prosthetic provision service. This is important as if the findings from prosthetic users and providers differ; we leave out relevant information by not including both perspectives. Having both perspectives indicates where gaps occur in the knowledge of each group as well as the differing perspectives on how healthcare should be delivered (Holt and Trelaor, 2008). Similar to the focus group study, it was deemed appropriate to draw the service provider sample from different countries. It was anticipated that by making the study cross-national a bigger base of knowledge could be accessed. As the important aspects of prosthetic services tend to be universal, such as matching the technology to the individual in terms of weight and componentry, it was deemed unlikely that information garnered from the study would not be widely applicable, especially within Westernised healthcare.

While the focus group was deemed an appropriate method of research for obtaining data for the services users of prosthetic care, it was not considered a viable option for obtaining from service providers. The main difficulty lay in organising a convenient time for a number of professionals to meet together for approximately an hour without it affecting the care of their patients by disrupting the work day. This would be especially true if individuals were coming from the same service provision centre. There was also the possibility that having heterogeneous groups of different professions might lead to some members of the group perceiving that their opinion
was not welcome, or as valuable as maybe those of a consultant or any other profession considered to have more experience or knowledge (Kitzinger, 1995). This became more of an issue when it was apparent that some care centres had different approaches to dealing with prosthetic prescription, and felt that their particular approach was better than another’s. For these reasons, it was important to employ a method that would allow the specific experiences and views of particular disciplines and services to be appropriately and adequately explored.

Semi-structured interviews are the most widely used method for collecting qualitative data (Polkinghorne, 2005). The qualitative research interview is usually performed on a conversational basis, using rather loose, broad and open-ended questions or interview themes, with the aim of encouraging the participant to talk (Ohman, 2005). These interviews are scheduled in advance at a designated time and location that occurs outside of daily events so that observation is not feasible and only verbal data is obtained (DiCicco and Crabtree, 2006). Semi-structured interviews offer much of the benefits associated with qualitative research as mentioned above, such as uncovering issue or concerns that had not been anticipated or considered by the researchers. They can also be used to inform quantitative inquiry much like the focus group method. They also give the opportunity for the researcher to follow the line of inquiry deeper within certain topics and thus gave the opportunity to explore different topics specific to each profession in more detail. Semi-structured interviews have been used often in health research, such as understanding the emotions and control issues associated with disabling conditions (Shroder et al., 2007), psychosocial maturity when transitioning to adulthood in people with motor disabilities (Galambos et al., 2008) and in the amputation literature to understand the personal meanings of being a prosthesis user (Murray, 2009) and to improve prosthetic prescription by understanding the actions underlying the choice of specific components in the clinical setting (Van der Linde et al., 2004a).
It was anticipated that by using semi-structured interviews to gather thought and opinions from service providers, more detailed data would be generated than would be collected by other, quantitative means. Using interviews meant there was more involvement from the service providers in the research process and the possibility to explore topics which may not have been addressed by the research team without participant involvement.

4.2 Method

4.2.1 Part 1: Focus groups

4.2.1.1 Identifying the Sample
Two hospitals in Ireland and one in the UK were contacted and permission was sought to purposively select volunteers to invite to focus group sessions held at a local venue. In hospitals, the cooperation of a named individual in the limb fitting centres was sought to facilitate the sampling that allowed participants to be selected and to be invited to participate in focus groups. When doing research in the health services, it is usual that intermediaries such as service providers need to be on board with the study to help with the recruitment and screening of potential participants (Woodring et al., 2006). Convenience sampling was used, but intermediaries ensured that the individuals invited to participate in the focus groups met the inclusion criteria of:

- Having a major limb amputation of one or both of the lower limbs.
- Being over 18 years of age and legally able to consent for themselves
- Having sufficient spoken English for the demands of the study.
- Being at least one year post amputation.

Exclusion criteria were:

- Having upper limb loss only.
• Having major psychotic illness which compromised the giving of informed consent.
• Currently receiving inpatient treatment for depression or considered at suicidal risk.
• Having a severe head injury.
• Currently taking medication that may impair cognitive capacity.
• Having severely impaired cognitive or mental capacity, and unable to give informed consent.

A number of individuals suitable for the study were identified and contacted by a (Appendix E) explaining the research study by an intermediary from each research site. Each individual was asked to return a completed consent form directly to the researcher if they wished to take part. It was felt that in being contacted by a letter, the individual might feel less obligation to take part in the study than if they were contacted over the phone or if they were given the information at an appointment within the health service.

A total of 24 participants took part in one of the 6 focus groups. Altogether 75 people from the participating hospital in the UK, 20 from James Connolly Hospital Blanchardstown, Dublin and an unknown number from the National Rehabilitation Hospital, Dun Laoghaire, Dublin, were contacted, although some of those contacted were reported deceased or had changed addresses. A number of people also replied to take part in the study, but were unable to attend any of the focus groups on the days that they were arranged due to a number of different reasons. To understand with greater depth the information put forward in the results section, the demographics of each focus group are outlined in Box 4.1.
Box 4.1: Demographic details for each focus group

<table>
<thead>
<tr>
<th>Focus group 1</th>
<th>Focus group 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>PT1: 70, F, Congenital, BK, 61 years</td>
<td>PT1: 58, M, Trauma, AK, 10 years</td>
</tr>
<tr>
<td>PT2: 45, F, Trauma, AK, 40 years</td>
<td>PT2: 75, F, Trauma, BK, 22 years</td>
</tr>
<tr>
<td>PT3: 49, F, Dysvascular, AK, 8 years</td>
<td>PT3: 63, F, Cancer, AK, 45 years</td>
</tr>
<tr>
<td>PT4: 29, F, Trauma, BK, 7 years</td>
<td>Focus group 5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Focus group 2</th>
<th>Focus group 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>PT1: 75, F, Cancer, AK, 32 years</td>
<td>PT1: 67, M, Dysvascular, BK, 3 years</td>
</tr>
<tr>
<td>PT2: 70, M, Aneurism, BK, 10 years</td>
<td>PT2: 84, M, Dysvascular, BK, 6 years</td>
</tr>
<tr>
<td>PT3: 59, F, Trauma, BK, 52 years</td>
<td>PT3: 72, M, Dysvascular/Infection, 2BK, 3 years</td>
</tr>
<tr>
<td>PT4: 50, F, Infection, AK, 41 years</td>
<td>PT4: 86, M, Dysvascular, 3 years</td>
</tr>
<tr>
<td>PT5: 81, M, Infection, BK, 9 years</td>
<td>Focus group 6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Focus group 3</th>
<th>Focus group 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>PT1: 56, M, Dysvascular, 4 years</td>
<td>PT1: 66, F, Infection, BK, 5 years</td>
</tr>
<tr>
<td>PT2: 43, M, Cancer, BK, 2 years</td>
<td>PT2: 65, M, Trauma, BK, 25 years</td>
</tr>
<tr>
<td>PT3: 55?, M, Dysvascular, BK,AK, 6 years</td>
<td>PT3: 63, M, Trauma, BK, 28 years</td>
</tr>
<tr>
<td>PT4: 74, F, Dysvascular, 2BK, 12 years</td>
<td>PT4: 64, M, Trauma, AK, 42 years</td>
</tr>
</tbody>
</table>

Key: Age in years, Male/Female, Cause of Amputation, Level of Amputation, Time since amputation

When collecting data from focus groups, there is no consensus on how many groups need to be conducted. Kreuger and Casey (2000) suggest that at least three or four should be planned with the same type of participants. After the initial groups have been conducted, whether saturation has been reached, that is, the point where no new information is being collected, needs to be determined. If there is still new information emerging after three or four groups, more groups need to be conducted (Kreuger and Casey, 2000). However, there is also the rationale that there are no general rules as to the optimal number of focus groups, and that one focus group may well be enough if saturation is believed to have been reached (Bernstein et al., 2003). Indeed, external influences such as time and resources often end up dictating how many focus groups can be conducted (McLafferty, 2004). For this study, 6
focus groups were conducted and it was believed that saturation was achieved as similar themes emerged from each group and it was believed that no new themes would emerge from further groups.

As with the number of groups conducted, there is no consensus on how many people should be in each group. Larger groups may limit productivity as it is generally more difficult to manage the discussions, with groups breaking up into small conversations all talking at once. This means large groups typically require higher levels of moderator involvement which are not desirable for some research purposes (Morgan, 1997). That said, if the participants have a low level of involvement with the topic, an active discussion may be difficult to maintain in a smaller group. Small groups also run the risk of being less productive because they are sensitive to the dynamics among the individual participants. Small groups thus work best when the participants are likely to be both interested in the topic and respectful of each other (Morgan, 1997). Generally speaking, numbers suggested can range from 4-20 participants (McLafferty, 2004), but smaller groups are usually more suitable in health research as they facilitate closer interaction and communication (Ohman, 2005).

As this research was dealing with people with lower-limb amputations, many of whom tend to be over the age of 60 years with dysvascular amputations, it was thought that smaller groups would work best as some of the participants might have comorbidities or sensory limitations such as hearing difficulties which could have affected participation in the group. Focus groups that include people with cognitive or sensory disabilities should be smaller (Barrett and Kirk, 2000) as more time is needed to present questions and for the participants to process. In addition, more time is required to allow everyone to express his or her thoughts and opinions (Kroll et al., 2007). Group sizes in this study ranged from 3 to 5 people and most participants, regardless of age, were able to partake actively in the research discussion.
4.2.1.2 Focus Group Topic Guide

In order to gain information on users’ perspectives of the prescription process and using a prosthesis, predetermined, open-ended questions were arranged into an interview guide to lead the focus group discussion. Potential questions were identified by a review of the literature and consultation with other researchers in the field of prosthetics. Subsequently, a number of brainstorming sessions were conducted to shorten the list to questions that were felt to be most advantageous in generating discussion to answer the research questions. The focus group topic guide consisted of the questions in Box 4.2.

**Box 4.2: Focus Group Topic Guide.**

1) What was your initial reaction to your first prosthesis? Were your expectations met?
2) What goals/achievements did you set yourselves when you were fitted with a prosthesis?
   - Have you been able to reach these goals?
   - If you were not able to, why do you think that was?
   - Was the reason related to your own personal circumstances?
3) If you did reach your goals, what helped you to achieve them?
4) What are the most common issues, if any, that arise because of having a prosthesis?
   - What are the most challenging aspects, if any of having a prosthesis?
5) Have we missed anything important that should be included?

The same set of questions were asked of each group but not necessarily in the same order, and in some cases the topics were reached without the question needing to be asked. Furthermore, there was the opportunity to ask questions that were relevant to each group and that had been unanticipated. The final question also meant that if anything had not been addressed already that the participants thought relevant to the study, they had a chance to discuss it.
The first focus group was conducted as a pilot. The working of the questions and the sequencing of questions was examined, but there were no major changes so the pilot focus group was also included in later analysis.

4.2.1.3 Procedure
Once a participant had agreed to take part in the study, they were contacted by the researcher by telephone and informed of the time and place of the focus group. They were sent further information on directions and transport options if needed. The location for each focus group was accessible to each participant, both by transport and in terms of having a room that was accommodated by a wheelchair ramp or lifts. Each person was also telephoned the day before the focus group to remind them of the session and to confirm their attendance. Participants were also offered remuneration for any expenses incurred when travelling to and from the focus group location and in some cases transport was also arranged.

Focus groups participants were seated around a table to encourage discussion, with two audio-recording devices placed in the middle to record and to facilitate verbatim analysis of the group discussion. This also ensured that the moderator was free from taking notes and could be more involved in the session. There was also an assistant moderator in attendance at the focus groups.

Each person was given an information sheet upon entering the study (Appendix F) and the researcher confirmed that each person had read and understood the information sheet by asking them each individually and answering any questions that were causing difficulty before getting them to sign the informed consent document (Appendix G). Each participant then also had to fill in a short demographic questionnaire (Appendix H) to collect information on age, gender, employment status, amputation cause, amputation level, time since amputation, prosthetic use and pain.
Before the discussion started, the group was informed again that they had permission to leave the study at any time, and that their confidentiality would be protected. They were also reminded that the discussion would be tape-recorded and some direct quotes may be used in the research. The group was also asked to refrain from talking over each other, to respect each person’s opinion, and that no answers were right or wrong in the context of the group. They were also reminded that if they had any issues arising from taking part in the study that they could be put in touch with a clinical psychologist for further support. Once the discussion started notes were taken by either the moderator or assistant moderator, with some quotes written verbatim to improve the quality of the data (Folsom et al., 1992) and in case the audio-recording equipment failed. Each group lasted from between 1 hour to 1 hour 20 minutes by which time all participants were satisfied that the important areas for discussion had been covered.

4.2.1.4 Ethical Considerations

Ethical approval for the study was obtained from the NHS ethics system, the National Rehabilitation Hospital Ireland, Connolly Hospital Ireland and Dublin City University.

Safeguards were introduced to minimize risk to participants and to deal with situations that might cause harm or distress to participants. Given the topic of the focus groups, there was a possibility of causing harm by bringing up vulnerabilities and uncertainties, as well as distressing memories that an individual may not want to discuss (Hyde et al., 2005). In the event that a participant became upset during the focus group, the option of withdrawing was immediately offered to them. The participant was also supported in accessing suitable support systems, if required. The presence of two moderators at each focus group was also important should such an eventuality arise.

Ethics were also an issue in terms of confidentiality. Qualitative data in which participants recount portions of their life stories contain a level of detail and
specificity that can make it difficult to offer confidentiality, especially when dealing with a minority group (Haverkamp, 2005). However, names were changed on all data collected, as well as details which may have indicated who the individual was to any third parties. The only personal data taken were participants’ names on consent forms and their email addresses/phone numbers if they wished to be informed of the study’s results. These were stored in a locked filing cabinet designated for project use only and accessible by the research and her supervisor. These contain no corresponding codes to connect participants’ details with data provided in any part of the study. Furthermore, all computers that have project information on them are password protected. Audio recordings were kept private, confidential and secure and were destroyed after transcription. The names of patients contacted were not known to the researchers until consent was obtained, meaning patient confidentiality was respected at all times.

As stated, informed consent was also needed for this study. It was necessary that all participants were aware that they could potentially become upset during the research procedure, that they would be tape-recorded, and that information from the study would be published at a later date. All participants were given an information sheet before agreeing to take part in the study (Appendix F), detailing all aspects of the research study. This was presented again before the beginning of every data collection so adequate time was given to read and understand the form, as well as pose questions to the researcher if needed. They were also offered the right to leave the study at any time and withdraw consent without reason.
4.2.2 Part 2: Service Provider Interviews

4.2.2.1 Identifying the Sample
Individuals known to the research team to be working in the prosthetic domain, through conferences, peer-reviewed journal articles and professional publication, and service providers from the centres involved in the focus group study were contacted to take part in this study. The inclusion criteria included participants currently working in some facet or service provision with the prescription and use of lower limb prosthetics, being over 18 years of age and legally able to consent for themselves and having sufficient spoken English for the demands of the study. Individuals who were involved in the organisation of the study were excluded.

Each participant was sent a letter or email explaining the research (Appendix I) as well as a consent form to complete and return to the researcher. Each individual was then contacted to arrange a convenient time to conduct the interview, which was done either face-to-face or over the telephone.

In total, 12 interviews were carried out, 3 of which took place over the telephone with the rest conducted face-to-face. Service providers contacted for an interview included 6 prosthetists, 2 consultants, 2 physiotherapists, 1 clinical psychologist, and 1 occupational therapist. Unfortunately, 2 of these interviews could not be used for data due to faulty recording. The final sample consisted of 6 prosthetists, 2 physiotherapists, 1 psychologist and 1 consultant in rehabilitation. Of these, 10 were located in the UK, and 2 were located in Ireland.

4.2.2.2 Interview guide
In order to gain information from the service providers on prosthetic use and prescription, a number of predetermined, open-ended questions were arranged into an interview guide for each of the service provider interviews. Potential questions were at first identified, and then a number of brainstorming sessions were conducted.
to shorten the list to the questions that were believed to be most useful in answering the research questions. The interview guide consisted of the questions in Box 4.3.

**Box 4.3: Interview guide for service providers**

1) What does your job entail?

2) How do you decide when someone is ready for a prosthesis?
   - Is there anything that would stop you prescribing a prosthetic limb to an individual or lead to advise someone to give up their prosthetic limb?
   - Are there any factors that may influence choosing to upgrade an individual’s prosthesis? (Prompt: physical, psychological, social?)
   - How do you know/determine when someone is doing well?

3) How do patients judge they are doing well? Is there a difference between when they feel they are doing well and when feel they are doing well?

4) From your experience, do you believe there are any preoperative characteristics, other than the physical ones, that can influence adjustment to amputation?

5) As a (insert profession) what do you feel are the important outcomes of using a prosthesis for the patient?
   - What would you consider a successful outcome for a patient?

6) Do you think there is anything that could make adjustment easier for the patient? Do you feel the fitting service could be changed to improve patients’ (initial) satisfaction with their prosthesis? (In what way?)

7) Has there been anything important missed that you think should be included?

The same set of questions were asked of each service provider but not necessarily in the same order, and in some cases the topics were either covered without the question needing to be asked or were not completely relevant to the person being interviewed. Furthermore, there was the opportunity to ask unanticipated questions that were relevant to each service provider and to explore in more depth certain areas that were of particular interest to the service provider and researcher. The final
question also meant that if anything had not been addressed already that the participant thought relevant to the study, they had a chance to discuss it. The first interview was conducted as a pilot, and while the working and the sequencing of the questions was examined, there were no major changes so the pilot interview was also included in later analysis.

4.2.2.3 Procedure
When an interview took place face-to-face, the researcher went to the place of work of the participant and interviewed them in a quiet room. The interviewer made sure that the participant had read and understood the information sheet (Appendix J) and reminded them that the interview would be tape recorded and some direct quotes may be used within the research, although anonymity would be protected. They were also reminded they had permission to leave the study at any time. Each participant was also asked to fill out and sign another consent form (Appendix K). Each interview lasted between 10 minutes to 45 minutes depending on the individual.

When the interview took place over the telephone, the researcher rang the participant at a convenient time and only after receiving his or her signed consent form in the post. The researcher again made sure each participant understood that the interview would be recorded and some direct quotes would be used within the research, but again, that anonymity would be protected. The researcher then indicated when the audio-recording device had been switched on so the participant would know the interview had been started. Interviews were conducted over speakerphone, and thus easily recorded using a minidisk recorder. Each interview lasted between 20 and 35 minutes, depending on the individual.

4.2.2.4 Ethical Considerations
Ethical approval for the study was obtained from Dublin City University. Confidentiality of the participants was the main ethical consideration. This made it important to change names on all data collected, as well as any details mentioned
which may have indicated who the individual was to any third parties. The only personal data taken were participant’s names on consent forms and their email addresses/phone numbers if they wish to be informed of the results of the study. These were stored in a locked filing cabinet designated for project use only. These contained no corresponding codes to connect participants’ details with data provided in any part of the study. All data has been kept confidential and secure. All computers that have project information on them are password protected. Audio recordings were kept private, confidential and secure and once transcribed were destroyed by a member of the research team.

Further to the above, there was also a need to maintain all those who took part in the study were giving informed consent for their participation. It was important all participants were aware that they would be tape-recorded, and that information from the study would be published at a later date. All participants were given an information sheet detailing any problems that could potentially arise from the research study before agreeing to take part, and again before the beginning of every data collection so that they had adequate time to read and understand the form, as well as pose questions to the researcher if needed. They were also offered the right to leave the interview at any time and withdraw consent without reason.

4.3 Combined Analysis of Focus groups and Interviews

In order to solidify the knowledge garnered from the focus group and interview stage of this study, it was deemed appropriated to combine the two separated data collections in the analysis stage. This meant it was easier to see where the two groups agreed and disagreed on certain issues of importance and also easier to generate a large database of knowledge garnered from personal users experiences and clinical expertise. By combining the two, there is less likelihood of valuing one source of information over the other and clear points of interest are pinpointed for informing the rest of the research.
The tapes of the discussions and interviews were transcribed verbatim to make sure that each participant in the focus groups or interviews was identified for each statement that they made. The goal of the analysis was to identify themes as described by the participants and to describe the range of issues and experiences within each theme by using inductive thematic analysis. This type of analysis was chosen as it was deemed most appropriate for generating themes for further use in the Delphi study, and also, by being inductive, was going to be data-driven, with findings arising from the participants and then becoming important, rather than trying to force previous theory or findings from the literature onto the data.

Thematic analysis focuses on identifiable themes and patterns of living and/or behaviour (Aronson, 1994). A theme is a pattern found in the data that “at the minimum describes and organizes possible observations or at the maximum interprets aspects of the phenomenon” (Boyatzis, 1998, p.vii). It was believed that coding and thematising the data would be more appropriate than other techniques available in qualitative analysis. Firstly thematic analysis is independent of theory unlike other types of analysis (Braun and Clarke, 2006). For a Grounded Theory approach, the study would have had to have been conducted in a Grounded Theory framework from the outset, which would have been inappropriate given that specific research questions needed to be answered. With Interpretive Phenomenological Analysis, the research needs to be again applied within a specific framework and the analysis is connected to phenomenological and hermeneutic backgrounds which were inappropriate for the current research. Thematic analysis can be “an essentialist or realistic method, that reports experiences, meaning and the reality of participants, or it can be a constructionist method, which examines the ways in which events, realities, meaning experiences and so on are the effects of a wide range of discourses operating within society” (Braun and Clarke, 2006, p.81). It can also fall between the two, with individuals making meaning of their experience, but the broader social context affects those meanings. Importantly, Braun and Clarke stress that the 'keyness' of a theme is not necessarily dependent on quantifiable
measures, but rather on whether it captures something important in relation to the overall research question.

The analysis was carried out by hand by the researcher and was then inputted into Nvivo8, a qualitative data management software package.

The data were analysed using the following process adapted from Kreuger and Casey (2000):

**Step 1**: Transcripts of the focus groups and interviews were read line by line and any emerging codes that appeared were noted. A number of codes were first generated based purely on the transcribed data.

**Step 2**: Samples of the focus group and interview transcripts was also open-coded by a research associate to ensure that there was no researcher influence on the codes generated, that the codes were reliable, and that the data was interpreted satisfactorily. There was little to no difference between the two separate codings.

**Step 3**: The transcripts were entered into NVivo 8 programme and codes then entered as free-nodes, with the text of each instance of a code recorded and stored. These instances of text ranged from one line from one participant, to large interactions among groups members. Each free-node was then checked to ensure that the data references for each were relevant to the code they were under, and also to see if the reference could also be labelled under another code. Using the computer programme meant that if re-coding was needed or changing the names and meanings of certain free-nodes was desirable, there was less physical work to be done by the researcher.

**Step 4**: The free-nodes were then grouped together under categories created by the research question (outcomes, predictors, etc) if possible. While the coding itself was
inductive, this stage of the analysis was important as without interpreting the information and themes within a framework, the research is not contributing to the development of knowledge (Boyatzis, 1998). Thus, within these different categories created in line with the research question, tree nodes were created to show interactions and hierarchies between the different codes that were generated by the focus groups and interviews, showing their importance in relation to the research questions and in terms of the participants of the groups.

**Step 5.** A number of different themes were generated that were found to be relevant to prosthetic outcomes and predicting of prosthetic use.

A diagram of how the analysis was carried out is in Figure 4.1
Combining of focus group and interview transcripts for open coding on line-by-line basis to create free-nodes

Open coding by research associate to confirm findings

Data entered in Nvivo 8

Free-nodes checked, altered, and cross-coded with other free-nodes.

Free-nodes sorted under research question headings.

Interactions and hierarchies between free-nodes studied to create tree-nodes

Themes relating to research questions reported along with examples from the data

Figure 4.1: Diagram of Analysis

Step 1.

Step 2.

Step 3.

Step 4.

Step 5.

Results
4.4 Focus Group and Interview Results

This aim of this study was to gain a better understanding of what prosthetic users and prosthetic service providers consider the important outcomes of having a prosthetic limb, factors which they think affect the use of the limb, and opinions and experiences of the prosthetic service and prescription process. As such three themes that were applied to the data were Outcomes of Prosthetic Prescription, Predictors of Prosthetic Prescriptions and Factors which Optimise Prosthetic Prescription. These themes and their subheadings are displayed in Figure 4.2 below and will be discussed in detail within this section.
Figure 4.2: Diagram of Results

Results

Outcomes of Prosthetic Prescription
- Age and Illness
- The Lower Limbs
- Ability Levels
- Psychological Factors

Predictors of Prosthetic Prescription
- Acceptance
- Prosthesis Fit

Factors Which Optimise Prosthetic Use
- Goal-setting
- Service Provision

Service Provision
- Fitting Process
- Service Infrastructure
- Publicly Funded Service
4.4.1 Outcomes of Prosthesis Prescription

As mentioned previously, it is important to distinguish the important outcomes of prosthetic prescription to improve the provision of prosthetic rehabilitation and thus the results of prosthetic rehabilitation. Within the data collected, a number of different outcomes were identified by both service providers and users. These outcomes ranged from the physical to the psychological, and it was noted that it is important to consider both in amputation rehabilitation:

Interview 7 (prosthetist): a successful outcome would be somebody, as I said before, that reaches their expectations, or exceeds their expectations as far as their mobility is concerned and just their general well being, and sometimes their mental well-being as well. Try and look at it holistically rather than just focusing on the prosthesis as such. I think that’s only part of it.

Certainly, within some concepts mentioned, the physical and the psychological were closely related. For example, independence was named as the most important factor by both service users and providers. However, the concept of independence not only included functional independence but also the psychological benefits that come from functional independence. Notably, service providers tended to discuss independence as a functional outcome while users focused more on the psychological benefits of independence, with increases in feelings of self-efficacy and improved self-esteem.

As such, for service users, the smallest gain of function, for example being able to go to the toilet unassisted, was important to them:

Focus group 3
PT1: to have the independence to just go on a use the toilet on your own
PT2: yeah
PT1: without having to ask someone to help you
PT3: yeah
PT1: you know, that was a killer to me in the wards on the hospital
PT4: I think when you’ve lost your leg it’s much worse than anything that can happen to you, your loss of independence
PT1: yeah, you feel embarrassed and you feel awkward about it

Further to this, returning home rather than to a care facility, especially among older service users, was a key outcome of having the prosthesis. Being in a care-facility was considered by many to be the last place they would want to be:
Focus group 6
PT1: but when you are living in the country, and there’s no one lives next to you, and you live on your own, it’s either be put into a home,
PT3: I know I know
PT1: or survive and I said “no, no way”

It was important for service users to feel that they were self-reliant at home rather than having to rely on others to help them within a care facility. Service providers noted that returning home and being self-reliant was facilitated by having a prosthesis, in contrast with a wheelchair, which could prove too difficult to use in a home environment:

Interview 1 (clinical psychologist): I think an artificial prosthesis can do that, you know, make some people more mobile around their homes. Let some people stay in the homes they want to stay because a wheelchair is not an option because of the size.

Functional independence is recognised as an important outcome in prosthetic prescription and is often measured as an outcome within the literature (Levin, 2004, Leung et al., 1996, Nehler et al., 2003). The data, however, emphasised the importance of regaining functional independence through prosthesis use rather than wheelchair use as it gives the user the opportunity to return to their homes, an opportunity which represents further self-reliance and autonomy. Indeed, for service providers, not using a wheelchair is seen as a sign of success. This factor was mentioned specifically by prosthetists, indicating it may be more important for prosthetists for a patient to return to walking as that is the primary focus of their job. However, the benefits of getting out of the wheelchair, even if a user is not able to walk, were also noted by prosthetists:

Interview 5 (prosthetist): oh, for me a successful outcome is if somebody walks in and they don’t come in in a wheelchair. If you see somebody coming in so many times in a wheelchair and then there’s a point, at some point they come in for a review and they walk in, and that’s just gets my heart, I feel like I like people to be walking.

Interview 7 (prosthetist): When you're standing up you feel a lot better than if you’re sitting in a wheelchair all the time, even if it’s only for a couple of minutes a day
The typical benefits of having the opportunity to stand were also identified by prosthesis users. The excerpt below highlights the way in which these benefits, along with the positive emotions of being able to stand again, outweigh the potential discomfort, and in particular the dislike of the first prosthesis:

Focus group 3
PT2: well I have to say I’m the opposite now, I had my first limb made by YX, and when you haven’t had anything to stand up on for 6 months, and even when you’ve go this horrible
PT4: yeh yeh
PT2: your first limb on it, it’s got a bigger leather strap on it across your knee
PT1: yeh yeh
PT2: to keep it in place, and it was about this wide, jeans didn’t fit over it or anything, I didn’t care, I was standing up again, it was fantastic. And it was really heavy it was, but you put those things to the back if your mind, I’m back up walking again, I’m standing.

The importance of not using wheelchairs also emerged for prosthesis users not only because a prosthesis can be less restrictive than a wheelchair, but also because it was perceived to be less stigmatising.

Focus group 2
PT3: we were in America on holiday, and it was very very hot, and when it gets very very hot you just can’t walk anywhere and so we, it was either a case of me sitting in a wheelchair or nobody was going anywhere because they weren’t going to leave me, so we went to the mall, and I got a wheelchair, and I realised you’re actually invisible when you’re in a wheelchair cos the people talk to your family and the people round about you “does your wife like this?” as if you’re not there.
PT2: aye
PT3: which I find shocking

I feel quite conspicuous when I get into the wheelchair. And helpless

This finding is not uncommon as wheelchair use is often associated with stigmatisation: Sapey et al (2005) noted that this could be related to the fact that the wheelchair is the symbol of disability and as such, the wheelchair as an object indicates that the person is disabled and different. By providing a prosthesis, the user gains the ability to stand upright and potentially walk, but may also avoid the stigmatisation of disability that comes from using a wheelchair. A lower limb prosthesis can generally be hidden by clothing, and so an individual is not
immediately recognised as impaired physically and stigmatised because of it. This finding again underlines the psychological benefits that come from the use of the prosthesis.

When using a prosthesis, it was important for service providers that a sense of balance was achieved so the user was able to walk safely.

Interview 2 (physiotherapist): And if you fall with the leg, the prosthesis on, it’s much more serious than if you have a fall without a prosthesis on. Because, particularly with the transfemoral, you have a locked knee and the knee doesn’t give and you can do yourself quite a lot of damage, both to the residual and to the rest of your body.

For service users, safety and balance were also important, but was related more to creating confidence and lowering self-imposed restrictions when walking in public. For users, falling may not only cause physical injury, but can also cause personal embarrassment.

Focus group 3
PT3: I can move my leg in and out like that. And you don’t have control.
PT2: no you have to have tight fit
PT1: your confidence goes completely
PT3: yeah, cos you’re afraid
PT1: you’re afraid to fall, that’ one of the reasons I carry a stick
PT3: that’s why I’m on them (crutches)

Earlier studies have also found balance confidence to be associated with mobility capability and performance, as well as being related to social activity (Miller et al., 2001b). These findings reiterate how physical outcomes are closely linked to social and psychological outcomes. The provision of the prosthesis and the improvements it creates physically in turn improve social interaction and psychological factors such as self-esteem.
Quality of Life was commonly mentioned in the data, though notably mostly from the service providers.

Interview 2 (physiotherapist): A better quality of life. You know? That’s one of the questions we ask the patients when they come to the clinic, is “what do you want to get out of this?” I mean we have patients who we give a limb to who we only want to transfer from A to B, we have others that want to go back to their jobs, we have others that want to go back to their, to driving, so it’s very individual. And a better quality of life, is at the end of the day, the best thing to say.

Quality of Life is a common concept in health care, especially in rehabilitation, which may explain why it was specifically referenced as a concept by service providers but was mentioned only once by service users. However, it is notable that improved quality of life may be considered a result of the factors mentioned before with service users: independence, not being in a wheelchair, remaining at home rather than a care facility. All these factors would combine to create a better quality of life for the prosthesis user, making improved quality of life, arguably, one of the most important outcomes of using the prosthesis. That said, quality of life can encompass a number of different outcomes, including the physical, the psychological as well as the social (Gallagher and Desmond, 2007), as well as being inherently subjective with definitions varying (Fitzpatrick et al., 1992), and in these cases it was not clear if quality of life meant health-related quality of life or if it encompassed life satisfaction and living standards. So while quality of life is an important outcome, it is not clear if each service provider was referring to health related quality of life or each service provider was referring to a different meaning of quality of life, making it difficult to unambiguously define as an outcome of prosthetic prescription despite it being often used within the amputation literature (Walters and Williamson, 1998, Meatherall et al., 2005, Riley et al., 1998, Hagberg and Branemark, 2001).

The most interesting finding in relation to outcomes was that for service providers, success was measured by whether an individual ‘reached their potential’. Essentially, this was whether the user has gained the mobility that it is established they will achieve from their first visits to the fitting centre. This potential is
established for each person individually, with some persons having a higher level of potential functionality than others due to a number of different factors which will be explored later in this study. It is stressed that it is important that the expectations and potential of each person is established in an individual manner. What is possible for one patient is not possible for another, and prosthetic technology is prescribed in that manner.

Interview 7 (prosthetist): If they’re coming in for a 3 month review, if the socket was still a good fit, it was still comfortable and they were achieving what they wished to achieve or more from sort of their initial expectations. That’s probably what I would say, it’s more to do with what the patient was expecting, whether they exceed that or not…a successful outcome would be somebody, as I said before, that reaches their expectations, or exceeds their expectations as far as their mobility is concerned.

Interview 1 (clinical psychologist): You need to have goals that are informed by professional opinion. So that’s the way we would run it here. We ask the person about their goals and what they're aiming for, but we give them some information about possibilities for them.

This is an interesting finding as service providers would need to establish an individual’s potential based on their current condition. If a service provider inaccurately predicts potential then it may have an effect on the recovery of the individual and may also affect what technology is made available to them. Most prosthetic prescription knowledge is based on assumption rather than on existing evidence and literature (Van der Linde et al., 2004a), increasing the chance of error. Gailey (2006) discovered that 30% of those getting a lower limb prosthesis were ‘underprescribed’, or received prosthetic components designated for persons functioning at a lower level, due to a lack of agreement among prosthetists on the prescribed components for various functional levels. This highlights the importance of discovering what predictors service providers use based on a patient’s current condition when establishing the potential of patients.

To summarise, a number of outcomes were identified in the data in relation to lower limb prosthetic prescription. Many of these were related to physical outcomes, such as balance and safety and not being in a wheelchair, but others were related to how
the physical outcomes can affect psychological well-being, such as remaining at home rather than being in a care facility as well as regaining independence and being self-reliant rather than having to rely on others. There were also differences in what service providers and users believed to be important outcomes, with service users placing more emphasis on the psychological outcomes of using the prosthesis than the service providers, who tended to emphasise function as an outcome. The findings of this section are now summarised in the Box 4.4 below.

| independence | remaining at home | self-reliance | not in wheelchair | balance and safety | quality of life | reaching potential |

**4.4.2 Predictors of Prosthetic Prescription**

As noted in outcomes section, service providers establish patient potential by looking at certain predictors within the rehabilitation setting and before prescribing a prosthesis. As such, these predictors need to be identified. In this study, predictors of prosthetic prescription are divided into four groups: Age and Illness Effects, Condition of the Lower Limbs, Ability Levels and Psychological Factors (See Figure 4.3).
4.4.2.1 Age and Illness

One of the most common factors used in prescribing prostheses was that of age. Age was believed to determine how well a person is going to do with the limb due to the effect of aging on the body’s physicality as well as cognitive processes and acceptance. Age was also strongly related to amputation aetiology and comorbidities and the effect these may have on prosthetic prescription.

For those users who had undergone amputation while still children, they recalled no difficulties in adapting to the amputation and with using their prosthetics at a young age.

Focus Group 1
PT2: well you’re a child and you don’t think that’s there’s anything you can’t do, and I certainly did, I didn’t think there was anything I couldn’t do,
PT1: and I bet you could do everything cos I could
PT2: well, yeah, yeah. No, I suppose that was the advantage of losing a leg at a young age
In contrast, people of an older age were more likely to encounter difficulties in terms of functionality.

Interview 2 (physiotherapist): You see, most of our patients are, 99% or our patients are over 65. So even if they never had a limb, their mobility and their general health would be decreasing, you know?...By and large, the age group that we have need more help when they are going home, they need more community care back up, you know?

Further to this, it was noted that older patients are generally more likely to suffer from comorbidities, such as coronary or respiratory problems, which may affect their ability to use a prosthesis. This is especially pertinent when energy expenditure is considered. Many service providers worried that the amount of additional energy required to walk may have a negative health effect on those in a weakened condition.

Interview 2 (physiotherapist): if they had a poor cardiovascular output, in other words, in order to use the limb they need a lot more energy, so if your body can’t cope with your normal O2 demands, well then if you put it under stress from increased demands from a prosthesis, well then you get cardiovascular problems. Similarly, people with respiratory problems. If they have a history of asthma, COPD, things like that, well then they wouldn’t be suitable........If the patient is doubly incontinent is another factor as well. If the patient has abdominal wounds, colostomies. All those things. Not one of these things preclude the person, but if you add them all together, we think at the moment that it isn’t quite suitable.

Cardiac, respiratory and neurological problems have been found to be significantly related to limited prosthetic limb wearing (Gauthier-Gagnon et al., 1998) and coronary artery disease has been found to be independently associated with not wearing a prosthesis (Taylor et al., 2005). The high incidence of comorbidities in older persons may also be related to disease being the most common amputation aetiology in the older amputation population (Unwin, 2000). This may also prevent prosthetic prescription (Fletcher et al., 2001). For example, diabetes is related to neuropathy, which may leave a patient vulnerable to skin breakdown on the residual limb which could lead not only to non-use of the prosthetic limb, but also a higher level of amputation if infection occurs (Roberts et al., 2006). Service providers discussed how individuals with health problems would have to forego certain
prosthetic components, such as particular cosmetic covers, in order to achieve mobility:

Interview 3 (prosthetist): Generally you would want for a vascular patient to keep the limb, for any patient, to keep the limb as light as possible. We always bear in mind that vascular patients tend not to be as active with the limb as the traumatic amputations would be so yeah, that would have a bearing on the prescription of the limb I would be providing....I think if you’re talking about the vascular patients, I think the biggest thing that we, that would be commented to us among the vascular patients is that the weight of the limb. Now obviously they have a certain amount of energy, a certain level of ability to get around, if you give them something that’s too heavy, then they can’t go as far. The cosmetic element, the high definition silicon, would be particularly heavy, when compared to an ordinary stock and foam finish, though yeah, I wouldn’t particularly recommend it for vascular patients as it limits their mobility.

Amputation aetiology may also distinguish if an individual experienced pre-amputation pain. Generally those who have vascular problems or infections prior to an amputation have been in considerable pain. The relief that comes from removing the limb often leads them to accept the amputation more easily than those who would not have experienced pain.

Focus group 3
PT4: because I was in pain beforehand, and I never thought I would be other than in a wheelchair, so the fact that I would be able to walk, was to me just the answer

Similarly, if an individual is aware that an amputation is a possibility (rather than an unexpected accident) they have the opportunity to get used to the idea and accept it into their lives:

Interview 10 (consultant in rehabilitation medicine): We did quite a bit of work both with prospective and respective studies in the past and we found out that the patients who have undergone a lot of pain, discomfort, problems with mobility and independence, there is, they cope with the amputation much more stoically as opposed to somebody who was perfectly normal one day then have an accident and wake up having lost a limb....because the people who are going through bad things, because amputation is in the background, is in the mind anyway, what I probably would call “anticipatory mourning” if you like

These findings then tend to indicate that an older person with a history of illness who has had time to consider the amputation as a possibility, as well as potentially
improving their situation with the removal of pain, may accept the amputation easier than a younger individual with an unexpected amputation.

Interview 6 (prosthetist): em, I think so far people have actually surprised me, they always assume that somebody who was a traumatic amputation for example will do better than somebody who maybe has vascular disease, but it doesn’t seem to always work out that way. Or if somebody’s young they’re just going to get up and go, and all of the time they’re a bunch of wimps! So it’s amazing, the older people tend to have a positive attitude in my experience cos they obviously think ‘ah well, I’m doing well for whatever age and they tend to kinda just accept things, especially if they’ve had pain previous to the amputation, this is like whole new lease of life to them so they think it’s great.

There is a caution to this: one service user explained that he had undergone many surgeries, such as progressive amputations and a number of vein replacement surgeries, before being fitted for a prosthesis. He found this situation distressing and it affected his confidence and well-being. So even though he was aware that amputation was a possibility, having multiple operations previous to the amputation to save his limb negatively impacted on the positive aspect of knowing the potential possibility of having an amputation. In an literature review on functional outcomes of amputation, Levin (2004) argues that service providers cannot ignore the grief and fear experienced by individuals while limb salvaging is attempted or after amputation has occurred as it may have an effect on functional ability. By the time amputation actually occurs, rather than being a life-saving, pain reducing procedure, it may viewed as a failure at limb-salvaging.

Focus group 3
PT1: and you think that’s it, after one operation, and to go through 13 in 18 months, it was soul-destroying. It will take me years to get back up to fully confident,

That this process can impact on confidence and psychological well-being indicates that disease-related anticipated amputation in an older individual does not always lead to better psychological outcome than traumatic amputation.

So while age is seen as a very important factor in determining functional ability, with an older age predicting lower functionality, the amputation aetiology associated
most commonly with older age is perceived as having better rehabilitation outcomes in terms of acceptance, indicating that age may not just be associated with negative outcomes as indicated in the literature (Fletcher et al., 2002, Taylor et al., 2005). Certainly older persons have been found to be more accepting of their situation because they have lower expectations (Nielson et al., 1989) and in some cases may be happy just to be alive. For a younger person, there may be high expectation of what mobility levels can be achieved, but as the amputation may arise from trauma, be unexpected, and also have a bigger impact on the individual’s mobility than if they were much older, psychological issues could affect whether the individual will actually achieve what is expected of them. Previous studies have found that general adjustment to amputation tends to be more difficult for younger persons (Livneh et al., 1999, Desmond and MacLachlan, 2006b).

In relation to other age and illness findings, one of the controversial issues evident in the limb fitting services was “downgrading” a prosthesis for a long-term prosthetic user. It was considered controversial due to the nature of offering a prosthesis user a prosthesis that is not a functional or as advanced as the one that they currently use which could be misconstrued as not offering the best options available. As a person’s physicality changes due to either aging and/or illness, his or her ability to use heavier and more mechanical components diminishes, so they must then be substituted for lighter, less mechanical or aesthetic parts. Sometimes an individual may have difficulty in accepting this reality.

Interview 1 (clinical psychologist): Several of my referrals are about people, particularly the long-term established users, and they are now aging and having some other sort of medical problems, and it’s not possible for them to stay on the limb they’re on, that’s the really seems to trigger some psychological difficulty with our service users here.

Interview 10 (consultant in rehabilitation medicine): And they sometimes forget that while their mind is willing, their body isn’t able to cope with it, because other things have happened. It’s a question of really counselling, talking to them, explaining that if necessary, it may need more than one visit, and also it’s about trying to meet with individual’s needs, which may be upgrading, which may be using different methods, different components, which maybe more sophisticated or less sophisticated, so the
whole purpose really, is to matching the individual to the prosthetic technology and capability that is available at a given time.

However, it appeared that many of the users were aware that changes do occur naturally due to age and illness and were accepting of it. Indeed some of the prosthetic fitters were more positive about ‘downgrading’, and pointed out that it is done in the interest of the patient.

Focus group 2
PT3: My problem has been that as I get older I find it. I find it more difficult to adjust to a new leg, and it’s never, it used to be like perfect from the word go, but I think it’s because I’ve become less adaptable, I don’t think it’s because of the service here or the fittings are any way inferior to what they were, it’s me.

Interview 3 (prosthetist): I think it’s only done in their best interests, so if they’re not managing with the limb that they’re using and yes, they don’t mind, then it’s really an upgrade for them.

Generally service users and providers tended to agree on the effects of age and illness on prosthesis rehabilitation psychologically and physically. However, it was clear that there could be some differences in opinion, and that service providers tended to place more emphasis on how predictive these factors were than service users. For example, there was one user who was able to recover from cardiac surgery and ambulate with two prosthetic limbs despite the reservations of his doctor:

Focus group 5
PT3: And I came out here to get fitted for a leg, and I eh, I’d a hard fight, they didn’t want to do me for the leg, because I’d to have open-heart surgery
ES: oh, ok yeah
PT3: so eh, Dr. X here said I’d to get the surgery first before I could get the leg, and go through the treatment, and then I got gangrene in the other toe, in the other foot. And the, I started from there, I didn’t mind…But I’d a hard fight; Dr. X just didn’t think that I’d be capable for the exercises that would go on.

While this finding indicates that other factors such as motivation, which is discussed below, play a role in prosthetic fitting, that the user was given the chance to at least try walking with the prostheses is indicative of the way prosthetic rehabilitation works: those who wish to try are generally given the chance.
A summary of the Age and Illness Predictors of Prosthetic Prescription from this data are displayed in Box 4.5 below.

**Box 4.5: Age and Illness Predictors of Prosthetic Prescription**

<table>
<thead>
<tr>
<th>Age</th>
<th>Comorbidities</th>
<th>Amputation Aetiology</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Many operations or amputation before fitting</td>
<td>Decline of functional ability due to age or illness</td>
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</table>

**4.4.2.2 Condition of the Lower Limbs**

An important physical factor when prescribing a prosthesis is the condition of the lower limbs, that is, the residual limb from the amputation and the remaining intact limb. The condition of these can help to indicate whether an individual is ready for a prosthesis. A related factor is the level of the amputation as this can affect the componentry prescribed and potentially some of the patient’s outcomes.

Service providers regularly mentioned the condition of the residual limb as a predictive factor in prosthetic prescription: whether it was fully healed, infected, or if the shape of it was suitable for fitting. Furthermore, contractures (when muscles in a limb become very tight and contract) were also considered to have an effect on the prescription of a prosthetic leg. If a patient is suffering from a severe flexion contracture in their hip or knee, it will be very difficult for that individual to gain the movement to use a limb. It is important for them to work on this particular ailment in physiotherapy so that it can be alleviated.

*Interview 4 (prosthetist):* yes, if people had perhaps, lots of hip flexion, if they were a transfemoral amputee, that would perhaps be something that you, they would make it very difficult for you to limb fit.

These residual limb factors were predominantly mentioned by the service providers as predictors of prosthetic prescription, presumably stemming from their greater professional and clinical knowledge of how these factors impact on componentry. There was agreement from all on the importance of considering these factors and the
effects they can have. It was also recognised that while these factors do affect
prescription in the short term, they will generally not prevent someone from getting
a limb.

Interview 3 (prosthetist): well, I think that em, within the MDT team, there are
certain things that would stop us prescribing: whether there’s a condition of the
residual limb, whether there was long term healing, rashes, things like that, we
wouldn’t start making a limb until all those were resolved.

Apart from the residual limb, the condition of the contralateral limb, that is the leg
that was not amputated, also has a bearing on prosthetic prescription. If this limb is
not in good condition the service user may have difficulty walking.

Interview 6 (prosthetist): yeah, there’ve been times when maybe a patient, if the
patient’s other leg, if they’re single amp, if their other leg, if we feel that that one
couldn’t take their weight

There is also the possibility that an individual may have bilateral amputations,
making walking more difficult. Amputation level was identified as another strong
predictor of successful prosthetic prescription by both users and service providers.
Having a transtibial or below-knee amputation is considered easier than having a
transfemoral or above-knee amputation because a below-knee prosthesis is lighter
and easier to walk with, using up less energy. Furthermore, having the extra joint
makes it easier for walking.

Focus group 6
PT4: oh below the knee, I wouldn’t know much about them, I wouldn’t mind having
one but
PT2: I’m below the knee but sure it has to be an advantage like. It keep your
alignment and holds it in your body and that, it is a big plus to have it below the knee
and have your knee, I mean it’s an extra joint instead of an artificial joint.

Interview 8 (physiotherapist): …with your transtibial amputees because the leg is useful,
it’s the same leg to be a cosmetic leg, to be a transfer leg or to be a walking leg, so at any
level a leg is useful for a transtibial amputee. So unless they were immobile before surgery,
they’re going to benefit from a prosthesis. It’s usually the transfemorals and the most
common problem is them thinking they want a leg, thinking it will be beneficial to them, and
they don’t have the physical or the cognitive capability to use it.
Amputation level has been discussed in the literature at length, with above knee amputation associated with not wearing a prosthesis, and level of amputation associated with failure to maintain independent living status (Taylor et al., 2005). Those with below knee amputation have a higher likelihood of prosthetic prescription than those with transfemoral amputations (Kurichi et al., 2007), and for older patients, the increased energy expenditure associated with the use of an above-knee makes prosthesis fitting unlikely (Fletcher et al., 2002). As seen from the above quotations, service providers and users were both aware of the higher level of difficulty with mobility for those with transfemoral amputations. A summary of the predictors of prosthetic prescription emerging from the data that are related to the condition of the lower limbs is in Box 4.6. The data indicated that the condition of the lower limbs, as either the residual limb or the contralateral limb, influences the fit of the prosthesis as well as how much rehabilitation may be needed before a prosthesis can be provided. Clearly though, these factors were created mostly by the service providers rather than users, potentially due to their influence on the tailoring of rehabilitation to the individual by the healthcare team.

Box 4.6: Predictors of Prosthetic Prescription Related to Condition of the Lower Limbs

| Condition of the residual limb |
| Contractures                  |
| Condition of the contralateral limb |
| Amputation level              |

4.4.2.3 Ability Levels

Ability levels are an important physical factor that predict and effect prosthetic prescription. Ability levels, in this instance, refer to the physical ability of the user prior to amputation; the physical ability of the user during the rehabilitation process; and then, if appropriate, changes in physical ability, either increasing or decreasing, occurring after prosthesis fitting. They are often used to indicate how well a person will do with their prosthesis.
If an individual walked prior to amputation, it was considered more likely for them to return to walking than someone who was previously immobile.

Interview 2 (physiotherapist): People’s previous reduced mobility. I mean we’ve had people referred to us and they haven’t walked and in years. And they’ve had an amputation and people say ‘well we’ll refer them for a limb”. Now if it was a cosmetic leg, it would be ok, but this if for a leg for walking. Well it’s just unrealistic; it’s not the policy on all ends.

This finding reflects current literature which found non-ambulation before amputation as significantly predictive of not wearing a prosthesis (Taylor et al., 2005). However, the ability level of the individual is also studied during rehabilitation to predict mobility outcomes, and in this study was one of the most mentioned physical factors to have an effect on prosthesis prescription.

Interview 8 (physiotherapy): So you've given them a programme, do they come in and do it everyday, do you need to push them to do it, are they progressing with that, and just how they're moving about the bed, and then we’ll know how they’re doing with and early walking aid, whether they’re getting up and managing with that, if they're learning to put it on themselves or if they’re needing us to go and do it. Those are the main things.

Principles for assessment of individuals in prosthetic prescription state that thorough knowledge of a individual’s ability level, including their medical condition and any complications associated with the musculoskeletal, neuromuscular and/or vascular system, is an essential element of evaluation and assessment for prosthetic prescription (Billock, 1996). The data from this study indicate that practitioners do adhere to these principles in practice.

Increases in ability level after prosthetic fitting will generally result in changes to the prosthesis for increased function. Firstly, a user may have moved beyond the mobility level of a certain set of components. Secondly, they may wish to return to certain jobs or hobbies or they may have become more aware of how the limb works and ask for certain things. Scherer et al (2005) noted that with assistive technology use, after a period of time using a specific device, consumers may report more
sophisticated perspectives of what constitutes a good match with their needs and priorities.

Interview 6 (prosthetist): usually we begin with you give patients not a basic prosthesis, but we’ll give them a leg to get started, and once I feel that their stump’s shrunk down, that they’re getting used to using it, I think a lot of it’s the patient needs to be a bit more conscientious about the leg, and once they realise that they are understanding it all better then we’ll start considering different options. Cos they start to want to go back to work, or start gardening again, or do things they would like to do formally, so we just go by what they are doing

Focus group 1
PT4: em, but yeah I’m happy. I think it’s like finding your voice as you said, it took me a long time to be able to articulate what I wanted and what I’m dealing with, you know what I mean? And even to get to the stage like dealing, like naming the parts and such and what they’re for. Once I kinda got my head around that I was able to say what I needed to adjust
PT1: you probably relied on them rather than telling them what you wanted
PT4: yeah
PT1: you probably didn’t know you could tell them what you wanted
PT4: yes definitely, exactly yeah. But as time just went on and I found my voice as a person as such, like, em, I’ve been able to say, like, what I need to be adjusted.

Essentially, the job of those supplying the prosthesis is “matching the individual to the prosthetic technology and capability that is available at a given time” (Interview 10, consultant), making ability level a crucial predictor for service providers.

A summary of the predictors of prosthetic prescription emerging from the data that were related to ability levels is in Box 4.7. Similar to the predictors related to the condition of the lower limbs, it appears that the majority of data related to ability levels was creditable to the service providers rather than users.

Box 4.7: Predictors of Prosthetic Prescription Related to Ability Levels

| Physical ability prior to amputation |
| Current physical ability |
| Changes in physical ability over time |
4.4.2.4 Psychosocial Factors
While physical factors were identified in the data as important in predicting prosthetic prescription, psychosocial factors also emerged as playing an integral role in prescription. Identifying these psychosocial factors along with the physical ones prior to prescription may inform whether an individual will be able to progress through the rehabilitation process to wearing the limb safely. Psychological difficulties arising from and specific to the amputation were mentioned, but there were also a number of other factors, such as cognitive ability, optimism and social support which were deemed to have an effect on prescription.

Cognitive ability is often assessed within the rehabilitation setting to see if a patient will be able to learn how to use a prosthetic device. It could be compromising to their safety to prescribe a limb if they do not have the ability to learn how to stand and walk without proprioceptive feedback from the lost limb, or to learn how to don and doff the prosthesis (O'Neill, 2008).

Interview 2 (physiotherapist): Reduced cognition is one of the greatest problems we have in giving a person a limb, cos that’s for safety purpose they can’t, some patients they can’t follow instructions, some people they can’t retain instructions so they could put on the limb incorrectly and they could fall.

This finding is similar to previous studies which have found cognitive ability to play an integral role in prosthesis use and level of disability with amputation (Larner et al., 2003, Hanspal and Fisher, 1997, Schoppen et al., 2003). The ability to learn and memory are well-established as important factors within prosthetic rehabilitation and prescription.

Less well-established within the literature, but mentioned within the data, were the effect of pre-existing psychological problems on prosthetic prescription, such as psychosis or alcohol and drug addiction. Service providers note how these psychological problems could potentially impact on the fitting process, by service
providers having difficulty dealing with the patients, to patients not returning to maintain their rehabilitation:

Interview 5 (prosthetist): I have a patient, who by his own admission has had mental health problems for a whole number of years. I find it very very difficult to deal with him as a patient. He has a very unhappy time as a patient.

Interview 7 (prosthetist): yes, yeah, we do have quite a lot of em, people that they’re social circumstance are really bad, like drug addicts and maybe alcoholics, that kind of thing, people that will just disappear.

The amputation itself was also cited as a cause of psychological problems, such as depression, anxiety, and drug or alcohol addiction, issues which may need to be addressed by service providers:

Focus group 6
PT3: it shouldn’t be a problem but it is you see and I think most of my problems are in my own head, you know, because I just don’t , I don’t think I was looked after well enough
PT2: yeah that’s my point now, it’s all psychological, there’s a lot of psychology in there. I would say like, forgive me for adding to this, I think we don’t get enough of help, psychologic help, at the start

Previous studies have shown amputation to have a negative effect on mental health, with depressive disorders common in the population, especially in the first few years following the amputation (Horgan and MacLachlan, 2004). Notably, studies have shown that clinical levels of depression and anxiety are negatively correlated with improvement in rehabilitation (Cully et al., 2005). This was a sentiment echoed by a clinical psychologist:

Interview 1 (clinical psychologist): So, for example, depression would influence motivation and engagement in rehabilitation, the ability to set goals for the future. Anxiety, anxiety about falling, anxiety about trying something new, we’ve seen in our setting here, people who are more shaky when they’re anxious, less confident, fear of falling. So also, people who have body image problems difficulties sometimes with managing, the managing process, the artificial limb being involved with their residual limb, so yeah, I think these things are definitely involved in whether somebody can learn to use an artificial limb, and also be successful and reach their potential.

Psychological difficulties are common with amputations because of the number of changes that occur in self-identity and self-concept, and the problems arising from these changes (Horgan and MacLachlan, 2004). From the data in this study and
previous studies mentioned above, we can see how these difficulties can impact on the rehabilitation process and prosthesis prescription, indicating the potential need for psychological assistance for both prosthetic service users and providers who may have difficulty dealing with some users’ psychological issues.

Interview 1 (clinical psychologist): Yes. I think limb-fitting services need to take into account psychological factors, I think they should be actively looking for psychological problems in service users. Because they’re important in themselves.

In contrast to the negative effects of the above psychological problems, a number of factors, such as enthusiasm, determination and motivation, were identified by both service users and providers as having a positive effect on prosthetic rehabilitation, and in turn on prescription. All of these factors suggest a commitment to and active interest in rehabilitating to full potential. Individuals are more likely to engage in rehabilitation if they are motivated to do so (Phillips et al., 2004a) which would predict better outcomes.

Interview 7 (prosthetist): Enthusiasm I think. I think when patients come in and you know, they are enthusiastic, and they’re looking forward and they’re wanting to improve their life, that tends, that’s got an awful lot to do with it, I mean I’ve tended to find that over the years, well over the last 30 years, that if somebody wants to do well, they will.

Focus group 5
PT 3: and I was determined, I didn’t care what exercises they would put me through I said “see you, you haven’t got one, forget about it mate.” I was determined.

Interview 8 (physiotherapist): Motivation as well, em how much they do in the gym gives us an idea of how committed they are, and the transfemorals need to be really committed and motivated to make a go of it… We see how well they um, conform to their exercise programme, how motivated they are. So you’ve given them a programme: do they come in and do it everyday? Do you need to push them to do it? Are they progressing with that?

It was also noted by service providers that if a patient is eager to reach their full potential, it is likely they will return to the fitting centre for adjustments. For example, a returning patient is always expected as a change in socket fit is necessitated by the residual limb shrinking as the body recovers from amputation. If
a patient does not return it is unlikely that they are using the limb. A returning patient indicates that the individual is keen to improve their situation.

Interview 3 (prosthetist): I suppose whether or not they came in at all, eh, it’s usually that’s an indication. If they don’t come in to appointments, usually that’s a indication that either they’re not using the limb at all, they don’t want to come into see us, or else they’re just getting on with their life and they don’t want to come in and see us. Eh, sometimes, we can get those mixed up.

Motivation has been identified previously in rehabilitation as an important factor in recovering from a disabling event and recovering functional activities (Resnick, 1998a, Resnick, 1998b, Resnick, 1999). In terms of a predictive factor for rehabilitation, it was identified in the Matching Person and Technology Model for prescribing AT as one of the personal factors that should be considered in the prescription process.

Further to the identification of motivation, enthusiasm and determination as having an effect on prosthetic rehabilitation, both service users and providers discuss how personality could also influence rehabilitation. For example, having an optimistic personality was regarded as resulting in better outcomes in rehabilitation, while a pessimistic personality would have the opposite effect.

Focus group 3
PT4: it never struck me, for instance, it never for a moment struck me, I mustn’t have a negative bone in my body, it never struck me “how am I going to manage?” It just didn’t…. But I never said anything negative about it. Now that was a blessing on my part, it was me “ok, you lost your legs” but I never ever got depressed about it. I’ll find a way around it. You know, and I think if you have a positive outlook, like I had.

Interview 4 (prosthetist): That some people just get up and going, and that’s perhaps their personality and has been there personality all their life, they’ve just got on with things. And other people just becomes really focused on certain issues to do with their leg and can’t get past that, and it becomes real difficult to rehabilitate them….And I think the ones that we still struggle with are the ones that are really tricky or refuse to be seen by a psychologist or em, just that’s the type of person they are, and it’s just becomes even harder to deal with them.
Phelps et al (2008) also found that negative cognitive processing at amputation was predictive of depressive and PTSD symptoms at 6 month follow up, and positive cognitive processing was predictive of post traumatic growth at 12 month follow up.

From the data it appears that changeable personal factors were being confused with unchangeable dispositional characteristics. Personal factors, while individual to the service user, may be altered by the rehabilitation setting and team (e.g. motivation and enthusiasm may be affected by setting goals and encouraging behaviour from the rehabilitation team (Resnick, 1999, Maclean et al., 2001)), while dispositional characteristics remain constant unless addressed by cognitive therapy (e.g. a pessimistic outlook may be altered by changing thought processes through therapy). Therefore, it is unclear if persons are talking about certain factors, such as determination, as personal factors or dispositional characteristics. This confusion indicates that difficulties may arise in identifying the difference between those who with extra help and motivation from the rehabilitation team will be able to use a prosthesis well, and those who will never be inclined to complete prosthetic rehabilitation without some form of targeted psychological intervention.

In terms of social factors, a number of service users mentioned how important the support of family and friends was when trying to come to terms with the amputation and the prosthesis, and accepting it into their lives.

Focus group 2
PT1: ah your family will help you out
PT5: you’ve got to, you’ve got to have the support of the family.
PT1: ah they’re great, ah yeah they are you know. They’ll take you out, one will take you out then the other will take you out. My son doesn’t do very much, but the rest of them are good.
PT2: I suppose they laugh and joke about my leg
ES: oh yeah?
PT2: which is quite good. You know, Eh, I suppose that nobody else would feel all that free to be able to do that, but eh, there’s lots of jokes about me and my leg, and what it means, and what it doesn’t mean, and what I’ve made it mean instead of what it really means, you know?
The importance of social support was also supported by the data supplied from the service provider interviews:

Interview 1 (clinical psychologist): Social support is recognised as one of the things that helps people to adjust positively and to avoid psychological difficulties and physical difficulties. We do have people who don’t have that, yeh. And the team do deal with, regularly, with problems like that. And obviously we involve social services and try to set up care packages as best we can, to assist with that.

These findings on social support are typical of those found in the literature. Persons with an amputation and with greater perceived social support reported more time out of bed, out of the house, in the community and greater participation in social and vocational activities (Williams et al., 2004). However, in one focus group it emerged that a number of the users had progressed without social support and that their progression came about from their own motivation. Some of these users also indicated that help from others is not always wanted or appreciated:

Focus group 6
PT2: but 95% of it is yourself, you have to do it
PT3: you have to do it
PT2: and back to the same one, your psychology, and your own attitude and your own focus. And it’s very much, people can help up to 5% but maybe not an awful lot after that, and it’s not, I don’t think people if they help anymore they might feel, well maybe you’re own family fair enough, might feel that they were intruding on your life and they might stand back a wee bit, and that applied to us all. And you don’t look for it, you don’t want it, you want your own independence.
PT1: that’s true, they sort of want to wrap you up in cotton wool, “oh don’t do this and don’t do that. You can’t do this”. That is there favourite word.
PT2: yeah
PT1: you can’t do this. But in your own head you can do it, and why can’t you do it? And that’s what people don’t understand, the ones I know anyway. “don’t fall on the bus, don’t, mind as you go up the steps”

The negative effect of social support was also touched upon by a service provider, in this case the idea that solicitous social support will discourage some people from progressing with their prosthesis if they are too well taken care of.

Interview 5 (prosthetist): Because you sometimes see some old people quite often, who you think should be doing quite well, and they should be doing better than they are, but they’ll sit back and let you do everything for them, and I think there are probably some people, some old people, who are particularly, who have lots of family
at home who will fuss over them and do lots of things for them “we’ll do that for you mum”.

While there is evidence that solicitous spouse responses are associated with increased levels of depression at one month post-amputation (Jensen et al., 2002) which may lead to poor participation in rehabilitation, and Newsom and Schulz (1998) also found that 40% of recipients of care giving reported some emotional distress in responses to help they received, there is no previous research on how social support can be appreciated and have a negative impact. The differing opinions within this data indicate that using social support as a predictor of mobility and optimal rehabilitation may prove difficult as while it can bring positive results for some people, it may also damage further progress with mobility. Despite this difficulty, the consideration of social support is warranted.

A summary of the psychosocial predictors of prosthetic prescription is displayed in Box 4.8 below. What is clear from this section is that while there are psychosocial factors which will help to predict prosthetic prescription, it is still unclear how all these predictors work, and how they can be measured and differentiated with the prosthetic prescription setting. Service users and providers however tended to agree with the predictive effects of each factor identified in this section, be they positive, negative or both.

Box 4.8: Psychosocial Predictors of Prosthetic Prescription

<table>
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<th>Cognitive ability</th>
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<tr>
<td>Psychiatric health previous to amputation (including addiction problems)</td>
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<tr>
<td>Psychological difficulties arising from amputation</td>
</tr>
<tr>
<td>Commitment to rehabilitation (Enthusiasm, Determination and Motivation to rehabilitate)</td>
</tr>
<tr>
<td>Optimistic outlook</td>
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<tr>
<td>Social support.</td>
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4.4.3 Factors Affecting Optimum Prosthetic Use

There were a large variety of factors that were seen to affect the optimum use of a prosthesis. Seven sub-themes relating to factors affecting optimum prosthesis use emerged: Acceptance, Prosthesis Fit, Goal-Setting, and Service Provision. ‘Service Provision’ encompassed a number of different facets within this particular data and so it also contains its own sub-themes: The Fitting Process, Service Infrastructure, and Publicly-Funded Services (see Figure 4.3). These factors were categorised separately from predictors of prosthetic prescription as they are not factors which can be identified prior to prosthesis provision to influence rehabilitation and component choices, but still have an impact on optimising the use of the prosthesis. Consequently, it is relevant to identify these factors as monitoring them during repeat visits and providing appropriate interventions or improvements will optimise prosthetic use and improve overall satisfaction for the user. Figure 4.3 demonstrates how these themes all fit together.

Figure 4.4: Diagram of Factors Affecting Optimum Prosthetic Use
4.4.3.1 Acceptance

Within the data collected, a number of different factors were identified as having an effect on acceptance of the amputation, ranging from comparing the self to others to collecting disability benefits from the State. These factors were all recognised as having an effect on how a person accepts the amputation and the new way of life it creates. Accepting the amputation in itself was acknowledged as an important factor in achieving an individual’s full potential with the prosthesis:

Interview 6 (prosthetist): they just accept it they’re like “right, I am an amputee, I am, ok I do have a slight disability” some of them more than others, and they just accept it and work their life around it rather than constantly striving to be back the way they were before, I think that’s very important for them

Focus group 6

PT3: you persist well, but you had to deal with all dramas in your head at the same time so you didn’t really know. So it took a long time, a long time I’d a say a few years till you just become accustomed that your mind and your leg thought the same way, you had the coordination to accept it

Some individuals in these groups had accepted the amputation better than others.

Focus group 6

PT2: Obviously you’ve got to accept things that you can’t do though, and that sometimes takes a little while, to come to terms with it, psychologically or what have you, you know, “you’re not going to be ever able to do that again”.

PT4: how are you ever going to be happy if you’ve got a piece of you missing? Do you know what I mean? It’s impossible to be happy about it. Everyday, every minute of the day you know it’s not there

PT3: I dunno you get used to it, 42 years I’ve had mine now and I’m used to it

PT4: well I’ve had mine 28 years and I’m not used to it

In this case, PT4 believed that he received enough psychological care initially after his amputation, but he felt that he was impeded by alcoholism.

PT4: I think most of my problems are in my own head, you know, because I just don’t, I don’t think I was looked after well enough

Interventions from the rehabilitation team and other personal circumstances and influences, such as alcoholism, may affect acceptance. Difficulties in adjustment and acceptance of the amputation are typically associated with reports of depression,
low self-esteem, feelings of hopelessness, anxiety, fatigue, and in the extreme, suicidal ideation (Desmond and MacLachlan, 2002). Due to the above’s effect on rehabilitation, acceptance of the amputation may affect prosthesis use. Furthermore, acceptance is the first step in adjusting to and adapting to an amputation. Due to the reported effect of adjustment to CID on AT and prosthesis use (Wielandt et al., 2006, Gauthier-Gagnon et al., 1998), acceptance may be integral to optimising outcomes with the prosthesis. By determining what factors may influence acceptance, and the way in which they do so, there is a possibility of improving acceptance among those with amputation, and in turn, potentially improving outcomes. As such, a number of other factors were identified in the data as having an effect on the acceptance of the amputation: making social comparisons, emphasising positives that come from amputation, family acceptance of the amputation, family understanding the limitations from amputation, an overprotective family, recognising the need for others’ help, body image problems and self-consciousness, romantic relationships and receiving disability benefits. Each of these factors and their effects on amputation acceptance will now be discussed in greater detail.

The idea of making social comparisons was identified by both users and providers as affecting acceptance. This is not a new concept, with its roots in Social Comparison Theory, which states that people compare themselves to others either by making upward comparisons to people better off than them or downward comparisons to people who are worse off than themselves. (Festinger, 1954). These comparisons can affect self-esteem, mental health and other aspects of behaviour (Skevington, 2004). Users in this study found that if they compared themselves to those less well off than them, it helped them to realise that their situation could be worse and that they should appreciate what they do have.

Focus group 3
PT1: one of the things I was very conscious of after was, it was important that I accept this, because it’s here for life, it’s not going to go away
PT3: yeah
PT2: it’s not going to grow back
PT1: I can lie in bed, and get the zippity (zimmer-frame?) thing, but that’s not going to get me anywhere
PT4: no
PT1: I mean I can get up and make use of it, and be in the rehab in X, I said to myself “there’s little kiddies there, and they’ll never walk in their life, and I’ve got a chance to do it again” and it’s important that I accept it, and get on with it.

This is similar to previous research which found that downward social comparisons may aid adjustment to a range of negative events (Taylor and Lobel, 1989). However, service providers noted that some users may compare themselves unfavourably and at times unrealistically with other users, and it can make them feel inadequate and potentially slow their progress.

Interview 9 (prosthetist): Sometimes a patient doesn’t think they’re doing very well because they’re comparing themselves to maybe more younger patients, or active patients when they’ve got other health conditions that would never allow them to achieve that level so…

This contrast between upward and downward comparisons shows the difficulties that can arise from making social comparisons. Sjodahl et al (2004) found that with patients of traumatic and tumour-related amputation, downward comparisons with other patients proved an effective short-term strategy for improving confidence, but that once patients returned home, the strategy was no longer viable, and patients found themselves making upward comparison between their current self and the self that used to live in the home. This finding indicates the double-edged sword of making social comparisons, and how they can be facilitative in the rehabilitation setting, but in the long run could prove unhelpful in accepting the amputation.

Finding positive meaning from the amputation was also mentioned as having an effect on amputation acceptance. Prosthetic users noted a number of positive gains that came after having the amputation, most notably those related to improving education and job opportunities. For example, in order to earn a living after the amputation, it was often necessary to retrain as a means of acquiring a less physically demanding job. However, by doing so they gained new skills and better paid employment, which helped with acceptance.
Focus group 3  
PT3: I even went back to college, you know, when I first came out of thing. Because I went to FAS, and they said, “oh we’ll pay for the course” and I always wanted to do it and I wasn’t able to. And I qualified as a health psychotherapist out of college, and you know, I was on air, I was working.

Gallagher and MacLachlan (2000b) found that 46% of participants in their study believed that something good had happened as a result of having a prosthesis, indicating that this is not a rare occurrence for prosthesis users. Finding positive meaning in one’s amputation is also associated with lower levels of depression symptomatology, and perceiving greater control over one’s impairment (Dunn, 1996), indicating the benefits of this approach to acceptance.

Further to emphasising positives, service users talked about how joking about the amputation can help change what it means to them. The idea is to turn something potentially distressing into a source of humour to help deal with the situation.

Focus group 2  
PT2: I suppose they laugh and joke about my leg  
ES: oh yeah?  
PT2: which is quite good. You know, Eh, I suppose that nobody else would feel all that free to be able to do that, but eh, there’s lots of jokes about me and my leg, and what it means, and what it doesn’t mean, and what I’ve made it mean instead of what it really mean, you know?

Users found that if they could joke and make light of the situation it helped to put others at ease as well as themselves. Indeed, the reaction of others, especially those within the family may have an effect on the acceptance of the amputation. How these people react to the amputation, and essentially whether they accept the amputation seems to affect the prosthesis user. Furthermore, it emerged that the user’s acceptance of the amputation will also affect family acceptance i.e. if the user accepts it, there is a greater likelihood that the family will also.

Focus group 1  
PT4: And as time went on, em, I think they all, I could see that they all found it kind of difficult because, I wasn’t just like an amputee, I had like multiple injuries, so it was like, there was a whole list of issues that I had to deal with at the time, so I could
see that they found it hard to deal with, and it was getting to the point where they could see that I was ok with it, and the more that I got ok with it, they were ok with it
PT3: aye that was the same for me

A two-way, reciprocal relationship occurs between the user’s and their family’s acceptance: as the prosthesis user accepts their amputation, this has a knock-on affect on the family’s acceptance of the situation. In turn, the family reacting in a positive way to the individual’s situation also aids acceptance for the user. However, in order to present a positive, familial reaction to the amputation and prosthesis use, it seems important for the family to understand the specific limitations of the user and what they are capable of achieving. Often they may compare them unrealistically to other, more capable users, creating expectations which can be difficult on the user.

Focus group 3
PT3: and another thing if find, do any of you find this? Well really it’s my wife; she looks at heather mills and says “oh jeez look at that, she’s dancing with a prosthesis” PT1 and PT2: yeah yeah
PT3: and I says to her “this is a Health Board prosthesis, that probably cost about 40 grand!” you know, but a lot of people, my boss has said that to me a few times “J, what about such person and such person” he’ll say
PT2: yeah, my wife, I think sometimes though my wife does it so you’re not sitting there, minding over yourself saying “oh woe is me and all that”
PT1: yeah
PT2: and she’ll say, “Listen, you’ve seen people who are worse off than you, they’re climbing Mount Everest”
PT4: yeah yes
PT2: and I’m going “to get up to the top of the stairs is my challenge today” you know?
PT1: yeah, that’s right yeah
PT2: and it’s different strokes for different folks, yeah Heather Mills is fantastic and she can do it yeah,
PT3: yeah I find that yeah
PT2: and some people say it, but once they say that then, it’s not to do you a disservice or anything, but they’re comparing, they’re not comparing like with like.

If family members are not aware of the user’s capabilities, they may also demand more of service providers:
Interview 3 (prosthetist): I think that sometimes the family would be saying “we want a limb” and in those instances about educating the family about the sort of effort it would be for the patient, because obviously, the family need to be educated as much as the patient sometimes you find that you’re dealing with, you’re treating the family more than you’re treating the patient sometimes, it depends on the situation.

From these findings it appears that there is a need for educating the family about the amputation, the prosthesis and potential rehabilitation as much as the individual with the amputation. For instance, over-protectiveness from family members was a common complaint that was seen as unnecessary by users but in some way unavoidable.

Focus group 2
PT3: I have two daughters, both in their twenties, and what I’ve always found is that they get terribly upset and angry if anybody stares or makes a comment, and I don’t even notice anymore
PT2: aye
PT3: but they really feel it, even now at this age their very protective. Em, so they get themselves into quite a state over things, and, which is quite a pity, but I suppose that’s loyalty isn’t it?

As with solicitous social support, many of the users would not look for help or to be protected from anything, and indeed many of them found the best approach to help accept their amputation was to give them no sympathy and to let them get on with it themselves.

Focus group 2
PT2: I think my wife helped me because she gave me absolutely no sympathy
PT3: absolutely, that’s…
PT2: you know, aye aye eh, there was not quarter given ha ha
PT4: Ah you shouldn’t give anybody any sympathy, I mean, it makes them feel worse, just let them battle, battle on with it, you know what I mean
PT2: yeah
PT3: that was my, I know the surgeon said to my parents, who were naturally devastated, not to, the best thing we could do was not to be too sympathetic and to make me stand on my own two feet. And they did, and they made me tough, they made me strong. I think if they had wrapped me up in cotton wool I would be an invalid to this day
PT2: yeah yeah, I think she was deliberately unsympathetic, yeah cause otherwise I would have fallen down a hole and never got out of it again. So I think she made that didn’t happen, yeah.
While many of the individuals in the focus groups disliked unwanted help from others, it may be important for users to recognise the need for others’ help in certain situations. In some situations frustration arises from relinquishing control however it is necessary during certain stages of the rehabilitation process to rely on the help and expertise of others.

Focus group 1
PT4: Cos I find like we’re brought up to solve a problem ourselves when something happens, so when you come here you’re putting the problem into somebody else’s hands. And I felt like that’s something I found very hard to adjust to, cos I was waiting for somebody else to come and have a solution to this…… But it’s just having to make that realization that you just have to let that part go, and let somebody else help and things like that.

Realising the need for others’ help, while removing some degree of control away from the user, is a key step in acceptance of impairment. Denying the need for assistance has been identified as contributing to non-use of assistive devices (Hocking, 1999). However, it is not necessarily a permanent situation, with some feelings of control returning when the user begins to understand the fitting process to a greater extent and can then offer their own expert opinions and insights.

One of the most mentioned factors in relation to acceptance of the amputation was that of body image. Accepting the new body image was seen by many as important in accepting the amputation as a whole.

Interview 1 (clinical psychologist): people who have body image problems have difficulties sometimes with managing, the managing process, the artificial limb being involved with their residual limb, so yeah, I think these things are definitely involved in whether somebody can learn to use an artificial limb, and also be successful and reach their potential.

Previously, body image was found to be associated with psychosocial adjustment to an amputation (Rybarczyk et al., 1995). Within the data, body image was discussed mostly in relation to avoiding certain situations due to self-consciousness, and also the impact it can have in terms of romantic relationships:
Focus group 1
PT2: see that’s something Jo that I can’t do, and I swam as a child, because I never felt any different really, but I couldn’t do it now as an adult, that’s the last of my issues, I can’t because I wouldn’t want people looking at me,
PT3: self-consciousness, aye, I was that oh, for a good couple of year, and it really just tore at me inside, and I thought “no I’m not doing it”
..........................................................................................
PT2: And it’s still an issue, it has sort of reared it’s head again if I’ve been in a new relationship, em, and I suppose it’s always there to a certain extent, maybe that’s the reason that I don’t have the confidence to go swimming, that’s just something I shut away in a cupboard and I think “well, ok, that’s something that I’ve got to live with”, but for the most part I’ve pretty much ok

Some users worried that their spouses would not be able to accept the amputation and what that might mean in the long term for them.

Focus Group 3
PT3: I think that’s a fear in the back of your mind too isn’t it? You know, will your marriage get through this?
PT4: yes
PT2: as we’ve said though, your confidence is down though and you start putting those doubts in your mind like “is my wife going to stay and back me on this?”
Jesus…
PT4: sure yes, it is
PT3: yeah
PT2: you’d put yourself through more torture than you need to, but if that’s where your mind’s at…
PT4: yeah yeah
PT3: it’s a natural human reaction
PT2: of course yeah
PT3: you know, “will people stay with me now that I’m not as perfect as I was?” you know?

A service provider also stated how spousal acceptance of the amputation could be held back if trying to maintain a sexual relationship: The spouse is confronted with the changed body without a prosthesis and finds it more difficult to accept the person as anything other than an ‘amputee’. As mentioned previously with family acceptance, this could further affect the individual’s acceptance of the amputation:

Interview 9 (prosthetist): I have noticed that obviously the body image thing, I have noticed married couples struggle, over the years, with some have told me that’s been an issue, with the husband or wife being able to look at them as an amputee.
Previous studies on sexuality and disability have shown that sexual esteem, that is, the positive regard for and confidence in one’s capacity to experience sexuality in satisfactory and enjoyable ways (Snell and Papini, 1989), is related to both depression and self-esteem in men and women with disabilities, with higher levels predicting higher self-esteem and lower levels of depression (Taleporos and McCabe, 2002b). Satisfaction with one’s sexual relationships with others was also found to predict quality of life in adult amputees (Walters and Williamson, 1998). These findings, along with the data from the study indicate that sexual relationships are an area that needs attention within rehabilitation in order to optimise user’s outcomes after amputation.

The issue of body image in relation to acceptance of the amputation is significant when considering the effect it may have on prosthesis use and acceptance. It has been hypothesised that having a more aesthetically pleasing prosthesis may help with self-consciousness and improving body image (Donovan-Hall et al., 2002), which was touched upon in this data by a clinical psychologist.

Interview 1 (clinical psychologist): I may be involved if somebody has body image issues and we thought that could be answered by some higher level prosthesis

That a psychologist is involved in recommending a higher level of prosthesis or cosmetic covering to improve use and acceptance is indicative of the importance of taking into account psychological factors when optimising the use of the prosthesis and improving quality of life for the user.

Notably in this data, nearly all the mentions of social discomfort and body image issues were attributable to women users in the focus groups. Men were also more likely to display their prosthesis in public than women were, together indicating that there may be a gender difference in relation to body image. Certainly, there have been findings in the literature to support that relationship (Murray and Fox, 2002).
Self-perception may also be affected by other factors. For instance, the concept of State granted disability benefits and how they may affect and individual’s perception of their self after the amputation. By pursuing disability benefits, some of the users felt that they had labelled themselves as ‘disabled’, and some did not claim disability because they did not feel ‘disabled’ and did not want that label.

Focus group 2
PT2: I think the thing that hampered me was the pursuit of DLA. I thought I should have got DLA.
ES: what’s DLA?
PT4: Disability Living Allowance
PT2: Disability Living Allowance, and I didn’t get the allowance, and in some senses I thought I made myself ill looking for it. Eh, and I got an offer of work towards the end of that process and I got out of it, I really think that helped me back, you know, I was thinking myself ill to get the allowance, and in some ways I’m quite pleased I didn’t get the allowance, you know? Because I didn’t get the definition of being disabled.
PT3: I’ve never had any kind of compensatory anything. And I think that’s helped me

However, there is a caveat to this, as while some individuals may be able to return to work and live as they had before the amputation, those who cannot return to work will benefit from the disability benefits they receive.

Overall, there are a number of factors which affect acceptance of the amputation, which in turn may potentially affect the optimisation of prosthesis use. A summary of these is in Box 4.9. There were minimal differences in opinion between service user and providers, though many of the factors identified were done so by users to a greater degree than providers. This however may be due to the fact that factors which affect optimal use of the prosthesis may not be as recognisable to those working in rehabilitation as they may become more relevant after rehabilitation.
Box 4.9: Optimising Factors Relating to Acceptance of the Amputation.

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<th>Making social comparisons</th>
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<td>Emphasising positives from amputation</td>
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<td>Family acceptance of the amputation</td>
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<td>Family understanding limitations of the user</td>
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<td>Overprotective family</td>
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<td>Body image problems and self-consciousness</td>
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<td>Romantic relationships</td>
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<td>Receiving disability benefits.</td>
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4.4.3.2 Prosthesis Fit

Apart from being able to wear the prosthesis without discomfort, there are a number of reasons why having a well-fitted prosthesis will help individuals achieve optimum rehabilitation. This section emphasises the need to replace and repair limbs as soon as possible for an individual as it will increase their likelihood of reaching their full potential.

Throughout all the focus groups and interviews, wearing the prosthesis with comfort was highlighted as an important factor in optimising the use of a prosthesis. Being able to wear the prosthesis in comfort facilitates walking without disruption.

Focus group 4
PT3: and the thing about the limbs too, and do you all agree with this, is if you get your socket right, do you know what I mean, your socket right? The foot, the bars, the covers, the liners, everything is brought in off the shelf you know what I mean? And it’s just that one thing they have to do, and that is the cast and get that right
PT2: yes that’s the most important
PT1: yeah
PT3: and if you don’t get that right, everything is wrong. You get that right
PT2: that’s number one
PT3: we all agree, that’s number one!
PT2: yes

Interview 4 (prosthetist)
But I would think that comfort’s the biggest thing. I think that’s a big part to wearing a leg: comfort.
A well-fitting prosthesis allows the person to walk with confidence. In contrast, a loose-fitting leg can lead to a loss in confidence, and a fear of falling. Indeed, balance confidence in a previous study was found to be independently related to limitations of daily activity and also to symptoms of depression in a study by Miller and Deathe (2004). A shrinking residual limb was identified as a key contributor to the changing fit of a prosthesis. This is a common occurrence, especially in the first few months after the operation. The problem arising from a shrinking residual limb is that it may go too far down into the prosthesis which can cause pain for the user, or it may shrink to the extent that wearing socks will not keep it in the prosthesis. As a result, the individual begins to lose control of the prosthesis and has less confidence in their ability to walk without falling over.

Focus group 3
PT3: I can move my leg in and out like that. And you don’t have control.
PT2: no you have to have tight fit
PT1: your confidence goes completely
PT3: yeah, cos you’re afraid
PT1: you’re afraid to fall, that’ one of the reasons I carry a stick
PT3: that’s why I’m on them (crutches)

This issue was also mentioned in another study, where many had difficulty in maintaining socket fit due to changes in body weight or temporary swelling of the residual limb, and the participants recommended the idea of a socket that could accommodate these changes in size (Legro et al., 1999). Interestingly, service providers did not raise the issue of a shrinking limb at all. This may be because service providers see it as a given that a shrinking residual limb will be addressed by a return visit to the fitting centre for a new socket fit. However, reluctance from users to get a new prosthesis for a shrinking residual limb, as they wish to avoid the time without a prosthesis and have socks to help increase residual limb size, may have led to its appearance as important in this data.
A fear of falling was often mentioned as affecting what a person does and how they walk. For example, some people discussed how they avoided certain situations and needed to actively think about every step.

Focus group 3
PT1: But if I’m going out anywhere, I’m very conscious that I don’t fall, I think that would knock me an awful lot, I make sure that there’s nothing on the ground or in my way.

PT3: For instance I was painting a bit of the parlour yesterday where somebody had marked the wall, and there was a hoover lying on the ground, and I unfortunately went to step back and I stepped on the bar of the hoover,
PT4: yes?
PT1: and I ended up on the floor there. Now if that had been anywhere else I would have died a hundred deaths you know? Cos the fact of trying to get back up again that’s absolutely nearly impossible unless you’ve a chair or something to lean on

Having a well-fitted limb and knowing a person’s limitations in terms of functionality appears to increase confidence and reduce fear. Increased confidence and familiarity with the prosthesis may also lead to a phenomenon known as embodiment. Embodiment is the feeling that the prosthesis has become a part of the prosthesis user’s natural body. A number of focus group participants mentioned that they had felt this with their prosthesis.

Focus group 3
PT3: now I feel kind of, I fell if it’s not there, even when I’m in bed it’s like there’s something missing, part of you not there. But it’s just a natural thing; it’s like putting on a shoe in the morning. Get up, stick it on.
PT2: as you say, you develop this peripheral awareness of having your limb there, you could tell where your limb is without even looking down to see where it is, you actually develop this awareness of it so, it becomes as normal as it’s going to get you know?

PT3: When I put it on in the morning the only time I think about it again is at night when I take it off. Other than that it’s just part of me now. It’s like as if I never had the other leg kind of, that’s the way you know, you get the feel for it. You grow it to it, to be part of your body now.

The issue of embodiment has been discussed in a study by Murray (2004) who found that embodiment resulted in an increased ‘naturalness’ in using the prosthesis
for participants, with confidence rising in prosthesis use and less concentration needed to achieve movement. Those users who had a ‘good’ fit with their prosthesis were able to reach this state of better ambulation and use of the prosthesis, indicating that the fit of a prosthesis can have a large influence on its acceptance by the user, to the point that it can be accepted as part of the body. Service providers again did not mention embodiment, though this may be related to it being a rather personal phenomenon that may not be discussed with prosthesis users in a clinical situation.

A summary of the factors affecting optimal use of the prosthesis which were related to prosthesis fit are displayed in Box 4.10. In comparison to the Acceptance factors, there was considerably more input from service providers, however, it was still clear that service users had more input on what could affect the optimal use of their prosthesis.

Box 4.10: Optimising Factors Related to Prosthesis Fit.

<table>
<thead>
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<th>Comfortable prosthesis fit</th>
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<tr>
<td>A shrinking residual limb</td>
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<tr>
<td>Confidence in walking ability with prosthesis</td>
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<tr>
<td>Fear of falling</td>
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<td>Sense of Embodiment</td>
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4.4.3.3 Goal-setting

A common practice in rehabilitation is to set functional goals that the individual works towards achieving (Siegert et al., 2004). Goal-setting gives the individual something to strive for in their rehabilitation and thus can help with optimising the potential of each individual with the prosthesis. This section emphasises the importance of tailoring goals to the individual, but making sure that the goals are achievable and realistic. By doing this, goal setting not only encourages a person to achieve higher levels of functionality, but can also create positive psychological affects from goal-achievement, both of which will help in optimising prosthesis use.
The data collected in this study reflected common rehabilitation practice as service providers indicated that goals tailored specifically to each individual, that is, goals that were important to the person and attainable based on their capacity, were identified for use with individual prosthetic limb users.

Interview 1 (clinical psychologist): I think the way that we would probably work would be on a patient-centred goal-planning approach. In a sense, the person finds what their goals are, and reaching those goals for themselves is what is successful.

Interview 10 (consultant in rehabilitation medicine): it’s about goal attainment, the goal that is set up, the realistic SMART (Specific, Measurable, Attainable, Realistic, Time-bound) goal that is set up at the outset if you like

This approach to goal-setting is especially needed in amputation rehabilitation due to the heterogeneity of the amputee population (Rushton and Miller, 2002). One goal that was commonly set was that of returning an individual to a job or hobby that they enjoyed prior to their amputation, or encouraging the uptake of a new one. Indeed, this was considered an important goal to set because realising this goal brought about other positive outcomes. For example, returning to work or a previous hobby can help to reintegrate a former image of the self into the current self-concept of the individual which will help with self-image and self-esteem. Self-worth and self-esteem is also boosted by successfully learning a new skill or hobby, with the added benefit of potentially increasing social interactions.

Focus group 6
PT4: I’m playing golf and everything when I got going on it. Actually that’s really what got me going, to pitch and putt, I got very interested in going to pitch and putt with me brothers and friends and that
ES: yeah
PT4: And they helped me to walk around, and playing the game of golf got me really used to it.
ES: just to get out and get into something
PT4: yeah yeah
ES: does anyone else find that actually, that they have something that helps them to get out and do thing, like PT4 is with his golf, is there anything in particular that you decided.
PT2: oh very much so, where you have to like just follow your interests, I suppose I’d be more into Gaelic and like eh not participating and the administrating of it, and I felt that, and I was a political activist at the time, and I thought to pick up those was very important to me. Actively like.
From this we see that goal-setting is seen as a practical way for service providers to help prosthesis users reach various levels of functionality, but also goal-setting can help users to build up self-worth and become more accepting of their impairment; achieving goals has a deeper meaning for users in terms of building self-esteem and creating valuable social interactions. However, it is important that goals are realistic to the individual and that the individual is fully informed of what is achievable and does not have unrealistic expectations, which can be encouraged by health care providers, family members, and making comparisons with other prosthetic users. If a user has difficulty progressing beyond the level they can achieve, they may become disheartened or upset when their expectations are not met, which may in turn affect their acceptance of the amputation.

Focus group 2
ES: did you find it very hard because you couldn’t go back to work; was that a big factor?
PT1: that was a big factor in the beginning, I though, I definitely thought that I would and the doctors said “oh you’ll go back to work in a couple of months”, and you just thought about it, you know it happens, you going back to work again.

The goal-setting literature supports the idea of increased dissatisfaction from increasing negative discrepancy from achieving a goal (Locke and Lantham, 2002). If the users cannot achieve their goals, they may become more dissatisfied with their situation which may impact on further rehabilitation and worsen outcomes with the prosthesis. Similarly, it appears that a common problem among service providers is dealing with unrealistic expectations from users:

Interview 6 (prosthetist): I’ve got somebody who is the perfect example, not been an amputee for even a year maybe, in a couple of months she’ll have been an amputee for a year, and she’s in her 60s, and she was a traumatic amputation, and she’s independent, I mean she walks about with a stick usually, but generally she’s independent and she’s always saying she’s not doing well, she always thinks she should be walking without the stick and that she should be able to do this, that and the next thing, but she’s doing very well.

However, it appears that again this may be related to the lack of information provided earlier during the amputation process, or even the provision of false information.
Focus group 1
PT4: my injuries were so severe I had to spend like a year in the bed in hospital, so I had a year of kind of kind of contemplating and people continually talking about limbs things and that, even before I got to see or come here. But even I that I still didn’t know what to expect, because there was no pamphlets, there was nothing visually that I could see, there was nobody…

Interview 1 (clinical psychologist): So I think expectations, and the management of expectations, is a key sort of element that we sort of highlight in our service. What we find is that people earlier down the line, that is people involved in the actual surgery, and em, you know all the sort of stuff that goes on, they might actually be giving high expectations, as a way to cope with what’s going on at that moment. For example if you’re saying “Sorry I’ve got to amputate your leg” it seems easy for the surgical teams to say “But, don’t worry, we can give you an artificial one”. Which, you know, makes it sort of sound like…it’s giving hope but it’s also, sometimes, you know, raising expectations too much sometimes.

These findings indicate a need to better inform patients of what to expect and what may be achievable, as well as streamlining the service so that all members of the team are delivering the same message. This then becomes relevant when we consider the effect that service can have on the optimisation of prosthesis use.

A summary of goal-setting factors which affect optimum use is in Box 4.11. In the area of goal-setting the service providers were much more vocal on indicating how factors might affect optimal prosthesis use than in other sections. This is probably related to the amount of experience they would have with setting goals in prosthetic rehabilitation. Service users were more likely to see goals related to personal factors, such as return to job or hobby, as having an impact on their prosthesis use than other potential goals.

Box 4.11: A summary of optimising factors related to goal-setting

| Setting achievable goals |
| Making sure expected goals are achievable |
| Returning to work |
| Returning to/taking up a hobby |
4.4.3.4 Service

The principal factor mentioned by service users and providers as having an effect on prosthesis wear was the limb-fitting service, with over 400 references made to service in both the focus groups and interviews, 100 more references than were garnered for predictors of prosthetic prescription. Many service users felt there were improvements that could be made to make these services more accessible, reliable and satisfactory for the patient. Indeed, the view that the quality of services impacted on prosthetic outcomes was raised by both prosthesis users and providers. This theme outlining the ways in which service factors impact on prosthetic outcomes is divided into three subheadings: The Fitting Process, Service Infrastructure and Publicly-Funded Services.

4.4.3.4.1 The Fitting Process

Within this section, a number of different topics are perceived as impacting on how well a person will do with a prosthesis, and whether they will achieve optimum outcomes. These occur within the fitting process, meaning the act of getting fitted, or getting adjustments with a prosthesis. This includes time to fitting since amputation, time taken with making adjustments and replacements, time spent with the prosthetist, the relationship with the prosthetist, user involvement in the process, and a multidisciplinary team approach.

Firstly it appears that those who are fitted soon after amputation are more likely to do well.

Focus group 3
PT3: this one is about 2 years old now, you know, and even if I, I’ve to go out there next Friday, and even if they sign me up for a leg, well measure me for it, it will take anything up to 3 months to get it.
PT2: well just to go back to, I think that the speed at which you get your prosthesis, to help build up that confidence before it’s totally knocked out of you. It’s a point of note, maybe for the hospital, that the quicker they can get you in and get you back up the better
PT1: yes
PT3: because the longer it goes, the harder it is to.
PT4: yes my surgeon said that to me she said “you couldn’t get a prosthesis quick enough”.

A number of studies have highlighted the importance of getting the individual back on their feet as soon as they are able without delay from the limb-fitting process (Pezzin et al., 2004, Gauthier-Gagnon et al., 1999). While a number of other factors such as residual limb condition may affect how quickly a person is fitted, it is important that the delay does not originate from the service alone. Furthermore, it is important that replacements and adjustments are made as fast as possible to help users avoid time in a wheelchair, and to avoid damage to their residual limb by using old prostheses while they await repairs.

Focus group 6
PT2: I probably was three weeks waiting and another 3 weeks, so a good 6 weeks, so you go back to original one and your stump would break down again because it wasn’t exactly what you needed and I felt it was maybe no fault of anyone, but it’s hard to understand with all modern technology why you have to go to England for a part. That’s what I found strange.

Many users also complained about the waste of time, money and effort of returning for numerous fittings. Since a change in the management from a consultant-led clinic to a prosthetic company-led clinic at their limb-fitting service, they had found the service less reliable, resulting in attending clinics for a number of weeks without any progress on the alterations to their prosthesis. They also felt that increasing the time needed to get a limb adjusted or replaced was a waste of the prosthetists’ time and health resources.

Focus group 4
PT1: it’s costing a fortune; it must be costing them an absolute fortune in wasted money. And it’s wasting people’s time. And to go, imagine going back over for 3 years to get a prosthetic. I myself have gone two years with the same, and E has gone a year and a half. And you know you’re, that’s 24 visits a year say, for two years is 48, and it should take 3 fittings. No more than 3 fittings, you know.
PT3: yea, and are those fitters are coming down, they’re coming down on a Tuesday night, sure they’re having their bed and breakfast in their hotel, and sure that has to be all, that has to be paid for all as well, you know what I mean.
Reasons for numerous fittings and wasted time seem to rest on a number of different factors. For instance, some users felt that they were not given enough time in their fittings to be treated to the proper standard of care.

Focus group 1
PT2: I think probably, a big thing is time. I’m lucky in that my prosthetist does give me a good bit of time, and that’s maybe because when I, if have a new leg made, I maybe spend a lot of time with her and then I’m ok and she doesn’t see me for a long long time,

Focus group 3
PT2: The amount of time that R takes in getting the fitting correct, and the amount of time after in making sure the alignment is correct, just adjusting the feet and if you’re not, she says “I’m not in any rush” she schedule to time with you, I’ve often been out there for 5 or 6 hours, and she wouldn’t have had another patient, she’ll say “we’re going to get you right, you’re not going to go home happy, you’ll be back next week”. It’s been fantastic. You know so; my experience has been different to yourselves.
PT3: I find with X you go out there and you’re there at 10, and you’re home and all by 11

Time spent in fittings helps to build the relationship between the patient and the prosthetist and helps to build trust in the prosthetist’s capabilities. Indeed, the relationship between the patient and the prosthetist was seen as important. For example, the prosthetist plays a significant role in how a patient finds the service experience and how a patient adjusts to using a prosthesis. If the relationship is good, the user is more likely to open up to the prosthetist about any problems or issues they have with the prosthesis.

Focus group 1
PT2: do you think it’s important to have a prosthetist that you can, be on the same wavelength as
PT3: uh huh, yes aye aye
PT1: hmmm yes
PT2: I think that’s very important, very important
PT3: definitely. Actually they’ve turned into good friends. Aye, a very good friend
PT1: I’ve found that too
PT3: through the years you can actually tell them anything, anything at all, whatever, and really the confidence and everything it’s lovely

Approachability in a prosthetist was recognised and commended, as well as understanding the needs of the patients, encouraging them to raise concerns if they
have them and being aware of the problems that they face with the prosthesis and the amputation.

Interview 6 (prosthetist): but I think that that effects the outcome, and if you’re an approachable prosthetist, then you’re patients are probably going to do a lot better because they’re absolutely fine with phoning you up and saying “look this isn’t quite right” and I’ll add, when I worked previously in a centre, I think some people shouted at their patients! So I think patients, years or two years down the line because they hadn’t been in in ages because they were too scared to come in. Just things like that, and you think “right ok”. So I think the relationship with your patients is important in this service especially, a lot of the times you’ll see a person once and then never see them again in the (health-care service), but this is definitely different.

This relationship between the prosthetist and the user also encourages the user to be actively involved in the fitting process. Users became dissatisfied when prosthetists weren’t working towards their needs and did not involve them in the fitting process. This may be especially true of long-term experienced users.

Focus group 3
PT3: and XY took it off and said "I’m going to do a bit of work on it X" I was sitting there for about an hour and the nurse came out to me, you know the blonde girl? Does be in the limb-fitting all the time? She does all the dressings and all of that. She came out to me and she says to me “jays X, you’ve been a long time sitting there this morning” I said, “I’m just waiting on XY, he’s down there” she said “no he’s not, he’s up the canteen having his breakfast”.

PT1: that’s not the right way to treat you either, that’s no way to treat a person, you know? There’s no respect out there

Focus group 4
PT1: you’re made to feel like a number, you’re not important it’s just for them to get rid of. You and the limb you know

Similarly, service providers in this study felt that patients should be given as much information as possible to help them to be involved in this process. Certainly in a study on consumer satisfaction with a prosthetics and orthotics service, 95% of participants said it was important or very important for the service to be client-centred, and also for the consumer to be involved in picking the device (Geertzen et al., 2002). This finding is also echoed within the AT prescription literature which states that involving the client in choosing the technology is essential for satisfaction and less associated with non-use (Scherer, 2000)
Interview 10 (consultant in rehabilitation medicine): absolutely, we believe very strongly in that, that the patient should be involved in the decision making process wherever possible, patients also will have to be given information for them to be able to cope with limb loss.

One factor that was repeatedly endorsed by service providers was the concept of using a multidisciplinary team (MDT) within the rehabilitation setting and then onwards within the fitting process so that the user’s issues, be they medical or psychological, can be dealt with by an appropriate person. For example, if an individual develops a sore on their residual limb that may need medical attention to prevent further problems and need to see a doctor. The MDT can also include clinical psychologists to deal with any psychological difficulties that arise from amputation and learning to use the prosthesis. The psychologist may also help interactions between the prosthetist and the patient, and they may even be involved with helping families through the rehabilitation process.

Interview 2 (physiotherapist): I think yeah, that as I say, I don’t work in the amputating hospital, I don’t see the patient preoperatively, but from what my colleagues tell me, these hospitals, and the prosthetist, their should be an MDT approach prior to, if possible prior to surgery. And I definitely think the prosthetist should be involved in that stage as well. Because sometimes they actually give the patient a transtibial amputation, when really they have no chance or using a, maybe because of extensive knee contractions, or whatever, where as the prosthetist I think should definitely be involved in the pre-operative decision. Now there are times when the patient is acutely ill and can’t or traumatic amputation, but an elective amputation, I think the amputee team should be involved more yes.

Interview 7 (prosthetist): Em, the biggest advantage that I see, that I have seen in the service over the last couple of years, is having a clinical psychologist on board. That is, I can see a huge difference in the patients that have been treated, and I can also see, and I include myself in this, a huge difference in the prosthetists’ approach to the patients cos he’s taught us a lot of em, we can understand a lot more of what happens to a patient, rather than just the physical side of amputation, more of a holistic side to the whole thing.

It is important that the psychologist is part of the MDT treating the patient and not someone who is unconnected with the team. If the psychologist is not involved with the MDT they may not share the findings with the rest of the team, or they may not offer sufficient advice to the MDT of how to help the patients.
Interview 2 (physiotherapist): well you see this was the problem, the psychologist came and made a diagnosis ‘yes the patient is rejecting their residual limb, they’re not accepting it’, but they didn’t offer counselling. That’s why I’m saying really, it’s fine to diagnose something, but you need to be able to treat it as well, but it wasn’t within their scope of practice to treat it, but they gave us guidelines, but I really think that we need a bit more than that.

A summary of the factors affecting optimal use of the prosthesis that were related to the fitting process in service are displayed in Box 4.12. Both users and service providers were aware of the problems in the fitting process that affect optimal use. Most of these were related to how service could be improved and suggestions made were done so by both groups.

Box 4.12: Optimising factors in the service relating to the fitting process

<table>
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<th>Time to fitting</th>
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<td>Time taken making adjustments and replacements</td>
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<td>Time allocated to the fitting process</td>
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<tr>
<td>Relationship with the prosthettist</td>
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<tr>
<td>User involvement in the process</td>
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<td>Multidisciplinary team approach</td>
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4.4.3.4.2 Service Infrastructure

This theme relates to the underlying foundations and systems of the prosthetic provision service and how they impact on increasing functionality for those who use them. For instance, accessibility is an issue for some users of prosthetic services. As a relatively small area of health care, prosthetic services tend not to be available in all parts of a country, meaning patients travel long distances to use them. If a patient is unable to drive, which is common, they have difficulty in reaching their facility for a fitting as they rely on public transport (which many dislike using) or on the ambulance service for the facility.

Focus group 3

PT3: the only thing about it is again is you have something with the leg during the week, and you don’t have your own transport to get out there, the X Health Board won’t bring you, only on a Friday.
ES: ok yeah
PT3: they won’t bring you any other day
It was suggested by service providers that it would be beneficial to have the fitting centre adjacent to wards for primary patients, that is patients recovering from amputation surgery, making the centre more accessible and increasing time spent with new users. This move would also include nurses within the MDT, increasing the available information on each patient and consolidation of care across all members of staff dealing with the patient.

Interview 7 (prosthetist): I think what might help them might be to have an onsite ward, you know, a ward that’s adjacent to the centre for primary amputees, and you could have much more of a, sort of a transaction between them, rather than you know, sending your patients away in an ambulance and getting them back three weeks later for maybe 2 hours or an hour and a half.

Interview 8 (physiotherapist): the only thing we don’t have and I’m sure improves outcome is amputee rehabilitation beds, so our amputees are either discharged early or be had in acute surgical beds, so if we had an amputee rehab ward then that would include the nursing staff within the team and they would have a much better environment to go back to.

As the service is not easily accessible to some people, it is important that when they travel, the service can be relied upon. Many patients mentioned that they could not rely on their service to deliver their repaired limb in a reasonable time, or to make sure adjustments had been correctly done. This left them disillusioned with the amount of care put into their service and discouraged them from getting repairs done.

Focus group 4
PT1: That’s 3 years that women’s been coming and going, from one clinic to another, time after time after time, basically sent back. There’s no facility to do any repairs or alterations on site, every time they must be taken, taken back, and we wait for it to come back to find that either the alteration hasn’t been done properly, or else there’s something else wrong with it.

…………………………………………………….
PT1: but there are Liz, an awful lot of elderly people who won’t keep coming back, they will give up, they will stay in the wheelchair, and they will take the leg and put it under the bed and that will be it, and they won’t wear it because it’s not right. And they won’t, I suppose, have enough energy, or what do you call it, to keep going back and keep going back and keep getting it altered and changed.

This was more of an issue to some of the focus groups because they were comparing their service to what it had been before a change in management. They had been
satisfied with the service they had received when the service was consultant-led, but now that the service was run by a prosthetic component manufacturer, they believed they were receiving a below-standard service as compared to what they had received previously. This feeling was also reflected in how many patients felt about the building in which the fitting appointments are held. Some groups noted that they lacked certain structural requirements for treating those being fitted for prosthetic limbs, such as adequate walking space. One particular limb-fitting clinic took place in a building with a poor entranceway for those with disabilities, and within the building there wasn’t space for wheelchairs, or the space to learn to walk with a prosthesis.

Focus group 4
PT3: you’ve nowhere that you can walk properly. If you go outside that’s all muck and it’s all stones and you can’t. Especially when you’re above the knee. You just can’t walk on it. You know.

This is important as the individual needs to firstly be able to access the clinic without difficulty, and then secondly have the opportunity to try to walk with the prosthesis before they are fully happy with how it fits. If they are not given the opportunity to walk and test out the leg then it may not be a good fit for them and they will not get the most out of it.

Lack of privacy for fitting was also mentioned by both users and services providers. Users found it upsetting to attend the clinic due to this lack of privacy.

Focus group 3
PT3: the unit we have, it’s terrible isn’t it? It’s just like a room with just a curtain down two person, like you stay this side, and just a curtain you know, and the people then are waiting, like are just here, and you’re just standing there behind those curtains, and you’re stripped off as whether you’re an above the knee amputee or below, and you’re there...because you have to strip off you know because you have no choice. And you’re there walking around, and you’ve no privacy walking up and down because sometimes maybe somebody walks by and the curtains will go, or somebody else will come and pull them
PT1: will come and pull them
PT3: and then somebody else will go in the puddle (outside), you’ve no privacy, you’ve no space whatsoever.
One provider noted that a lack of privacy may affect the way individuals behave during fitting sessions which could in turn affect fit.

Interview 6 (prosthetist): PT: I think sometimes I would like, probably like to think that patients should have a bit more privacy, not all of them like to be sitting in a big room of people, in their pants. Just because everybody else is. So yeah, I think that would be quite nice to have that available to them.
ES: and do you think having more privacy would help people adjust? Or is that just...
PT: I think it would just help when they come in here, because they’re always, there’s people that absolutely don’t care, I’m fine, and they’re people, and they do tend to be younger people, and they do tend to be a lot more cagey about it and it takes me a while to get to know them because they’re vary stand-offish and I don’t mean they’re horrible or anything like that it’s just they’re very, they just answer your questions and that’s that. I don’t try and, a lot of people get to know you, and I think that that probably a good part of that. I had a girl in the other day who asked if it was possible for her to be seen in a private room cos she just doesn’t like people, people will tend to say “well how did you get yours?” and not everyone wants to talk about it, and I think that’s what she doesn’t like it.

These findings support the notion that even the location, appearance and accessibility of the service may have an effect on an individuals rating of a service, and may effect whether an individuals will use it or not.

A summary of factors affecting optimal use of the prosthesis relating to service infrastructure are displayed in Box 4.13. Most of these were identified by service users, which may be related to users being more aware of the obstacles when trying to get to and to use the fitting service, especially from the perspective of the person with the amputation.

Box 4.13: Factors affecting optimal use relating to Service Infrastructure

| Available transport for those unable to drive |
| Fitting centre adjacent to primary amputation ward |
| Reliability of service |
| Entrance to building suitable for wheelchairs and prosthetic walking |
| Suitable walking space for testing prosthesis |
| Privacy in fitting rooms |
4.4.3.4 3 Publicly Funded Services

Many of the focus group participants noted that they were unlikely to receive the best prosthetic limbs available because there is no budget within the health care system to cover expensive prosthetic components, especially with regards to cosmetic covers. However, in general they felt the service they received as part of a publicly funded service was much the same as a private service.

Focus group 1
PT4: I think like em, there’s a lot of misconceptions as regards going private, having limbs like Heather Mills, from what we have there’s no difference to the service, if you get NHS or private, that’s a fact, there’s no difference
PT3: see (name) he did private, he worked in private and with the leg he says “they’re actually the same” he says. The only real difference in the cosmetic
PT2: I’m not sure I entirely agree with that, I’ve seen some legs, I’ve spent a long time on the internet looking at is available privately, than on the NHS, I would say that there probably is a better service, em, I think probably, a big thing is time.

Similarly, service providers believed that they were restricted in terms of components and cosmesis, but that they provided as good a service as a privately run company.

Interview 4 (prosthetist): I don’t think they get a lesser limb functionally. I think cosmetically there are some issues out there that would be resolved if we had more funding for that type of thing

Interview 6 (prosthetist): Even though they might not believe us, we are always constantly trying to get the best limb or what we can. I mean I don’t think the NHS holds them back on medical components and that kind of thing, that is mostly available to them, although someone’s got the stigma that they’re not. You’ve got the whole MDT they need around them all the time, so It’s not like they’re being…I dunno. The service generally is good.

However, the lack of funding to provide the best components for a person was an issue of frustration for service providers.

Interview 10 (consultant in rehabilitation medicine): One of the difficulties is, the cost-benefit ratio is not properly worked, so therefore you may have a cost which may cost 10 times more, but it does it improve the benefit 10 times for a given individual? But you cannot deny that giving a different component, while it costs a lot more money, may make life easier for a given individual….but we do not have funding to go down this route, and so therefore there is always a degree of frustration.
It has also been noted in the literature that a future problem for publicly-funded prosthetic services is that there will be an increasing amount of choice within the prosthetic services due to the improvement of technology, but that there will be less available choice because of financial reasons (Geertzeen et al 2002). This may lead to more frustration on the part of prosthetists and on the part of users.

A lack of available alternatives was also identified in publicly-funded services. This was related to the presence of private contractors in publicly-funded limb-fitting centres (so only components from that manufacturer are used), the lack of rehabilitation centres for those with amputations, and the small amount of fitting services that are available in a given country.

Focus group 1
PT4: every company I think has a like, a strength, like certain companies that do the finish really well and different companies that provide as you say the components, and then there are other companies that provide like everything, and that’s the case, I think it would be good if you knew what areas are kind of good that you can go to and you could work with, do you know what I mean, and I think it’s that, I think at the end of the day it’s about money and what they can get so

One patient was informed that if they went to a different limb fitting centre than the one they were currently using, they would forfeit returning to that rehabilitation unit for any future care they needed.

Focus group 4
PT1: to say that a patient can’t change to anybody else and that rehab will wash the hands of that patient….but we can have a situation where em, with amputees, where the X, I believe wrongly, can actually refuse service. That should not be allowed. That’s like somebody turning up with cancer at some hospital and them saying “I’m sorry but you know, you didn’t come out to us last time so we’re not taking you this time, you’ve got to go somewhere else.” You can’t have that you know, the service should be there for everybody. So I think that’s very important, that eh, that that is recognised by the board of the X, you know. As far as I know I think it was a nun’s order that owns the building but of course all of the servicing comes from public funds, all of the funding come from public funds so, to refuse somebody treatment, that’s outrageous.
PT3: yeah, like they took away my choice of going to the, because I never had a limb made in xx as I told you, I was there and I learnt how to walk there in the beginning like, and my limb was there but it came from H, because X wasn’t up and running at that time, and em, it was in X I reckon, where I learned to walk and all, you know? I
went to by for years and years and when they moved that out to z. and then to be told all of a sudden that you can’t go to z any more. You end up like, really with no service

Using contractors within the public health service was also an issue for those who work for the contractors. They felt that they were treated differently to other members of staff in the fitting clinic who would be employed by the hospital. Another problem for those receiving services from contractors was that many users felt that there was a lack of accountability within the service for those providing the limbs. Many felt that there was no one directly in charge of limb-fitting who they could complain to who would take action.

Interview 5 (prosthetist): well I think for us as prosthetists, something that could make it better is to be treated with more regard, we think, by the health service management, because we are contractors, we are… that’s a very personal thing, we feel that as a group. Em because we are treated as a contractor rather than the way the physios are treated or the nursing staff are treated, they’re included in things as we’re always the last ones to be thought of in a certain regard. And I understand that we are a private company but we have all been employed by, I’ve been employed by the health service and I’ve been employed by 5 companies since I started working 20 odd years ago, so it’s not our fault who we’re employed by, but we’re always here, doing the same job with the same group of patients and with the same staff, but the management don’t always regard us, we feel, with the same way that other people would like to be regarded

Focus group 3
PT4: But my main problem, my main problem was, was that they had nobody in charge. That they’d nobody that you could go to.

Focus group 4
PT1: and as for em, it’s gone then from in-house limb-fitters, where everybody knew…you need a chain of command, you need a line of command. Where the consultant knows the limb-fitter and the limb-fitter knows the consultant, and they know the work that’s being carried out.

A summary of the factors which affect optimal use of the prosthesis that are related to publicly-funded services are in Box 4.14. There appeared to be tension between what the user felt they receive from a contractor within the service, and what an individual employed by a contractor felt they offered. In many ways it appears to service users that by using a contractor, a service is reducing the amount of choice a
consumer has when getting a leg fitted. However, those working within the service would argue they still work to the best of their ability and provide the best prosthesis they can. While this may be true of most providers, data collected from focus groups indicates this may not always be the case, offering up an interesting debate on outsourcing prosthesis fitting from rehabilitation hospitals to private companies. While it may be cost effective and in most cases offer the same standard of care, it appears that a decrease in the standard of care may result if there is no one available onsite to offer medical care or be held accountable for the service.

Box 4.14: Factors Affecting Optimal Use Related to Publicly Funded Services.

| Restrictions on component choice due to financial constraints |
| Restriction on component choice in privately contracted service |
| Choice in fitting services available in area/country |
| Communication between private-contracted prosthetists and public service employees in same fitting centre |
| Accountability for service |
4.5 Discussion

This aim of this stage of the study was to gain a better understanding of what prosthetic service users and prosthetic service providers consider the important outcomes of having a prosthetic limb, predictors of prosthetic prescription, and factors which they consider affect the optimal use of the limb. Combining prosthetic service user and service provider data in a single qualitative study gives this study a unique insight into the process of prosthetic prescription. Combining service provider and service user data created a large variety of useful data based on both clinical expertise and patient experience. The juxtaposition of service provider and user viewpoints showed that there was not always agreement on both sides of the best predictors of prescription or the important outcomes of prosthetic use.

4.5.1 Outcomes of Prosthetic Prescription

A number of outcomes of prosthetic prescription were generated in the data: Independence, Remaining at home, Self-reliance, Not in Wheelchair, Balance and safety, Quality of life and Reaching potential. From this list it is clear that outcomes do not relate solely to the functional gains, but also to psychological improvements. Although there was general agreement between service providers and users on these outcomes, there were some differences which could impact on the way prosthetic rehabilitation is carried out. Service providers considered the user walking or being out of a wheelchair as successful, while it was clear from users that even the smallest gains in function from rehabilitation were appreciated and celebrated for the psychological benefits they offered. As such, Independence as an important outcome for service providers was related more to functional independence, whereas for users independence was expressed as more of a psychological outcome, related to feelings of self-efficacy and self-esteem. Clearly the two are related, but the subtle difference is important when studying outcomes in rehabilitation and furthermore when goal-setting during the rehabilitation process. In fact one of the criticisms levelled at goal-setting in rehabilitation is that professionals have a tendency to set goals in terms of physical outcomes primarily concerned with
mobility and physical independence, with goals that are psychological in nature appearing to be relatively rare (Wressle et al., 1999). This then raises the question that if users and service providers have different ideas of what constitutes a good outcome, how can goal-setting be effective? With goal-setting outlined as an important factor in optimising the use of the prosthesis, it is important to make sure that it is an effective strategy, by engaging the user in the process, making sure that the goals set are relevant to the person, and the consider the user’s understanding of the process and its meaning (Siegert and Taylor, 2004).

The finding of independence as an important outcome from the prosthesis was not unusual. The prosthesis offers the chance to those with lower limb amputations to regain mobility which in turn can lead each person to gain some level of independence. However, in this study independence could be being able to go to the toilet unassisted. This finding contrasts with what many studies would consider a “successful” rehabilitation with a prosthesis. Prosthesis use has been defined variously as wearing the prosthesis ‘regularly’, using it ‘daily’, ambulation indoors or outdoors, number of hours used per day, and the number of activities done with the prosthesis (Gauthier-Gagnon et al., 1998). With the above findings it is clear that while these can be considered useful measures, even small levels of functional independence are appreciated by both those who use the prosthesis and those who prescribe them, highlighting the importance of providing a prosthetic limb for even the smallest gains in mobility. Having independence as an important outcome of prosthetic prescription, even if it is only rated in terms of going to the toilet unassisted, helps to make a cause for more amputation patients to be offered a prosthesis and to be considered to have had a successful outcome.

‘Not being in a wheelchair’ was also a similar finding to other studies. In open-ended questions on a questionnaire, many participants said that they greatly valued having a way to get around other than in a wheelchair e.g. “It’s not like having the real thing but it beats the alternative” (Legro et al., 1999). Many of the participants
had also been given wheelchairs that necessitated an attendant to move as they could not be propelled forward by the user themselves. This meant that the individual was essentially dependent on the help of others to move about, which may have impacted on these results. Despite this possibility, it did appear that service providers were more inclined to view it as a functional outcome; while for service users it was clear that not being a wheelchair was about increasing self-esteem and avoiding being visibly disabled.

A ‘better quality of life’ was a common outcome identified as important to service providers. This is not unusual considering how often it appears in rehabilitation literature and research. Quality of life is a difficult outcome to measure however, due to the number of conflicting definitions that exist and knowing which one applies best to prosthetic rehabilitation. In other studies, patients have reported high levels of life satisfaction while also reporting constant pain and inability to work or participate in desired leisure activities (Nielson et al., 1989). This finding suggests that quality of life is a highly subjective process that while considered important within amputation rehabilitation, may prove difficult to measure objectively. However, the aim of creating a list of outcomes is to identify areas that can be measured objectively, suggesting that quality of life as a catch-all term may not be suitable as a measure of outcomes in prosthetic prescription.

In many ways quality of life is a standard answer for service providers, taking into account a number of different outcomes without much specificity. It is telling that none of the service users mentioned quality of life specifically as an outcome, but mentioned more specific ways in which their quality of life could be improved, such as becoming more self-reliant or being able to stay at home rather than living in a care facility. Quality of life then needs to be further defined in relation to amputation and prosthetic provision if it is to be considered an important outcome to achieve within service provision. That said, QOL had been measured in relation to amputation and the use of a prosthesis with a number of different measures, such as
the TAPES, PEQ, and OPUS. These measures have been previously found to have quite good validity (Gallagher and MacLachlan, 2000a, Legro et al., 1998, Heinemann et al., 2003) though in all cases further testing in the clinical environment needs to be done.

Another outcome identified by service providers related to how they wished users to “reach their potential”. This indicates that individuals are somehow evaluated for potential when they are being fitted for a prosthesis, although it is not really clear that there is a standardised method by which to do this. ‘Reaching potential’ was about meeting the expectations of the service provider as regards to a person’s walking and physical ability, based on common probabilities, such as younger persons being more active than older persons, and those with comorbidities generally doing worse than healthier persons. This is not to say that these generalisations are inaccurate, but to indicate that this ‘potential’ is not something that has been established in a measurable or standardised way. Currently the AMP and AMPnoPRO (Gailey et al., 2002) along with the Medicare Functional Classification Levels, or K-Levels (HCFA, 2001) are considered the best rehabilitation guidance tools in terms of predicting prosthetic outcome (Miller and McCay, 2006), but notably only the AMP and AMPnoPRO are not based on subjective measurements and have some predictive validity. From the data it was not clear if the service providers used these or any other specific measures for establishing the potential of each user, with only one service provider naming them as something which they used in the service setting. If users are being evaluated on their ‘potential’, which could affect their future care; it is important that what constitutes ‘potential’ is standardised and measurable.

Outcome measurement in prosthetic prescription currently covers a number of different outcomes and measures them in a number of different ways. This makes it difficult to compare and evaluate different interventions or prosthetic components. By identifying the most important outcomes of prosthetic prescription to both
prosthetic users and service providers, we are better served to compare and evaluate research in the field, but also to understand why and when prosthetic technology should be provided.

It appeared then from the data that there were a number of other factors which the service providers used to establish potential and that these could then impact on the prescription of prosthetic technology. This emphasised the importance of identifying the predictors of prosthetic prescription.

4.5.2 Predictors of Prosthetic Prescription

The data relating to prosthetic prescription predictors were split into four different headings: Age and Illness, Condition of the Lower Limbs, Ability Levels and Psychological Factors. While there was an emphasis on physical factors, it was also clear that psychological factors can and do play a role in prescribing the technology. In terms of physical predictors, age, comorbidities, amputation aetiology, ability levels and their effects were the main predictors identified, along with the condition of the lower limbs, such as amputation level, the presence of contractures and the condition of the contralateral limb. These findings are similar to those found within the amputation literature (Taylor et al., 2005, Roberts et al., 2006, Bilodeau et al., 2000, Dudek et al., 2005, Kurichi et al., 2007). Less common within the amputation literature is the finding that going through a number of amputations or operations before prosthetic prescription, either as limb-salvaging procedures or as consequence of progressing illness increasing the level of amputation, will impact on prosthesis prescription. Service users explained how the process of having hopes raised by the prospect of limb salvaging by vascular surgery, but to end up with an amputation was a blow to self-confidence and also depressing. While this is similar to sentiments expressed by Levin (2004), it is also important to note that for those who have gone through painful reconstructive surgeries after accidents, having an elective amputation may actually be a relief (Sjodahl et al., 2004) or improve functional ability (Pavlou, 2009), meaning that the same psychological effects would
not be present. This indicates that noting the presence of multiple surgeries in a patient’s medical history is insufficient to predict prosthetic prescription, but that its presence is something to be examined and explored with the individual to determine its potential effect.

Studies looking at the decline of functional ability due to age or illness and its effect on prosthetic prescription are uncommon within the literature. Flood et al. (2006) refer to how prosthetic management has to take into account changes across the lifespan, but does not go into the issue of how ‘downgrading’ a prosthesis may have a negative psychological affect on the user. Service providers in this study noted how it was difficult for some users to accept changing to a less complex prosthesis in order to function to the best of their ability. Reasons for this reaction could be related to different factors. The user could have difficulty trying to accept a new idea of the self as older and more impaired, a natural process in life which is emphasised by the changing of the prosthesis. Alternatively, the user could have become attached to the prosthesis as a part of the body, which could be related to feelings of embodiment, meaning the change of prosthesis is akin to losing a body part again. Thirdly, the user could be upset at the idea of not being offered the best prosthesis available and is uncomfortable with the idea of using a ‘lesser’ prosthesis. Of these, the first explanation seems most likely. Some service users in the data understood that new prostheses were given to make it easier for them to walk, making a new prosthesis actually a ‘better’ one. However, it may be possible that the individual forms an attachment to the device as they would any inanimate object. There is no literature that specifically looks at this type of attachment in prosthetics or assistive technology, although strong emotional attachments have been recognised between users and mobile phone devices, and that attachment is to a large degree attributable to a sense that the device is an essential part of life (Kolsaker and Drakatos, 2009). This finding then has the potential to be replicated with a prosthesis which could be considered as important in a user’s life.
In terms of the psychological and social factors which predict prescription the factors identified were Cognitive ability, Psychiatric health previous to amputation (including addiction problems), Psychological difficulties arising from amputation, Commitment to rehabilitation (Enthusiasm, Determination and Motivation to rehabilitate), Optimistic outlook and Social support. Many of these factors have been studied previously in the field of amputation rehabilitation, with studies looking at the prevalence of mental health issues (Horgan and MacLachlan, 2004, Desmond and MacLachlan, 2006a, Atherton and Robertson, 2006), and how the presence of psychological issues can impact on outcomes (Darnall et al., 2005, Larner et al., 2003), but this study shows how they impact on the rehabilitation and prescription process from the individual’s perspective. Service users described the difficulties of coming to terms with their impairment psychologically and socially and how it affected their progress through rehabilitation. Service providers recounted how service delivery improves when a psychologist is present within the MDT to help users with acceptance, body image problems, or other relevant issues.

For cognitive ability, there were similar results with other studies (Larner et al., 2003, O'Neill, 2008), with deficient cognitive ability affecting use of the prosthesis due to difficulties in remembering specific walking techniques and transfers. However, there appeared to be some different opinions of the effects of other psychological factors on prosthetic use. For example, social support was found to have both positive and negative effects in this study by service users and service providers alike. Social support helped some individuals with the acceptance process, but also hindered when trying to assert independence. In previous studies, emotional support from families was recognised in focus groups with rehabilitation clients as an important factor in the rehabilitation process (Williams et al., 2004). However, there is evidence that solicitous spouse responses are associated with increased levels of depression at one month post-amputation (Jensen et al., 2002) which may lead to poor participation in rehabilitation. Newsom and Schulz (1998) also found that 40% of recipients of care-giving reported some emotional distress in
responses to help they received. These findings are similar to those of the study, with contrasting opinions provided by both the users and service providers. This indicates that using social support as a predictor of mobility and optimal rehabilitation is not as simple as observing if the user has an available social support network, but also what type of social support they receive and the impact that has on the specific individual. In terms of theory, this fits into that of the Buffering Effect Hypothesis: that the presence of social support helps ease stress by being a mediating presence, as opposed the Main effect hypothesis, which states the mere presence of social support will have an effect on well being. It is clear from this data that while having family and friends to support you is beneficial, is the type of social support that is given, rather than just having an extended social network, which has an effect on how someone will do.

Commitment to rehabilitation was identified by both service providers and users as having a strong effect on whether someone would be able to progress with a prosthesis, although it is unclear exactly how this can be evaluated within the service setting. This is especially pertinent when you consider that motivation is difficult to measure objectively and is prone to value judgements (Siegert and Taylor, 2004). Maclean and Pound (2000) found that while there is widespread belief among health care providers that positive outcomes are associated with higher levels of motivation, these service providers are also aware that the evidence is mostly anecdotal and that the term ‘motivated’ is loosely defined. Their review of the literature also found that ‘motivation’ as a concept was changeable from one research study to the next, considered a personality trait but also a changeable variable.

This confusion within the literature reflects the different opinions that exist within the service setting. Caution therefore should be taken when considering motivation as having an effect on prosthesis use as it is unclear exactly what motivation is. However, it is useful to consider the other factors mentioned in this study that are related to commitment to rehabilitation, such as determination and enthusiasm.
These factors are potentially more easily recognised and evaluated than motivation and do not include the value judgements that are associated with motivation. There is no concept of intrinsic or extrinsic enthusiasm, and whether one is considered better than the other as there is in motivation (Maclean et al., 2001). An individual may show enthusiasm and determination to walk again by just turning up at rehabilitation and partaking in their exercises. They may also express verbally how much they want to succeed. In some ways, the simplicity of these concepts makes them easier to measure, whereas motivation has been extensively studied with a number of different theories underlying its causes and effects. That is not to demerit the effect of motivation on prosthetic rehabilitation and use, but to highlight that a quantified measure of motivation may not be what is needed, but rather an identification of and enthusiasm and determination to partake in rehabilitation.

One of the important issues repeatedly raised was the fact that fitting has to be done on an individual basis, and in many situations you cannot prejudge how a patient is going to do. Users remarked on how they had exceeded the expectation of limb fitters, and service providers noted that many times they have thought someone would do well, when in reality they do not. For these reasons, prosthesis fitting must be viewed individually, considering past and current medical history, past and current physical and psychological function, the patients’ goals and objectives, as well as the other psychological, social and environmental difficulties that they have to face. This individual approach is commonly cited among prosthetic prescription literature (Billock, 1996).

However, one thing that has been shown from this study is that opinions differ from one service to the next as what are the most important predictors of prosthetic prescription; which factors need to be measured individually to determine prescription. These differences in opinion highlight a need to standardise the prescription process and to include the opinions of patients and service users to improve prosthetic fitting and the quality of care. By combining opinion it is hoped
that the best possible solution is achieved. So while it is clear that prescription must be conducted on an individual basis, it will still prove useful to create a list of the most important factors within prescription so that the process is standardised rather than based on subjective clinicians’ judgements which are often accurate, but may not always lead to the best outcomes and user satisfaction. This process will also prove helpful in trying to pinpoint factors that could potentially be used as predictors of prosthetic use and thus reduce prosthesis abandonment and optimise use after prescription. The aim is not to develop a universal intervention for every individual, but to create an applicable, standardised way to approach prescription that will identify which individualised interventions need to be applied.

4.5.3 Factors Which Optimise Prosthesis Use

In terms of optimising the use of the prosthesis, the findings were subdivided into different headings: Acceptance, Prosthesis Fit, Goal setting and Service Provision. The aim was to identify factors in the prosthesis fitting service that optimise the outcomes for the service user. Unexpectedly a large amount of data regarding the impact of service provision on optimising outcomes emerged. Only a handful of studies have looked at the influence of service provision on lower limb prosthesis satisfaction. Van der Linde et al (2007) looked at how participants rated factors in relation to service delivery regarding how important they were and their personal experience of them in the authors’ limb fitting service. They found that in terms of importance, it was most important for the prosthetist to be up to date with new technology, for prescription of the limb to be on time, for time to be given to get used to new prostheses, for information to be given on changes that may need to be made in the future, and for the care providers to have good knowledge on prosthetic prescription. These findings are similar to those within this study, especially in relation to prescription being on time, and time being given to get used to the new prosthesis. It was important for users in the current study to not only receive a well-fitted prosthesis in the quickest time possible to prevent extended non-use of a prosthesis or use of an ill-fitting prosthesis, but also feel that they were considered in
the prescription process and that time was being taken to provide the best individualised options.

In terms of experience, Van der Linde et al concluded that they needed to give more attention and information to users about the existence of patient associations, the aspects concerning costs of the prosthesis, cosmetic aspects of the prosthesis (especially shoes), the possibility to return to their old job, and the maintenance of the prosthesis. These were also similar to some of the findings from this study, though due to the participants being from a number of different fitting centres, the experiences differed from service to service; service users in some centres would have appreciated more information on what to expect from the amputation and where to look for extra support whereas others were happy with the information they received. Where these studies differed is in relation to complaints in the data relating to the state of facilities within the fitting centres. Users complained about how the infrastructure of the building in terms of privacy, space and accessibility could have an effect on how a patient interacts within fittings, and also whether they are likely to return to the fitting service. These then are factors that need to be considered to a greater extent than they have been before. Only one previous study has looked at similar factors, such as accessibility, privacy, equipment as well as the appearance of physical facilities (Geertzen et al., 2002). This was done using the SERVQUAL instrument (Parasuraman et al., 1985). Within this study, consumers rated the importance of these facilities as well as how they found them within their own service. Privacy, waiting room appearance, and fitting room appearance had a mean rating of either important or very important to those surveyed. While these findings are similar, there are no previous studies which examine how these factors could impact on prosthesis use. The current study has shown them to be important in aiding the fitting process for maximum results and also in encouraging users to avail of adjustments and new components when needed. Clearly more work is needed to improve facilities in all centres to encourage participation and return fittings. By
making the service more accessible, say with provided transport and flexible appointments, users are more likely to improve their outcomes.

Other issues raised in relation to service included the use of private contractors within a publicly run service. Some users felt that the use of contractors affected the range of components they were able to achieve, reduced the level of care and removed the MDT, a key part of the rehabilitation process. This was in contrast to contractor-employed prosthetists who felt they offered the same care as they would in a privately-run service, but were treated differently by other staff members because they did not have the same employer. These findings raise the question of including private business in a service that is also publicly serviced and the impact on patient outcomes. There has been little research to date, and what is available is related to the implementation of contracted health service in developing countries, and has mixed findings that are affected by a number of uncontrollable variables (Mills, 1998). If care is to be optimised, there is a need for the public services that contract out the fitting service to remain accountable for the care the contractors provide. Having more interested parties in improving service evaluation could potentially improve service.

The fit of the prosthesis was also identified by users and providers as an important factor in optimising use. Tellingly, if the prosthesis does not fit well or is uncomfortable, then the user is less likely to use it, and will also not be able to use it optimally. If the prosthesis is loose it may also cause a lack of confidence in walking ability and prevent users from going out and interacting socially. Many long-term users complained of bad-fitting that came from a shrinking residual limb, an unusual occurrence many years after amputation that seemed to arise from a new way to attach the prosthesis to the residual limb using rubber wraps.

There is currently no valid or reliable tool that can be used to measure socket fit and socket comfort (Smith, 2006) indicating how important it is for certified prosthetists
to know when there are problems and to fix them efficiently. It is also important for
the prosthetist to have a good relationship with the user so that when problems do
occur, the user feels that they can express themselves and offer opinions without fear
of rebuttal, a point that was important to improving service provision. However, the
Trinity Amputation and Prosthetic Experience Scales (TAPES) (Gallagher and
MacLachlan, 2000a) has been used previously to specifically measure satisfaction
with the prosthesis, measuring three specific domains: Functional Satisfaction
(including Reliability, Fit, Overall Satisfaction, Comfort and Usefulness), Aesthetic
Satisfaction (including Appearance, Shape, Colour and Noise), and Weight. The
Prosthesis Evaluation Questionnaire (PEQ) (Legro et al., 1998) also evaluates the
prosthesis and QOL, though in the areas of ambulation, appearance, frustration,
perceived response, residual limb health, social burden, sounds, utility, and well
being. While these two measures do not specifically relate to socket fit and socket
comfort, with the former used with the aid of check sockets to get the most accurate
results, they both have good reliability and validity and could prove useful in
determining user satisfaction with comfort.

Closely related to the factor of social support in the predictors section is the potential
effect of the family on optimising prosthesis use, which fell under the Acceptance
subheading. Users worried about how family members may deal with the
amputation, and it appeared that often family members were unaware of what to
expect from the amputation process and how they could help maximise potential.
Service providers also complained that family members could be too demanding on
the services as they were unaware of what the individuals would be able to achieve
with the prosthesis. These findings indicate that it may be useful to educate the
family as well as the patient within the service to make sure that everyone knows
what to expect. Providing family counselling and education within the service may
aid all concerned individuals to adapt to the idea of the amputation. If a family is
informed of what an individual can achieve, and what an individual is looking for in
terms of support, it may prove useful when adapting to using the prosthesis. In the
AT literature, it has been stated that due to the importance of context for the use of the AT in social interactions, it is important that AT is considered efficient not just by the user, but also those who interact with the user, for AT to be used (Johnston and Evans, 2005). Thus previous information on what to expect from the prosthesis may aid acceptance from family members.

Information provision was often mentioned among the data and not just in relation to family members. Service providers were keen to make sure that users were fully informed of what the amputation process involved and what they could expect from the rehabilitation with a prosthesis. They noted that trying to handle the false misconceptions about how well a patient was going to do was a common problem on their job and they felt more information throughout the whole process, from amputation to rehabilitation, could contribute to resolving this issue. Similarly, patients felt that they were misinformed at several stages of their rehabilitation by various people and that in some cases they were not aware of what to expect, or what was going to happen to them. Sjodahl et al. (2008) had similar findings with amputation patients who felt that they lacked information in the acute phase of their amputation, specifically with clarifying certain information and increasing communication between service providers and users, leaving many feeling unprepared for the fitting process and the amputation. This indicates a need to standardise the information being given to amputation patients at all stages of their amputation so that the message given by all service providers is the same, and making sure all users are informed. A study on client-centeredness in rehabilitation provision (Ham and Cotton, 1991) found that by informing and educating individuals about their condition and their rehabilitation prospects, individuals felt more prepared to cope with their condition as well as participate in decision making about their treatment. If client-centeredness is to be considered an important factor in health care, then it follows on that providing information should also become important. Furthermore, studies with AT have noted that it is important for the user
to have information about the technology so that they may be included in the prescription process, a factor that is strongly linked to AT use (Wielandt et al., 2006).

Guidelines by the Committee on Quality of Health Care in America indicate that to achieve client-centred care in rehabilitation, six dimensions need to be met: respect for patients’ values, preferences and expressed needs; coordination and integration of care; information, communication and education; physical comfort; emotional support; and involvement of family and friends (CQHCA, 2001). These guidelines directly relate to the findings for optimising prosthetic use that emerged from the data. In order to optimise the outcomes for patients and users, it appears to be standard to follow many of the recommendations made from this study, regardless of whether in prosthetic provision or any other facet of rehabilitation or health.

4.5.4 Strengths and Limitations

There were strengths to this study. By combining both user and service provider data a unique insight was offered into what is important when prescribing a limb. Notably, there was not a large difference in opinion on what were considered the main outcomes and predictors, but having the two different viewpoints offered the chance to examine the prescription process, how it takes place and how it affects the individual, from both sides of the limb fitting process. Furthermore, where differences did occur it was clear that by gaining both user and provider information a greater understanding of the prosthesis prescription process was gained.

It was clear from the data that differences can exist between the expected potential of patients derived from physical predictors and the eventual outcomes of those patients. Differences in opinions between the two groups did occur, such as in important outcomes, highlighting the need to not only include users within the goal-setting process of rehabilitation, but to also ensure that users are actively involved in the goal-setting. Findings such as this further support the notion that physical factors need to be supplemented with psychosocial information if prosthetic
prescription is to be optimised, while also supporting the individualised approach to prosthetic fitting.

The use of focus groups to collect data among service users proved a successful data collection method due to the large amount of data generated on a wide variety of different subjects. Participants enjoyed the experiences, swapping tips on how they dealt with various problems, supporting others within the group with their own advice, and using the opportunity to express their likes and dislikes of the service in a setting that was non-threatening. The focus group process also created unique social situations within each group which brought about different topics for discussion and steered the data collection. For instance, in one group consisting entirely of women, many of which would be considered younger prosthetic users, the participants were comfortable enough to discuss sexual relationships and the effect of wearing a prosthesis, while in other groups this topic was barely mentioned. Certainly the coming together of many users from the same service facilities was a chance for individuals to discuss their service with others in a similar situation.

Within the service provider interviews, all the participants were happy to share their knowledge of the field and to discuss any issues that they felt needed to be remedied within the service. Furthermore, some felt that they were made to think about their decision making in their jobs and why they make the decisions that they do.

This section of research has shown that there are a number of outcomes and predictors of prosthetic prescription that are important to both service users and providers. Some of these have been addressed before in previous research, such as coping strategies and residual limb condition, though there were a number which have not been looked at before in specific prosthetic literature and are a new findings in relation to amputation rehabilitation and prosthesis provision. These include looking at users ‘reaching their potential’ as an outcome, the decline with
age and illness as a predictor of prescription, the effect of family on prosthesis use, the problems arising from using private contractors in a publicly funded service.

However, as discussed, previous research within other related fields of healthcare such as AT, have indicated the potential for these outcomes and predictors to be further addressed in relation to prescribing prosthetic technology. Factors which have been successfully associated with AT use may have a similar effect with prosthesis use, so while unique to this study, may prove essential to consider in optimising the use of prosthetic technology. The identification of these new factors may aid improvement of prosthetic prescription and prevention of non-use if they are found to be important and relevant to prescription in further research inquiries.

4.6 Conclusion

The sheer amount of data generated indicates that there are still inconsistencies in what different service providers and service users consider important when prescribing a prosthetic limb. It would then be profitable to gain a consensus among a group of experts on the most important outcomes of prosthetic prescription, the most important predictors of prosthetic prescription, and which factors are useful to identify in order to optimise the use of the prosthesis. By gaining this consensus more efforts can be placed on deciding how to optimise these factors for individuals, as well as providing substantiation to permit a borderline patient to go through prosthetic prescription, and on the decision making choices for prosthetic prescription for third-party insurance payouts. Consensus would also importantly direct future prosthetic prescriptions to provide the most suitable components for an individual and prevent loss of resources on unsuitable technology due to over prescribing or under prescribing.

While the above findings are important and relevant to prosthetic prescription, it is still necessary to further clarify which of the outcomes, predictors and optimising factors of prosthetic prescription are the most relevant to address in the prosthetic
rehabilitation and fitting service. Due to time and resources constraints with patients in modern healthcare, it is not feasible to address all the factors identified in this study, and furthermore it may not be required. Identifying the most important factors in relation to prosthetic prescription may lead to decrease in time and resource wasting on unnecessary measurements of factors which are not deemed to have as great an effect on prosthetic use. Therefore, the next step of this research is to gain a consensus on the most important outcomes, predictors and optimising factors of prosthetic prescription. This will be done using a Delphi study.
Chapter 5: The Delphi Study

Aim: The aim of this part of the study is to create a consensus from a panel of experts on what are the most important outcomes of lower limb prosthetic prescription, the most important predictors in prosthetic prescription, and the most important factors in optimising the use of prosthetic limbs. This will be done using an online based Delphi study.

5.1 Introduction

A large amount of data concerning prosthesis prescription and use was generated by the focus groups and interviews. However, it is still undetermined how important these data are with regard to the prescription process: is every factor of the same importance within the process, or are some more important than others? Due to the time restrictions placed on those working within the rehabilitation setting it is important to ascertain which of the factors generated within the qualitative data collection are most important to measure and identify prior to prosthesis prescription to optimise prosthetic use and prevent non-use of the technology. Similarly, by identifying the most important outcomes of prosthetic use of those identified previously, providers of prosthetic technology are able to have definitive aims to achieve and measure.

One of the ways to determine which of the factors are considered the most important and influential in prosthetic prescription is to gather expert opinions systematically. Systematically combining available evidence-based literature and expert opinions has been defined as creating knowledge-based measures (Campbell et al., 2000). Formal consensus methods offer the ideal means by which to do this. These methods have been defined as “group facilitation techniques designed to explore the level of consensus among a group of experts by synthesising and clarifying expert opinions” (Campbell and Cantrill, 2001, p.5). Their main purpose is to define levels of agreement on different subjects by a group of experts. On many important health issues, there can be a relatively small group of acknowledged experts whose
knowledge and opinions can guide best practice in relation to the issues of concern; sometime a large survey would not be appropriate (de Meyrick, 2003). Group judgments of professional opinions are also noted to be preferable to individual practitioner judgments because they are more consistent and less prone to personal bias. Furthermore, advocates of consensus methods suggest that, when properly used, consensus methods can create structured environments in which experts are given the best available information, allowing their solutions to problems to be more credible and justifiable than otherwise (Fink et al., 1984).

Formal consensus methods have become more common as tools for solving problems in health and medicine. They have been used to develop guidelines for topics as varied as prescribing psychotropic medication in mental health settings (Pope et al., 2002), identifying essential elements for assessing person with neurological impairment for computer access using assistive technology (Hoppestad, 2006) and best practice with youths who are sexually abusive (Hackett et al., 2006). Consensus methods have also been widely used as part of the development of ICF core sets for various different disabling conditions (Stucki et al., 2002), most notably with patients with chronic health conditions (Weigl et al., 2004), diabetes mellitus (Ruof et al., 2004) multiple sclerosis (Khan and Pallant, 2007) and intervention categories for physical therapy (Finger et al., 2006).

Currently, there are a number of different formal consensus methods available to use within research, such as the Nominal Group Technique (NGT), the RAND Appropriateness Method (RAND) and the Delphi Technique (Delphi). The NGT is best described as a structured meeting which uses an ordered procedure to create consensus among target groups close to the problems (Fink et al., 1984). The procedure involves silent generation of ideas, round-robin feedback from each group member to record ideas, group discussion of each idea in turn for evaluation and clarification, individual voting on priority ideas, and feedback of the results, with further discussion and voting (Campbell and Cantrill, 2001). The RAND is
described as a formal group judgement process which systematically and quantitatively combines expert opinion and scientific evidence gained from a systematic literature review. Indicators are created by the researchers and then rated by a select group of experts by a postal survey which also includes the available evidence. The panel then meet to further discuss their ratings and the indicators and further ratings are collected. Final analysis of ratings is carried out to develop recommended indicators or criteria. While both these methods have their own particular strengths and weaknesses, it was decided that for this study it would be most beneficial to use the Delphi Technique to gain a consensus on how to optimise prosthetic prescription. An outline of the technique and the reasons why it was chosen over other consensus methods is discussed in subsequent sections.

5.2 The Delphi Technique

The Delphi Technique is based on the premise that “two heads are better than one”, and that pooled intelligence enhances individual judgement and captures the collective opinion of experts (Linstone and Turoff, 1975). It has been recognised as an effective method for reaching consensus (Hung et al., 2008). It involves sending a questionnaire (structured or unstructured) to an “expert panel” of respondents, then collating the responses to create a revised questionnaire which is then re-circulated to the panel along with a summary of the results. Panellists may then modify their previous response if they wish. This process is repeated until research purposes have been fulfilled. The Delphi is therefore distinguishable from other formal consensus methods due to a number of distinct characteristics:

- **Repetitive Process:** Those who take part in the Delphi have to participate in a number of rounds where they rate various statements, or fill out questionnaires individually. The least amount of rounds that can exist is two.

- **Controlled Feedback:** After each round, feedback is given to each participant on how their ratings compared to others within the expert group as well as justifications from other panellists as to why they rated a statement in a certain way. This feedback can be both statistical and qualitative.
• **Opportunity to Modify Judgments:** Each participant may reconsider their answer on previous rounds in light of the information gained from the controlled feedback. This possibility allows for consensus to be reached after a number of rounds.

• **Anonymity:** Experts who participate in a Delphi are polled individually and anonymously. Each participant is not aware of who the other participants are, and comments are not attributed to any person. Identities are however known to the researcher so that records can be kept of who has participated in each round and results can be fed back.

In their seminal work on the Delphi, Linstone and Turoff (1975) outlined a number of reasons why a Delphi approach would be used in research, such as having a research population that presents diverse backgrounds with respect to experience and expertise or a research problem that does not lend itself to precise analytical techniques but can benefit from collective subjective judgments. These reasons make the Delphi Technique an ideal method for gaining consensus on the important factors involved in optimising prosthetic technology; the area has a number of different disciplines working within it and outcomes tend to be subjective in nature rather than objectively measurable. Furthermore, the Delphi offers the opportunity to include a large number of experts from geographically diverse places, an opportunity that is not necessarily available with consensus methods that involve a meeting of all participants, such as the NGT and the RAND.

The use of the Delphi offers the opportunity to obtain a broad spectrum of opinion which, due to the iterative process of the method, recreates the sharing of views and opinions that would occur if practitioners had been brought together in a group (Hackett et al., 2006). This may thus help highlight the key issues within this area (Hartman and Baldwin, 1995). A Delphi study has been used previously within the prosthetic sector to successfully develop national clinical guidelines for prescription of lower-limb prostheses in the Netherlands (Van der Linde et al., 2005), a study
which focuses on prescribing specific prosthetic components to individuals based on physical factors alone.

5.2.1 Strengths
The distinctive characteristics of the Delphi mean that it can be viewed as having a number of strengths. To start, by making the expert panel member anonymous, it provides individual participants with a considerable amount of freedom to express their opinions on a subject (de Villiers et al., 2005). Anonymity also removes the effect of status, group pressure and powerful personalities which can arise in meetings (Mullen, 2003) and can lead to the reconsideration of an originally expressed viewpoint without a ‘loss of face’ (SumSION, 1998) and without having to defend their initial position (de Meyrick, 2003) indicating that consensus may be more achievable. However, the use of anonymity means that there is the possibility that as no individual is accountable to their responses, so may not make considered answers (Sackman, 1975). While this is a notable problem, others have commented that if the commitment and understanding of the aims of the study are clarified from the outset, there may be a reduction in the risk of it occurring (Goodman, 1987).

The repetitive processes involved in a Delphi are a further strength to the method as they allow individuals to change opinion on certain issues and lead the group towards consensus and final decisions, a quality that has been judged as important in the future development of health research and for the acceptability of the results obtained from the study (Wielandt et al., 2006). This process also means that more extensive consideration is given to each questionnaire through the simple fact that they are viewed more than once (Landeta, 2006). It has also been argued that as participants are not under pressure to express opinions as they would be in a group meeting, they have more time to consider their answer and reflect on all arguments given (Thomas, 1980). The feedback between rounds has also been noted to widen knowledge, stimulate new ideas and can in itself be highly motivating and educational for the participants (Powell and Myers, 1995).
Another strength to the Delphi, which has been utilised in this study, is that it enables the researcher to access a larger field of experts as they do not need to be brought together for a meeting to create consensus. This means that researchers from a wide range of disciplines and countries can offer expert opinion on a topic, creating a wider knowledge base and offering opinions from different perspectives that could be invaluable to getting the best and most applicable results from the study.

Despite the strengths mentioned above, many criticisms do arise from how regulated the method is and how this affects its validity and reliability (Mullen, 2003). These will now be addressed.

5.2.2 Methodology Issues

5.2.2.1 Expert Panel
A Delphi does not depend on a representative sample of the population, but instead requires qualified experts with a deep understanding of the issues under study (Okoli and Pawlowski, 2004). However, much has been made about the labelling of the panel as “experts”. What exactly is an ‘expert’ and how is it decided that someone has ‘expert’ enough opinion to be included in the panel? Literature around the expert panel acknowledges that it is important to choose the right kind of person: “it is crucial to secure the participation of the right kinds of experts, who understand the issues, have vision, and represent a substantial variety of viewpoints” (Czinkota and Ronkainen, 1997, p.829).

Sackman (1975) has questioned whether responses from ‘experts’ would be significantly better than responses from ‘non-experts’ who are suitably informed. Certainly Pill has suggested than an ‘expert’ should be defined as anyone with a relevant input (Pill, 1971). However, since so much criticism can be levelled at the choice of experts used, Cook and Frigstad (1997) recommend using expert
knowledge that is “widely recognised and can be verified…A Delphi sample is a census of relevant decision makers (p.28).” Furthermore a rigorous selection process developed by Delbecq et al (1975) for a nominal group technique was used successfully for the selection of an expert panel for a Delphi (Okoli and Pawlowski, 2004) and provides a reliable method of expert selection that stands up well to scientific scrutiny. It involves identifying relevant organisations, literature and disciplines or skills. Individuals in each of these are then contacted and asked to name further experts. This list of names are then put together and ranked based on qualifications. Experts are then invited to take part, starting with those with the highest qualifications, until the panel size wanted is achieved.

Keeney et al (2006) alternatively argue that there is no magic formula to help researchers decide on who is considered an expert, but that the decision is often based on funding, logistics and rigorous inclusion and exclusion criteria. Certainly in many health-related areas, the identity of experts is commonly acknowledged within the circle of health professionals meaning that the Delphi panel can be swiftly and uncontroversially recruited (de Meyrick, 2003). Many studies have not stated how their experts were recruited as experts, but indicate how they could be concluded as experts by indicating their profession or length of experience of the subject (O’Hara et al., 2000, Wemeke et al., 2005). It appears then that the key is to describe the panellists fully so that independent judgements may be made about their credibility (Powell Kennedy, 2004) and how that may effect the validity of the research.

Further issues with the panel of experts relate to the size of the panel as well as to the make-up of the panel. There are many different sizes of panels noted within the literature on Delphi, ranging from 15 people to studies that have included thousands of people (Burns, 1998, Linstone, 1978). It is important to note that accuracy deteriorates rapidly with smaller sized panels and improves more slowly with large numbers (Mullen, 2003). Increasing the group size beyond 30 has also seldom been
found to improve results (Fink et al., 1984), suggesting that it may be more beneficial to have experts numbering in the tens rather than the hundreds or thousands.

In terms of the make-up of the panel, representative sampling techniques, even among a group of experts, may be inappropriate (Beretta, 1996) and it should be noted that the Delphi “is not an opinion poll” (Helmer, 1977), so representative sampling is not necessary. Some studies require panels that include a wide range of interests and disciplinary viewpoints. Indeed, Linstone and Turoff (1975) list studies where the “heterogeneity of the participants must be preserved to assure validity of the results” (p.4), which then led to the need to employ Delphi. In terms of different viewpoints, it appears that having persons from different disciplines and background may be beneficial for the study: Pills suggests (1971) that “many innovations and real breakthroughs…occur from outside a discipline or specialty”, adding that “one asset of the use of a group is the diversity of opinion they bring to bear thus minimizing the possibility of overlooking some obvious facet of a question” (p.62). Other Delphi studies in healthcare have used this approach, by including experts from a number of different professions and in some cases also including patients (Marsden et al., 2003, Khan and Pallant, 2007, Weigl et al., 2004, Petry et al., 2007).

Issues also arise around those who would volunteer to take part in the study. If individuals are to be affected directly by the decisions made after the Delphi process, they are more likely to become involved in the process, leading the technique to be open to researcher and to subject bias (Hasson et al., 2000). Importantly, group members who are familiar with or use various interventions or patterns of care are more likely to rate them higher (Coulter et al., 1995, Campbell et al., 1999). However, it could be argued that any bias reflected by an individual within the panel may be overcome by the process of reaching consensus: if the bias is not in keeping with the rest of the group then it will not be reflected in the final results of the
Delphi. Furthermore, how is someone who is supposed to be an expert in the field not able to be affected by decisions made in the field?

It has been shown that doctors who agreed to participate in an expert panel were representative of their colleagues (Gillen et al., 2001) so it seems unlikely that those who volunteer to take part are very different from those who do not. That said, it is still important for consideration to be made on the panel composition as there is potential for it to affect the Delphi results. Campbell and Cantrill (2001) state that the panel must reflect the stakeholders it is intended to represent, which in health research can include academics and specialists in the field as well as those who are based in the clinical setting. Certainly it has been noted that in the development of ICF core sets the membership of the consensus process strongly determines the content of the core sets (McIntyre and Tempest, 2007), indicating the need to have a wide range of different experts to cover all relevant topics.

With the increasing identification of client-centeredness as important within health care and rehabilitation (Ham and Cotton, 1991), it is then necessary to include the patient as an expert when devising the important factors when optimising rehabilitation practice and outcomes. Jones and Hunter (1995) have suggested the use of patients in certain situations where lay input will be valuable and in the case of this study it would be necessary to continue to include user opinion in data collection to optimise the findings generated. Also, considering that patients and prosthesis users should be “decision makers” within prosthesis prescription, they are then relevant experts within this Delphi study.

5.2.2.2 Consensus
The issue of consensus is one of the most contentious components of the Delphi (Crisp et al., 1997). While achieving consensus is seen as one aim of the technique, it would be difficult to gain 100% agreement on all the issues (Keeney et al., 2006). Therefore, it is clear that not all Delphi studies may seek to obtain consensus, rather
to determine the extent to which a panel of experts agree or disagree about a given issue (Jones and Hunter, 1995). Crichter and Gladstone (1998) also suggest that the intended outcome of a Delphi may include: identifying the degree of consensus or dissensus (that is, the convergence of views among panellists), revealing the rationales that lie behind different judgements, or specifying the range of different positions on a subject. A number of researchers have tried to define consensus and have identified two key elements: convergence and stability (O'Hara et al., 2000). Stability refers to a consistency of responses across rounds.

Whatever the aim of the study, there are currently many kinds of criteria for describing when consensus is reached with no firm rules available (Fink et al., 1984). This lack of specific guidelines is one of the greatest critiques levelled at the method (Crisp et al., 1997, Mullen, 2003, Landeta, 2006). Therefore it is good practice for the researcher to decide what percentage of agreement they would consider as synonymous with consensus and to outline this clearly before starting the research (Keeney et al., 2006). It is also important to realise that when ascertaining agreement, that a high percentage of agreement amongst the panel members does not mean that the ‘right’ answer has been found but just that experts agree with it (Jones and Hunter, 1995).

In studies related to health care and prescription research, consensus has been found with

- ≥70% agreement (de Villiers et al., 2005),
- ≥75% agreement (Wielandt et al., 2006, Hoppestad, 2006, Van der Linde et al., 2005),
- ≥80% agreement (Finger et al., 2006, Petry et al., 2007, Green et al., 1999),
- ≥90% agreement (Avery et al., 2005) and
- 100% agreement (Pope et al., 2002).
Some studies have also reported whether items had overall consensus (≥80% agreement), approaching consensus (≥60% agreement) or overall divergence (<65% agreement) (Hackett et al., 2006), rather than just reporting items that made consensus, and also presented all proportions of responses for each item rather than choose a cut-off point (Werneke et al., 2005). Other methods of defining consensus include

- a mean rating of 4.0 or over on a 5-point Likert scale along with a low standard deviation (Whitehead, 2008),
- a mean rating of 3.7 or over on a 5-point Likert scale with a high standard deviation, indicating a statement is controversial (Karmarker et al., 2009),
- discarding the lower rated items in a Likert scale (Campbell et al., 1999), and
- items with an overall median of 8 or 9 on a 9-point Likert scale (Campbell et al., 2000).

One study included items that were below a benchmark of 80% as the items warranted inclusion due to analysis of respondents comments, overall percentage, distribution of responses, and a limited number of negative ratings (Hoppestad, 2006). Another study took into account the percentage agreeing with an item, the median and the interquartile range to determine the strength of consensus for each item (Hackett et al., 2006). This allowed the researchers to separate items into categories such as items achieving overall consensus, items that were approaching consensus, and items that had overall divergence.

5.2.2.3 Validity and Reliability

The Delphi has been criticised for its lack of psychometric validity and reliability, (Sackman, 1975), although it has since been argued that this criticism dates from the qualitative versus quantitative debate, and it can be argued that Delphi straddles the divide between qualitative and quantitative methodologies (Crichter and Gladstone, 1998). Lincoln and Guba (1985) have suggested that criteria for qualitative studies could be applied to the method to encourage credible interpretations of findings (de Meyrick, 2003, Hasson et al., 2000). These criteria are credibility (truthfulness),
fittingness (applicability), auditability (consistency) and confirmability. This approach means that while the method may not fit into the conventional metrics of quantitative research, it may still be considered as a robust and valid method of scientific enquiry with similar strengths to many other scientific qualitative research methodologies. While criticisms of the Delphi do exist these can be addressed by a rigorous approach to the method. Contextualising the results by reporting as much about the method as possible and enhancing and expanding on the results by linking them to previous findings or observable events may add greater strength to the validity of the findings (Powell Kennedy, 2004).

5.2.2.4 Quantitative or Qualitative?
There is some debate as to whether the Delphi method is considered a qualitative or quantitative method. Arguably it would seem to rest on how the initial first round of enquiry is undertaken. In some instances, the first round of inquiry would consist of open-ended questions for the panel which would then be thematically analysed to put together a more structured questionnaire for the second round of the Delphi (Powell and Myers, 1995). This approach obviously incorporates a qualitative element to the Delphi, but there is also the opportunity for the research team to start the Delphi with a structured questionnaire developed from an extensive literature, a sub-panel of ‘experts’ or by the research team (Mullen, 2003). This formulation would seem to eschew the need for a qualitative approach.

It is important to note that there is a small qualitative element to the Delphi even if the first round is quantitative in nature. Feedback is collected from any participant who does not agree with a particular statement. This information is then fed back to the rest of the panel to use for the second round of the study. This is an important part of the study as it highlights the reasons for disagreement with a certain item and also may affect the consensus generated in further rounds. It is also important to know the disagreements to the consensus because as mentioned previously, what is considered correct by consensus may not be the correct answer (Mullen, 2003).
Furthermore, it is important to gain reasons for non-consensus to maintain a rigorous approach to the research by contextualising all the results (Powell and Myers, 1995). Despite this small element of qualitative data collection, the Delphi remains predominantly quantitative in nature. The qualitative data is not analysed in any depth, and it could be argued that it is used mainly to create the next round of the survey and inform decision making, rather than contributing to the final results. Furthermore, the collected data, quantitative and qualitative, does not go through any stage of integration, and the qualitative data is not presented as part of the results.

5.2.2 Aim
The aim of this study is to create a consensus from a panel of experts on what are the most important outcomes of lower limb prosthetic prescription, the most important predictors in prosthetic prescription, and the most important factors in optimising the use of prosthetic limbs. This will be done using an online based Delphi study.

5.3 Method

5.3.1 Recruitment
A number of different individuals for the expert panel were identified from published literature, personal contacts and recommendations of the project management group, and the use of snowball sampling, which involved identified experts identifying other key stakeholders in the prosthetic field. This type of sampling was chosen as it meant that more people who would be considered experts could be contacted to take part in the study even if they were unknown to the research team, thus widening the sample. A number of Inclusion and Exclusion criteria were established to ensure all panellists could be considered experts.
Inclusion criteria

• Participant must currently work in some facet of service provision with the prescription and use of lower limb prostheses OR have been using a lower limb prosthesis for at least 2 years OR must have considerable recognised knowledge of the prescription of lower limb prosthetics through academic research or specialisation.

• Participants must be over 18 years of age so they are legally able to consent for themselves

• Participants must have sufficient spoken English for the demands of the study.

Exclusion criteria for interviews

• Individuals who are involved in the organisation of the study.

• Individuals who are not deemed to have sufficient experience in the prosthetic prescription process. This may be due to lack of experience of using a prosthetic limb or lack of knowledge of the prescription process. All potential respondents were asked to confirm their current involvement in practice and to individually decide if they were eligible to offer expert opinion.

Individuals who met the inclusion criteria were contacted by email prior to the start of the study to inform them of what they were expected to do as part of the study and the expected duration of the study, and to gain their informed consent to partake in the study (Appendix L and Appendix M).

In total, 81 experts were contacted to take part in the Delphi. Of these, 26 completed the first round of inquiry, 23 completed the second round and 21 the third round. Reasons given for non-participation included not being an expert in the field (n=1), not agreeing with the Delphi process (n=1) and not having sufficient time to complete the surveys (n= 7). Other contacted individuals did not reply with a reason.
Reasons given for drop out were related to the length of the survey, although in one case a participant had died before the third round could be administered. These response rates are typical of previous studies, with Hoppestad (2006) getting 33 participants out of 83 contacted, Campbell et al (2000) getting 99 participants out of 305, and Finger et al (2006) reporting only 263 participants out of a potential 6200. Other studies have also reported doing studies with approximately 20 participants (Avery et al., 2005, Pope et al., 2002, Marsden et al., 2003).

In terms of the composition of the first round group (n=26), 18 were female, 8 were male, 18 were prosthetic practitioners and 8 were prosthetic users. Of the users, 5 had a unilateral transfemoral amputation, while 3 had a unilateral transtibial amputation. The time as prosthetic user ranged from 2 years to 38 years, (\(\bar{X} = 12.31\) years, \(\sigma = 12.40\)). Of the practitioners, 9 were physiotherapists, 6 were an academic/researcher in prosthetics, 3 were prosthetists, 3 were consultants in rehabilitation, 3 lectured in prosthetics, 2 were clinical psychologists in rehabilitation, 2 were doctors in rehabilitation, 1 was an occupational therapist, 1 was a counsellor in rehabilitation and 1 was a rehabilitation engineer. Years of experience working with prosthetics ranged from 2 years to 53 years, (\(\bar{X} = 17.47\) years, \(\sigma = 11.47\)). Participants were predominantly from the UK (England, Scotland, and Northern Ireland were named individually) (n=15), but also the United States of America (n=5), Canada (n=3), Sweden (n=1) and The Netherlands (n=1). Tables outlining the composition the participants over the three rounds are located in Appendix N.

### 5.3.2 Level of Consensus

As discussed earlier, it is important to establish what is meant by consensus prior to the commencement of the study and what percentage of agreement is needed within the study to conclude that a high level of consensus has been achieved. Establishing this percentage is crucial as it determines which items are retained or discarded as the rounds of the Delphi progress. Although consensus levels have been reported as
low as 51% (Loughlin and Moore, 1979), 100% agreement may be desirable for deciding procedures in life or death situations (Keeney et al., 2006). While there is no definite rule on the percentage of consensus needed, most studies tend to use a cut off rate of 70-80% agreement on an item at a certain rating, usually the higher end of a Likert Scale, to include it in the next round of the Delphi.

It was decided to use a 5-point Likert scale in this study to rate how important each item is in prosthetic prescription and outcomes (1=very unimportant, 2= unimportant, 3= neither important or unimportant, 4= important, 5=very important), or how useful it is to consider it in optimising the use of the prosthetic limb (1= not at all useful, 2= not really useful, 3= somewhat useful, 4= useful, 5= very useful). This method was chosen as it is the most simple to use, is clear, and is the most commonly used method of ratings within the studies mentioned previously. A 5-point scale, rather than a 7-, 9- or 10-point scale was chosen so that answers were clearly distinctive from each other. The scale was also labelled to make sure that all panellists were using the same scale. For an item to be considered important for prosthesis prescription or for optimising use in this study, it had to have an average rating of 4.5 or higher, without any negative ratings i.e. ratings of 1 or 2. Items which also had an 80% agreement on importance, with an average rating of 4.0 or higher, again without negative ratings, were also included as important. This was done to ensure that only items which had the most agreement on importance or usefulness were included, but also to ensure that items which had not achieved many ratings of 5, but had many ratings of 4, were not excluded. When an item was considered important, it was removed from the next round of the survey. Items which reached consensus on unimportance, that is with an average rating ≤2.0 and 0% of positive ratings were also removed.

This approach to consensus was chosen as it leaves less of a chance to a false consensus being created (the one negative rating could be the right one), and it creates a list of the definitive most important factors, rather than listing them in
order of importance (e.g. This item had very good agreement, this item had good agreement, this item had moderate agreement etc.). This approach encourages viewing the items considered important as a collective, rather than as a list from most important to least important, therefore avoiding considering each item as important to some degree.

Creating a consensus from the method, while desirable, was not necessary across the rounds, though rationales for divergence from the norms of the panel were sought and examined. Therefore, while we were looking to gain a consensus, it was important to this research to ascertain all viewpoints, positive and negative, and build a knowledge base that is accurate rather than based on inaccurate agreement falsely created by the method.

5.3.3 Ethical Considerations
Ethical approval for this part of the study was obtained from Dublin City University Research Ethics Committee. With regard to anonymity and confidentiality, it is important that at least quasi-anonymity is maintained throughout the study, that is, the panellists are not known to one another throughout the study, but will be known to the researchers to aid the feedback process (Keeney et al., 2006). No participant was identified by name and each participant was assured of confidentiality and that they would not be identified in any published material arising from the research. There was also a need to maintain that all those who took part in the study were giving informed consent for their participation. All participants were given an information sheet detailing all aspects of the research study before agreeing to take part so that they had adequate time to read and understand the form, as well as pose questions to the researcher if needed (Appendix O and Appendix P). They were also offered the right to leave the study at any time and withdraw their consent without reason. Consent was also asked for at the beginning of each online survey. Without consent, the participant was unable to progress and complete the survey. Names were taken only at the beginning of each survey collection so that data could be fed
back accordingly. All data has been kept confidential and secure. All computers that have project information on them are password protected.

5.3.4 Procedure
A diagram of the full procedure is in Figure 5.1.

5.3.4.1 Round 1
Once participants had agreed to take part, the first questionnaire was sent out to all the participants to fill out. In this study the Delphi was conducted using email contact and directing participants to a web link (www.SurveyMonkey.com) which provided an electronic version of the questionnaire, rather than posting the Delphi surveys. This process had been used successfully before (Brill et al., 2006) and it has been ascertained that while emailing questionnaires is possible, it may sometimes lead to different technical problems (Snyder-Halpern et al., 2000), meaning that using a web link would be the best way to administer the questionnaire electronically. Furthermore, the creation of an online survey provides a quicker way to obtain and collate data than using a mailed survey. It was decided that as focus groups and interviews had been conducted prior to the Delphi study, the first round of the Delphi would not consist of open-ended questions but would be a structured questionnaire based on the data from the previous study. The questionnaire sent out in Round 1 is in Appendix Q.

A total of 86 items were generated for rating in the survey. These items were split up into 8 different sections: Outcomes (n = 10), Age and Illness Predictors (n = 6), Physical Condition Predictors (n = 10), Psychological and Social Predictors (n= 17), Acceptance and Goal-Setting Optimising Factors (n = 8), Social Optimising factors (n = 12), Prosthesis Optimising Factors (n = 5) and Service Optimising Factors (n = 18). Participants were asked to rate each item on a 5-point Likert scale as either how important it is as an outcome of prosthetic fitting, how important it is as a predictor of prosthetic fitting, or how useful it is to consider in optimising prosthesis
Figure 5.1: Diagram of Delphi survey construction (Adapted from Baker et al (2002))

Items created from focus group and interview study and literature review

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>Predictors</th>
<th>Optimising Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>n = 10</td>
<td>n = 33</td>
<td>n = 43</td>
</tr>
</tbody>
</table>

**Round 1** – item rating on 5-point Likert Scale (n = 86)
New items generated by participants (n = 39)

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>Predictors</th>
<th>Optimising Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>n = 14</td>
<td>n = 38</td>
<td>n = 33</td>
</tr>
</tbody>
</table>

**Round 2** – item re-rating on 5-point Likert Scale and rating of new items (n = 85)

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>Predictors</th>
<th>Optimising Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>n = 10</td>
<td>n = 9</td>
<td>n = 24</td>
</tr>
</tbody>
</table>

**Round 3** – Item re-rating on 5-point Likert Scale n = 43

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>Predictors</th>
<th>Optimising Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>n = 5</td>
<td>n = 1</td>
<td>n = 2</td>
</tr>
</tbody>
</table>

Important Outcomes n = 13
Important Predictors n = 19
Useful Optimising Factors n = 34

Items that reached consensus removed n = 40
Items that reached consensus removed n = 19
Outcome and predictors rated twice excluded n = 23
Items did not reach consensus removed n = 35
All items that reached consensus combined n = 66
use. They were also asked to leave a comment explaining their choice if they gave a negative rating (<3). Suggestions of any important items that might be missing from the questionnaire were also requested. The panellists were given 6 weeks to complete the questionnaire and were reminded of the study 3 times before the time limit ended.

5.3.4.2 Round 1 Analysis
Once each questionnaire was completed, data was collated to get an idea of which items were believed to be the most important in optimising prosthetic limb prescription. The means for each item were calculated to show the group opinion of the panel, and the percentage of replies to each response (1-5) were also calculated to ascertain which items reached consensus on being important or useful within prosthetic prescription and optimising use. These results are presented in Table 5.1 below. All comments received were also compiled for use in the next round of the study.

5.3.4.3 Results Round 1
A total of 26 people completed Round 1. For the first round, 39 items reached overall consensus on being important (≥80%+ ≥4.0). Gender was the only item that reached consensus on not being important: it had an average rating <2 and had 0% of replies as important. A further 12 items were deemed close to consensus (≥80% + ≥4.0 but had at least one negative rating). Other items were also close to consensus but in different ways: three items had ratings that averaged over 4.0 but did not have over 80% in agreement on importance or usefulness (Privacy in fitting room, Level of amputation, Not relying on a wheelchair), while another two items had over 80% agreement on importance or usefulness, but were less than 4.0 on average ratings (Respiratory illness and Coronary illness). However, these items also had negative ratings. These items will be administered again in Round 2.
The 29 remaining items received mean ratings from 2.27 to 3.92, and percentages ratings of importance/usefulness from 7.6% to 76.9%. A total of 39 new items were also generated for inclusion in the second round.

Table 5.1: Results of Round 1 of the Delphi

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Mean</th>
<th>% agreement</th>
<th>Negative rating?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improved quality of life*</td>
<td>4.92</td>
<td>100.0</td>
<td>no</td>
</tr>
<tr>
<td>Regaining independent movement (that is, movement without help of other people)*</td>
<td>4.85</td>
<td>100.0</td>
<td>no</td>
</tr>
<tr>
<td>Regaining sense of freedom*</td>
<td>4.73</td>
<td>100.0</td>
<td>no</td>
</tr>
<tr>
<td>Self-reliance*</td>
<td>4.73</td>
<td>100.0</td>
<td>no</td>
</tr>
<tr>
<td>Walking with safety*</td>
<td>4.73</td>
<td>100.0</td>
<td>no</td>
</tr>
<tr>
<td>Balance when walking*</td>
<td>4.69</td>
<td>100.0</td>
<td>no</td>
</tr>
<tr>
<td>Living at home rather than in care *</td>
<td>4.62</td>
<td>96.2</td>
<td>no</td>
</tr>
<tr>
<td>Meeting established rehabilitation goals</td>
<td>4.04</td>
<td>88.4</td>
<td>yes</td>
</tr>
<tr>
<td>Not relying on a wheelchair</td>
<td>4.00</td>
<td>65.4</td>
<td>yes</td>
</tr>
<tr>
<td>Meeting the expectations of health care providers regarding walking and physical ability</td>
<td>3.38</td>
<td>53.9</td>
<td>yes</td>
</tr>
</tbody>
</table>

Age and Illness Predictor Ratings Round 1

<table>
<thead>
<tr>
<th>Factors</th>
<th>Mean</th>
<th>% agreement</th>
<th>Negative rating?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decline of functional ability due to age or illness</td>
<td>4.08</td>
<td>84.6</td>
<td>yes</td>
</tr>
<tr>
<td>Respiratory illness (breathing-related illness)</td>
<td>3.96</td>
<td>88.5</td>
<td>yes</td>
</tr>
<tr>
<td>Coronary illness (heart-related illness)</td>
<td>3.88</td>
<td>88.5</td>
<td>yes</td>
</tr>
<tr>
<td>Many operations or amputation before fitting</td>
<td>3.58</td>
<td>69.2</td>
<td>yes</td>
</tr>
<tr>
<td>Reason for amputation (trauma V. illness/disease)</td>
<td>3.38</td>
<td>53.9</td>
<td>yes</td>
</tr>
<tr>
<td>Age</td>
<td>3.12</td>
<td>46.1</td>
<td>yes</td>
</tr>
</tbody>
</table>

Physical Condition Predictor Ratings Round 1

<table>
<thead>
<tr>
<th>Factors</th>
<th>Mean</th>
<th>% agreement</th>
<th>Negative rating?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Condition of the residual limb/stump*</td>
<td>4.54</td>
<td>92.3</td>
<td>no</td>
</tr>
<tr>
<td>Condition of contralateral limb (remaining leg condition, may also be amputated)*</td>
<td>4.50</td>
<td>100.0</td>
<td>no</td>
</tr>
<tr>
<td>Residual limb pain (stump pain)*</td>
<td>4.42</td>
<td>96.2</td>
<td>no</td>
</tr>
<tr>
<td>Physical ability previous to amputation</td>
<td>4.19</td>
<td>88.4</td>
<td>yes</td>
</tr>
<tr>
<td>Current physical ability</td>
<td>4.15</td>
<td>84.6</td>
<td>yes</td>
</tr>
<tr>
<td>Contractures (tightening of muscles in residual limb preventing flexible movement)</td>
<td>4.08</td>
<td>92.3</td>
<td>yes</td>
</tr>
<tr>
<td>Level of amputation (above knee v. below knee)</td>
<td>4.04</td>
<td>76.9</td>
<td>yes</td>
</tr>
<tr>
<td>Other pain (e.g. back or hip pain)</td>
<td>3.92</td>
<td>76.9</td>
<td>yes</td>
</tr>
<tr>
<td>Phantom limb pain</td>
<td>3.81</td>
<td>69.3</td>
<td>yes</td>
</tr>
<tr>
<td>Gender *</td>
<td>1.96</td>
<td>0.0</td>
<td>yes</td>
</tr>
</tbody>
</table>

* Items which reached consensus
## Psychological and Social Predictors Ratings Round 1

<table>
<thead>
<tr>
<th>Factors</th>
<th>Mean</th>
<th>% agreement importance</th>
<th>Negative rating?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social support*</td>
<td>4.46</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Motivation in rehabilitation setting*</td>
<td>4.46</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Determination to walk*</td>
<td>4.50</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Optimistic outlook/positive thinking*</td>
<td>4.42</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>Attending clinic regularly/returning for more fittings*</td>
<td>4.19</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>Feeling in control of the situation*</td>
<td>4.27</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>Enthusiasm for rehabilitation</td>
<td>4.27</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Ability to learn</td>
<td>4.12</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>Memory ability</td>
<td>4.00</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Anxiety</td>
<td>3.73</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Depression</td>
<td>3.81</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Addiction problems</td>
<td>3.85</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Avoiding acknowledging the situation</td>
<td>3.92</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Body Image issues</td>
<td>3.81</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Suffering from Post-Traumatic Stress Disorder</td>
<td>3.77</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Seeking help from others</td>
<td>3.77</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>Psychiatric disorder</td>
<td>3.58</td>
<td>no</td>
<td>yes</td>
</tr>
</tbody>
</table>

* Items which reached consensus

## Optimising Use: Acceptance and Goal-setting Factor Ratings Round 1

<table>
<thead>
<tr>
<th>Factors</th>
<th>Mean</th>
<th>% agreement usefulness</th>
<th>Negative rating?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Setting achievable goals*</td>
<td>4.65</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Making sure expected goals are achievable*</td>
<td>4.58</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Accepting the amputation as part of life</td>
<td>4.35</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Returning to work*</td>
<td>4.31</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Taking up a hobby</td>
<td>4.19</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Emphasising positives that have come from amputation</td>
<td>3.81</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Comparing self to those worse off</td>
<td>2.81</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Comparing self to those better off</td>
<td>2.27</td>
<td>yes</td>
<td>yes</td>
</tr>
</tbody>
</table>

## Optimising Use: Social Factor Ratings Round 1

<table>
<thead>
<tr>
<th>Factor</th>
<th>Mean</th>
<th>% agreement usefulness</th>
<th>Negative rating?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Family accept the amputation*</td>
<td>4.38</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Family understand limitations of user*</td>
<td>4.19</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Family accept and understand the expected potential of user*</td>
<td>4.19</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Establishing/Continuing romantic relationships*</td>
<td>4.12</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Type of job</td>
<td>3.62</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Receiving disability benefits/disability allowance from the State</td>
<td>3.58</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Place of residence</td>
<td>3.46</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Employment status</td>
<td>3.38</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Education level</td>
<td>3.31</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Self-consciousness with prosthetic in social situations</td>
<td>3.04</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Earnings</td>
<td>2.92</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Over protective family</td>
<td>2.81</td>
<td>yes</td>
<td>yes</td>
</tr>
</tbody>
</table>

* Items which reached consensus
**Optimising Use: Prosthesis Factor Ratings Round 1**

<table>
<thead>
<tr>
<th>Factor</th>
<th>Mean</th>
<th>% agreement usefulness</th>
<th>Negative rating? &lt;3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Having a comfortable prosthesis fit*</td>
<td>4.96</td>
<td>100.0</td>
<td>no</td>
</tr>
<tr>
<td>Confidence in walking ability and using prosthesis*</td>
<td>4.85</td>
<td>100.0</td>
<td>no</td>
</tr>
<tr>
<td>Feeling the prosthesis has become part of the user’s own body*</td>
<td>4.46</td>
<td>88.5</td>
<td>no</td>
</tr>
<tr>
<td>A shrinking residual limb (stump)</td>
<td>4.00</td>
<td>80.8</td>
<td>yes</td>
</tr>
<tr>
<td>Fear of falling due to loose prosthesis</td>
<td>3.92</td>
<td>73.1</td>
<td>yes</td>
</tr>
</tbody>
</table>

**Optimising Use: Service Factor Ratings Round 1**

<table>
<thead>
<tr>
<th>Factor</th>
<th>Mean</th>
<th>% agreement usefulness</th>
<th>Negative rating? &lt;3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limb alterations done in reasonable time*</td>
<td>4.88</td>
<td>100.0</td>
<td>no</td>
</tr>
<tr>
<td>Multidisciplinary support*</td>
<td>4.77</td>
<td>96.2</td>
<td>no</td>
</tr>
<tr>
<td>A returned leg is usable and altered properly for the user*</td>
<td>4.77</td>
<td>100.0</td>
<td>no</td>
</tr>
<tr>
<td>Patient and prosthetist relationship*</td>
<td>4.73</td>
<td>100.0</td>
<td>no</td>
</tr>
<tr>
<td>Limb alterations done on-site*</td>
<td>4.73</td>
<td>100.0</td>
<td>no</td>
</tr>
<tr>
<td>Suitable walking space in fitting centre to test legs*</td>
<td>4.69</td>
<td>92.3</td>
<td>no</td>
</tr>
<tr>
<td>Amount of time allocated to fitting process*</td>
<td>4.65</td>
<td>96.1</td>
<td>no</td>
</tr>
<tr>
<td>Entrance to building suitable for wheelchairs and prosthetic walking*</td>
<td>4.65</td>
<td>88.4</td>
<td>no</td>
</tr>
<tr>
<td>Patient involvement in prosthetic choice*</td>
<td>4.54</td>
<td>100.0</td>
<td>no</td>
</tr>
<tr>
<td>Choice in components of the limb*</td>
<td>4.42</td>
<td>96.2</td>
<td>no</td>
</tr>
<tr>
<td>Available transport for users who cannot drive*</td>
<td>4.35</td>
<td>88.5</td>
<td>no</td>
</tr>
<tr>
<td>Accountability for service*</td>
<td>4.35</td>
<td>92.3</td>
<td>no</td>
</tr>
<tr>
<td>Communication between private-contracted prosthetists and public service employees in same fitting centre*</td>
<td>4.27</td>
<td>84.6</td>
<td>yes**</td>
</tr>
<tr>
<td>Privacy in fitting rooms</td>
<td>4.15</td>
<td>73.1</td>
<td>yes</td>
</tr>
<tr>
<td>Choice in fitting services available in area/country</td>
<td>4.00</td>
<td>80.7</td>
<td>yes</td>
</tr>
<tr>
<td>Enough space to deal with many people</td>
<td>3.88</td>
<td>57.7</td>
<td>yes</td>
</tr>
<tr>
<td>Fitting centre adjacent to primary amputation ward</td>
<td>3.65</td>
<td>57.7</td>
<td>yes</td>
</tr>
<tr>
<td>Restrictions on components available</td>
<td>2.88</td>
<td>46.1</td>
<td>yes</td>
</tr>
</tbody>
</table>

*Items that reached consensus.

**Item made consensus as despite the negative rating, the participant’s comments showed they were not familiar with the public/private provider’s situation as this does not occur in the USA.

5.3.4.4 Round 2

A new questionnaire was developed to administer in Delphi Round 2. Items that reached consensus (n=39) were removed from the questionnaire. Items which reached an overall consensus of unimportant or very unimportant were also discarded (n=1). Those items which were close to consensus on importance and usefulness (n=17) and items with minor agreement (n=29) were presented back to the individuals, along with new items (n=39) which had been suggested by the participant in Round 1. A total of 85 items were then available for rating in the survey and were divided up in the following way:
• New Outcomes (n = 11),
• Previously Rated Outcomes (n = 3),
• New Age and Illness Predictors (n = 3),
• Previously Rated Age and Illness Predictors (n = 6),
• New Physical Condition Predictors (n = 8),
• Previously Rated Physical Condition Predictors (n = 6),
• New Psychological and Social Predictors (n = 4),
• Previously Rated Psychological and Social Predictors (n = 11),
• New Acceptance and Goal-setting Optimising Factors (n = 1),
• Previously Rated Acceptance and Goal-setting Optimising Factors (n = 5),
• New Social Optimising Factors (n = 4),
• Previously Rated Social Optimising Factors (n = 8),
• New Prosthesis Optimising Factors (n = 2),
• Previously Rated Prosthesis Optimising Factors (n = 2),
• New Service Optimising Factors (n = 6), and
• Previously Rated Service Optimising Factors (n = 5).

All the average ratings from Round 1 were sent to the recipients along with their original responses (see Appendix R), and comments from other panellists were also included to provide extra information on items where panellists had been unsure before. Participants were again asked to rate each item on a 5-point Likert scale as either how important it is as an outcome of prosthetic fitting, how important it is as a predictor of prosthetic fitting, or how useful it is to consider in optimising prosthesis use. It was however clear from ratings and their accompanying comments in Round 1 that some participants had potentially misunderstood the directions relating to optimising the use of the prosthetic leg: they considered an item not useful to consider, but then indicated that it would have a negative effect on prosthesis use in the comment section. Consequently the question was reworded in the second round to make sure it was understood that an item that had a positive or negative effect on
optimising use would be useful to consider for prosthesis prescription. They were also asked to leave a comment explaining their choice if they gave a negative rating (<3).

The questionnaire sent out in Round 2 is in Appendix S. The panellists were given 6 weeks to complete the questionnaire and were reminded of the study 4 times before the time limit ended.

5.3.4.4 Round 2 Analysis
The means and percentage ratings for each item in the Round 2 questionnaire were calculated and are presented in Table 5.2 below. All comments received were also compiled for use in the next round of the study.

5.3.4.5 Results Round 2
A total of 23 people complete Round 2. In the second round, 20 items reached consensus on being important (≥80%+ ≥4.0). Of these, three had been presented in the previous round (Decline in functional ability due to age or illness, Current physical ability, and Avoiding acknowledging the situation). The first two of these had been very close to consensus in Round 1 (≥80% + ≥4.0 but had at least one negative rating). The remaining 17 items were new items generated in the first round. In this round there were 12 items that were very close to consensus, three of which had been in the previous round. Of these, two had not previously been close to consensus, with Level of amputation and Fear of falling due to a loose prosthesis both gaining in mean ratings and percentages to make this category, and A shrinking residual limb, while gaining a higher mean rating and percentages, still remained in the same category. This was the only item that had been very close to consensus in the first round that did not increase ratings enough to reach consensus and did not drop its mean rating or percentage rating. Other items were also close to consensus but in different ways: three items had ratings that averaged over 4.0 and had no negative ratings but did not have over 80% in agreement on importance or
usefulness (Prosthetist who speaks the same language as user, and from Round 1, Physical ability previous to amputation and Enthusiasm for rehabilitation), while one item, Contractures, had over 80% agreement on importance or usefulness and no negative ratings, but were less than 4.0 on average ratings. Six items were either over the 4.0 mean rating or the 80% agreement, but also had negative ratings (Stamina, Strength, Home environment suitable for prosthesis use, Previous lifestyle and routine, Attitude of society to disability and from Round 1, Meeting established rehabilitation goals). No items in this round reached consensus on not being important or useful.

The rest of the items received mean ratings from 2.13 to 3.96 and percentage agreement ratings on importance/usefulness from 8.7% to 78.3%.

**Table 5.2: Result of Round 2 of the Delphi**

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>Mean</th>
<th>% agreement</th>
<th>Negative Rating?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comfort while walking and sitting</td>
<td>4.70</td>
<td>95.70%</td>
<td>Yes</td>
</tr>
<tr>
<td>Meeting individual needs of the service user</td>
<td>4.57</td>
<td>95.70%</td>
<td>Yes</td>
</tr>
<tr>
<td>Capability and competence when using the prosthesis</td>
<td>4.43</td>
<td>95.60%</td>
<td>Yes</td>
</tr>
<tr>
<td>Participation in valued activities</td>
<td>4.39</td>
<td>95.70%</td>
<td>Yes</td>
</tr>
<tr>
<td>Return to previous hobby or work*</td>
<td>4.35</td>
<td>95.70%</td>
<td>No</td>
</tr>
<tr>
<td>Community access and improved socialisation (avoiding isolation)</td>
<td>4.22</td>
<td>91.30%</td>
<td>Yes</td>
</tr>
<tr>
<td>User has knowledge and understanding of prosthetics</td>
<td>4.04</td>
<td>87.00%</td>
<td>Yes</td>
</tr>
<tr>
<td>Normalisation of gait (walking patterns)</td>
<td>4.04</td>
<td>82.60%</td>
<td>Yes</td>
</tr>
<tr>
<td>Meeting established rehabilitation goals</td>
<td>3.87</td>
<td>82.60%</td>
<td>Yes</td>
</tr>
<tr>
<td>Minimising use of walking aids</td>
<td>3.78</td>
<td>56.50%</td>
<td>Yes</td>
</tr>
<tr>
<td>Tolerating limitations in speed etc</td>
<td>3.70</td>
<td>69.60%</td>
<td>Yes</td>
</tr>
<tr>
<td>Not being obviously disabled</td>
<td>3.61</td>
<td>65.20%</td>
<td>Yes</td>
</tr>
<tr>
<td>Not relying on a wheelchair</td>
<td>3.57</td>
<td>52.20%</td>
<td>Yes</td>
</tr>
<tr>
<td>Meeting the expectations of health care providers regarding walking and physical ability</td>
<td>3.13</td>
<td>39.10%</td>
<td>Yes</td>
</tr>
</tbody>
</table>

* Items which reached consensus
### Age and Illness Predictor Ratings Round 2

<table>
<thead>
<tr>
<th>Factor</th>
<th>Mean</th>
<th>% agreement</th>
<th>Negative rating?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Renal disease/Dialysis*</td>
<td>4.26</td>
<td>86.90</td>
<td>No</td>
</tr>
<tr>
<td>Joint-related conditions or illness*</td>
<td>4.13</td>
<td>91.30</td>
<td>No</td>
</tr>
<tr>
<td>Visual impairment*</td>
<td>4.13</td>
<td>87.00</td>
<td>No</td>
</tr>
<tr>
<td>Decline of functional ability due to age or illness*</td>
<td>4.09</td>
<td>91.30</td>
<td>No</td>
</tr>
<tr>
<td>Coronary illness (heart-related illness)</td>
<td>3.74</td>
<td>69.50</td>
<td>Yes</td>
</tr>
<tr>
<td>Respiratory illness (breathing-related illness)</td>
<td>3.74</td>
<td>69.50</td>
<td>Yes</td>
</tr>
<tr>
<td>Reason for amputation (trauma v. illness/disease)</td>
<td>3.82</td>
<td>56.50</td>
<td>Yes</td>
</tr>
<tr>
<td>Many operations or amputation before fitting</td>
<td>3.52</td>
<td>60.90</td>
<td>Yes</td>
</tr>
<tr>
<td>Age</td>
<td>3.04</td>
<td>34.80</td>
<td>Yes</td>
</tr>
</tbody>
</table>

### Physical Condition Predictor Ratings Round 2

<table>
<thead>
<tr>
<th>Factor</th>
<th>Mean</th>
<th>% agreement</th>
<th>Negative rating?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ability to donn and doff prosthesis if carers not available*</td>
<td>4.35</td>
<td>91.30</td>
<td>No</td>
</tr>
<tr>
<td>Severity of pain experienced (phantom pain, join pain, residual limb pain)*</td>
<td>4.22</td>
<td>95.70</td>
<td>No</td>
</tr>
<tr>
<td>Level of amputation (above knee v. below knee)</td>
<td>4.09</td>
<td>86.90</td>
<td>Yes</td>
</tr>
<tr>
<td>Current physical ability*</td>
<td>4.04</td>
<td>82.60</td>
<td>No</td>
</tr>
<tr>
<td>Residual limb length/amount of limb below joint*</td>
<td>4.04</td>
<td>82.60</td>
<td>No</td>
</tr>
<tr>
<td>Physical ability previous to amputation</td>
<td>4.00</td>
<td>78.20</td>
<td>No</td>
</tr>
<tr>
<td>Range of motion</td>
<td>4.00</td>
<td>87.00</td>
<td>Yes</td>
</tr>
<tr>
<td>Feeling in residual limb/stump (nerve damage may effect development of sores)</td>
<td>4.00</td>
<td>87.00</td>
<td>Yes</td>
</tr>
<tr>
<td>Contractures</td>
<td>3.96</td>
<td>87.00</td>
<td>No</td>
</tr>
<tr>
<td>Strength</td>
<td>3.96</td>
<td>86.90</td>
<td>Yes</td>
</tr>
<tr>
<td>Stamina</td>
<td>3.96</td>
<td>86.90</td>
<td>Yes</td>
</tr>
<tr>
<td>Other pain (e.g. back or hip pain)</td>
<td>3.70</td>
<td>65.20</td>
<td>No</td>
</tr>
<tr>
<td>Ability to stand on one leg</td>
<td>3.57</td>
<td>60.90</td>
<td>Yes</td>
</tr>
<tr>
<td>Phantom limb pain</td>
<td>3.39</td>
<td>39.10</td>
<td>Yes</td>
</tr>
</tbody>
</table>

### Psychological Predictor Ratings Round 2

<table>
<thead>
<tr>
<th>Factors</th>
<th>Mean</th>
<th>% agreement</th>
<th>Negative rating?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoiding acknowledging the situation*</td>
<td>4.13</td>
<td>82.60</td>
<td>No</td>
</tr>
<tr>
<td>Enthusiasm for rehabilitation</td>
<td>4.00</td>
<td>78.20</td>
<td>No</td>
</tr>
<tr>
<td>Ability to learn</td>
<td>3.96</td>
<td>78.20</td>
<td>Yes</td>
</tr>
<tr>
<td>Previous lifestyle and routine</td>
<td>3.87</td>
<td>87.00</td>
<td>Yes</td>
</tr>
<tr>
<td>Home environment suitable for prosthesis use</td>
<td>3.87</td>
<td>82.60</td>
<td>Yes</td>
</tr>
<tr>
<td>Body Image issues</td>
<td>3.86</td>
<td>73.70</td>
<td>No</td>
</tr>
<tr>
<td>Memory ability</td>
<td>3.78</td>
<td>69.60</td>
<td>Yes</td>
</tr>
<tr>
<td>Anxiety</td>
<td>3.73</td>
<td>72.70</td>
<td>No</td>
</tr>
<tr>
<td>Depression</td>
<td>3.70</td>
<td>56.50</td>
<td>No</td>
</tr>
<tr>
<td>Suffering from Post-Traumatic Stress Disorder</td>
<td>3.70</td>
<td>69.50</td>
<td>Yes</td>
</tr>
<tr>
<td>Seeking help from others</td>
<td>3.65</td>
<td>60.90</td>
<td>Yes</td>
</tr>
<tr>
<td>Learning Disabilities</td>
<td>3.65</td>
<td>65.20</td>
<td>Yes</td>
</tr>
<tr>
<td>Addiction problems (e.g. alcoholism, drug addiction)</td>
<td>3.55</td>
<td>50.00</td>
<td>Yes</td>
</tr>
<tr>
<td>Psychiatric disorder</td>
<td>3.48</td>
<td>57.80</td>
<td>Yes</td>
</tr>
<tr>
<td>Culture/Ethnicity</td>
<td>2.78</td>
<td>17.30</td>
<td>Yes</td>
</tr>
</tbody>
</table>

* Items which reached consensus
### Optimising Use: Acceptance and Goal-setting Factor Ratings Round 2

<table>
<thead>
<tr>
<th>Factors</th>
<th>Mean</th>
<th>% agreement usefulness</th>
<th>Negative Rating? &lt;3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accepting the amputation as part of life</td>
<td>3.91</td>
<td>73.90</td>
<td>Yes</td>
</tr>
<tr>
<td>Taking up a hobby</td>
<td>3.65</td>
<td>56.50</td>
<td>Yes</td>
</tr>
<tr>
<td>Emphasising positives that have come from amputation</td>
<td>3.61</td>
<td>52.20</td>
<td>Yes</td>
</tr>
<tr>
<td>Spirituality</td>
<td>3.26</td>
<td>34.80</td>
<td>Yes</td>
</tr>
<tr>
<td>Comparing self to those worse off</td>
<td>2.61</td>
<td>26.10</td>
<td>Yes</td>
</tr>
<tr>
<td>Comparing self to those better off</td>
<td>2.13</td>
<td>17.40</td>
<td>Yes</td>
</tr>
</tbody>
</table>

### Optimising Use: Social Factor Ratings Round 2

<table>
<thead>
<tr>
<th>Factors</th>
<th>Mean</th>
<th>% agreement usefulness</th>
<th>Negative rating? &lt;3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ease of getting about in public (ramps, uneven surface etc.)*</td>
<td>4.39</td>
<td>91.30</td>
<td>No</td>
</tr>
<tr>
<td>Supportive work environment*</td>
<td>4.30</td>
<td>91.30</td>
<td>No</td>
</tr>
<tr>
<td>Specific movements needed for job/leisure/home life aided by prosthesis*</td>
<td>4.26</td>
<td>86.90</td>
<td>No</td>
</tr>
<tr>
<td>Attitude of society to disability</td>
<td>4.04</td>
<td>78.20</td>
<td>Yes</td>
</tr>
<tr>
<td>Place of residence</td>
<td>3.41</td>
<td>36.40</td>
<td>Yes</td>
</tr>
<tr>
<td>Type of job</td>
<td>2.96</td>
<td>30.40</td>
<td>Yes</td>
</tr>
<tr>
<td>Receiving disability benefits/disability allowance from the State</td>
<td>2.91</td>
<td>21.70</td>
<td>Yes</td>
</tr>
<tr>
<td>Self-consciousness with prosthetic in social situations</td>
<td>2.86</td>
<td>36.30</td>
<td>Yes</td>
</tr>
<tr>
<td>Employment status (employed, unemployed etc)</td>
<td>2.74</td>
<td>21.70</td>
<td>Yes</td>
</tr>
<tr>
<td>Over protective family</td>
<td>2.57</td>
<td>17.30</td>
<td>Yes</td>
</tr>
<tr>
<td>Education level</td>
<td>2.43</td>
<td>8.70</td>
<td>Yes</td>
</tr>
<tr>
<td>Earnings</td>
<td>2.43</td>
<td>17.40</td>
<td>Yes</td>
</tr>
</tbody>
</table>

### Optimising Use: Prosthesis Factor Ratings Round 2

<table>
<thead>
<tr>
<th>Factors</th>
<th>Mean</th>
<th>% agreement usefulness</th>
<th>Negative rating? &lt;3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Understanding changes in the residual limb/stump and managing them*</td>
<td>4.35</td>
<td>86.90</td>
<td>No</td>
</tr>
<tr>
<td>A shrinking residual limb (stump)</td>
<td>4.26</td>
<td>82.60</td>
<td>Yes</td>
</tr>
<tr>
<td>Fear of falling due to loose prosthesis</td>
<td>4.26</td>
<td>86.90</td>
<td>Yes</td>
</tr>
<tr>
<td>Understanding prosthetic maintenance and function</td>
<td>3.91</td>
<td>70.50</td>
<td>Yes</td>
</tr>
</tbody>
</table>

* Items which reached consensus
### Optimising Use: Service Factor Ratings Round 2

<table>
<thead>
<tr>
<th>Factors</th>
<th>Mean</th>
<th>% agreement usefulness</th>
<th>Negative rating? &lt;3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sufficient time spent on different surfaces with walking training (e.g. slopes, grass, gravel etc.)*</td>
<td>4.74</td>
<td>100.00</td>
<td>No</td>
</tr>
<tr>
<td>Access to all member of Multidisciplinary team if needed *</td>
<td>4.52</td>
<td>95.60</td>
<td>No</td>
</tr>
<tr>
<td>Use of trial periods outside of clinic environment for new fittings *</td>
<td>4.35</td>
<td>91.30</td>
<td>No</td>
</tr>
<tr>
<td>Prosthetist who speaks same language as user</td>
<td>4.30</td>
<td>69.60</td>
<td>No</td>
</tr>
<tr>
<td>Access to active user group/support group*</td>
<td>4.30</td>
<td>91.30</td>
<td>No</td>
</tr>
<tr>
<td>Use of check sockets (see-through sockets to check fit on residual limb)*</td>
<td>4.22</td>
<td>82.60</td>
<td>No</td>
</tr>
<tr>
<td>Enough space to deal with many people</td>
<td>3.91</td>
<td>69.50</td>
<td>No</td>
</tr>
<tr>
<td>Privacy in fitting rooms</td>
<td>3.70</td>
<td>56.50</td>
<td>Yes</td>
</tr>
<tr>
<td>Choice in fitting services available in area/country (i.e. a number of different fitting services are available)</td>
<td>3.65</td>
<td>60.90</td>
<td>Yes</td>
</tr>
<tr>
<td>Fitting centre adjacent to primary amputation wards</td>
<td>3.65</td>
<td>52.10</td>
<td>Yes</td>
</tr>
<tr>
<td>Restrictions on components available (e.g. financial constraints)</td>
<td>3.13</td>
<td>39.10</td>
<td>Yes</td>
</tr>
</tbody>
</table>

*Items which reached consensus

#### 5.3.4.6 Round 3

It was necessary to administer a third Delphi survey to ensure that clarification was achieved on the ratings used for optimising prosthesis items, and also to ensure each item was rated at least twice by the expert panel. For the construction of the third survey, all items that had reached consensus were removed, as were all items that had been rated twice by the participants but did not reach consensus.

However, items which had been rated negatively in the optimising prosthesis use section over the three rounds were included again. Despite efforts for clarification in the second round, it was clear that some participants were still incorrectly rating items negatively e.g. some participants rated items as ‘not at all useful’ to consider, then commented that said items negatively effect prosthesis use. This indicates that the items are in fact useful to consider in prosthesis use as they enact an effect on use. Items which made consensus despite the potential misunderstanding were considered correctly rated, as it was concluded that these items were considered by participants to have a positive effect on optimising the prosthesis use. Therefore there was no need to rate all items again in this section as they were believed to enact an effect.
This meant that there were only 43 items to be rated in this last survey under the following headings: Previously Rated Outcomes (n = 10), Previously Rated Physical Condition Predictors (n = 5), Previously Rated Psychological and Social Predictors (n = 4), Previously Rated Acceptance and Goal Setting Optimising Factors (n = 6), Previously Rated Social Optimising Factors (n = 9), Previously Rated Prosthesis Optimising Factors (n = 3) and Previously Rated Service Optimising Factors (n = 6).

All the average ratings from Round 1 and 2 were sent to the recipients along with their original responses for both rounds (see Appendix T). Comments from other panellists were also included to provide extra information on items where panellists had been unsure before. Participants were again asked to rate each item on a 5-point Likert scale as either how important it is as an outcome of prosthetic fitting, how important it is as a predictor of prosthetic fitting, or how useful it is to consider in optimising prosthesis use. They were also asked to leave a comment explaining their choice if they gave a negative rating (<3). The questionnaire sent out in Round 3 is in Appendix U. The panellists were given 6 weeks to complete the questionnaire and were reminded of the study 4 times.

5.3.4.7 Round 3 Analysis
The means and percentage ratings for each item in the Round 3 questionnaire were calculated and are presented in Table 5.3 below.

5.3.4.8 Results Round 3
In total 21 people completed Round 3. In the third round 8 items reached overall consensus on being important (≥80% + ≥4.0). Two of these items had also been presented in the first round (A shrinking residual limb and Fear of falling due to a loose prosthesis). In this round there was only one item, Home environment suitable for prosthesis use, which was very close to consensus due to meeting the cut-off points, but still having a negative rating. In the previous round this had been close
to consensus, indicating an improvement of rating. Other items were also close to consensus but in different ways: three items had ratings that averaged over 4.0 and had no negative ratings, but did not have over 80% in agreement on importance or usefulness (User has knowledge and understanding of prosthetics, Prosthetics who speaks same language as user, and from Round 1, Accepting the amputation as part of life), while two items had over 80% agreement on importance or usefulness and no negative ratings, but were less than 4.0 on average ratings (Strength and Previous lifestyle and routine). Another three items were either over 4.0 on the mean ratings, or 80% on agreement, but had negative ratings (Normalisation of gait, Tolerating limitations in speed etc and Understanding prosthetic maintenance and function). No items in this round reached consensus on not being important or useful. The rest of the items received mean ratings from 2.48 to 3.95 and percentage agreement ratings on importance/usefulness from 9.5% to 76.2%.

Table 5.3: Results of Round 3 of the Delphi

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>Mean</th>
<th>% agreement importance</th>
<th>Negative rating? &lt;3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comfort while walking and sitting*</td>
<td>4.90</td>
<td>100</td>
<td>No</td>
</tr>
<tr>
<td>Capability and competence using prosthesis*</td>
<td>4.71</td>
<td>100</td>
<td>No</td>
</tr>
<tr>
<td>Meeting individual needs of the service user*</td>
<td>4.71</td>
<td>95.2</td>
<td>No</td>
</tr>
<tr>
<td>Community access and improved socialisation*</td>
<td>4.52</td>
<td>90.5</td>
<td>No</td>
</tr>
<tr>
<td>Participation in valued activities*</td>
<td>4.48</td>
<td>90.4</td>
<td>No</td>
</tr>
<tr>
<td>User has knowledge and understanding of prosthetics</td>
<td>4.05</td>
<td>71.4</td>
<td>No</td>
</tr>
<tr>
<td>Normalisation of gait</td>
<td>3.95</td>
<td>84.7</td>
<td>Yes</td>
</tr>
<tr>
<td>Minimising use of walking aids</td>
<td>3.95</td>
<td>76.2</td>
<td>Yes</td>
</tr>
<tr>
<td>Tolerating limitations in speed etc</td>
<td>3.90</td>
<td>81</td>
<td>Yes</td>
</tr>
<tr>
<td>Not being obviously disabled</td>
<td>3.38</td>
<td>52.4</td>
<td>Yes</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Factors</th>
<th>Mean</th>
<th>% agreement importance</th>
<th>Negative rating? &lt;3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range of motion*</td>
<td>4.00</td>
<td>80.9</td>
<td>No</td>
</tr>
<tr>
<td>Strength</td>
<td>3.95</td>
<td>85.7</td>
<td>No</td>
</tr>
<tr>
<td>Feeling in residual limb</td>
<td>3.81</td>
<td>76.2</td>
<td>Yes</td>
</tr>
<tr>
<td>Stamma</td>
<td>3.71</td>
<td>66.6</td>
<td>Yes</td>
</tr>
<tr>
<td>Ability to stand on one leg</td>
<td>3.52</td>
<td>42.8</td>
<td>No</td>
</tr>
</tbody>
</table>

*Items that reached consensus
**Psychological Predictor Ratings Round 3**

<table>
<thead>
<tr>
<th>Factors</th>
<th>Mean</th>
<th>% agreement importance</th>
<th>Negative rating? &lt;3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Home environment suitable for prosthesis use</td>
<td>4.05</td>
<td>85.7</td>
<td>Yes</td>
</tr>
<tr>
<td>Previous lifestyle and routine</td>
<td>3.90</td>
<td>80.9</td>
<td>No</td>
</tr>
<tr>
<td>Learning disabilities</td>
<td>3.62</td>
<td>57.2</td>
<td>No</td>
</tr>
<tr>
<td>Culture/Ethnicity</td>
<td>3.19</td>
<td>28.5</td>
<td>Yes</td>
</tr>
</tbody>
</table>

**Optimising Use: Acceptance and Goal-setting Factor Rating Round 3**

<table>
<thead>
<tr>
<th>Factor</th>
<th>Mean</th>
<th>% agreement usefulness</th>
<th>Negative rating? &lt;3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accepting the amputation as part of life</td>
<td>4.10</td>
<td>76.2</td>
<td>No</td>
</tr>
<tr>
<td>Emphasising the positives that have come from amputation</td>
<td>3.90</td>
<td>66.7</td>
<td>No</td>
</tr>
<tr>
<td>Taking up a hobby</td>
<td>3.67</td>
<td>57.1</td>
<td>Yes</td>
</tr>
<tr>
<td>Spirituality</td>
<td>3.38</td>
<td>47.6</td>
<td>Yes</td>
</tr>
<tr>
<td>Comparing the self to those worse off</td>
<td>2.71</td>
<td>33.3</td>
<td>Yes</td>
</tr>
<tr>
<td>Comparing the self to those better off</td>
<td>2.48</td>
<td>23.8</td>
<td>Yes</td>
</tr>
</tbody>
</table>

**Optimising Use: Social Factor Ratings Round 3**

<table>
<thead>
<tr>
<th>Factors</th>
<th>Mean</th>
<th>% agreement usefulness</th>
<th>Negative rating? &lt;3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attitude of society to disability</td>
<td>3.76</td>
<td>71.5</td>
<td>Yes</td>
</tr>
<tr>
<td>Place of residence</td>
<td>3.62</td>
<td>57.2</td>
<td>No</td>
</tr>
<tr>
<td>Self-consciousness with prosthetic in social situations</td>
<td>3.48</td>
<td>57.1</td>
<td>Yes</td>
</tr>
<tr>
<td>Type of job</td>
<td>3.33</td>
<td>47.6</td>
<td>Yes</td>
</tr>
<tr>
<td>Over-protective family</td>
<td>3.24</td>
<td>47.6</td>
<td>Yes</td>
</tr>
<tr>
<td>Receiving disability allowance/benefits from the state</td>
<td>3.24</td>
<td>38.1</td>
<td>Yes</td>
</tr>
<tr>
<td>Employment status</td>
<td>3.14</td>
<td>78.1</td>
<td>Yes</td>
</tr>
<tr>
<td>Education level</td>
<td>2.86</td>
<td>19</td>
<td>Yes</td>
</tr>
<tr>
<td>Earnings</td>
<td>2.67</td>
<td>9.5</td>
<td>Yes</td>
</tr>
</tbody>
</table>

**Optimising Use: Prosthesis Factor Ratings Round 3**

<table>
<thead>
<tr>
<th>Factors</th>
<th>Mean</th>
<th>% agreement usefulness</th>
<th>Negative rating? &lt;3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fear of falling due to a loose prosthesis*</td>
<td>4.33</td>
<td>81</td>
<td>No</td>
</tr>
<tr>
<td>A shrinking residual limb*</td>
<td>4.29</td>
<td>90.5</td>
<td>No</td>
</tr>
<tr>
<td>Understanding prosthetic maintenance and function</td>
<td>4.05</td>
<td>71.4</td>
<td>Yes</td>
</tr>
</tbody>
</table>

**Optimising Use: Service Factor Ratings Round 3**

<table>
<thead>
<tr>
<th>Factors</th>
<th>Mean</th>
<th>% agreement usefulness</th>
<th>Negative rating? &lt;3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prosthetist who speaks same language as user</td>
<td>4.19</td>
<td>4.19</td>
<td>No</td>
</tr>
<tr>
<td>Enough space to deal with many people</td>
<td>3.81</td>
<td>61.9</td>
<td>Yes</td>
</tr>
<tr>
<td>Privacy in fitting rooms</td>
<td>3.67</td>
<td>52.3</td>
<td>Yes</td>
</tr>
<tr>
<td>Choice in fitting services available in area/country</td>
<td>3.57</td>
<td>47.6</td>
<td>Yes</td>
</tr>
<tr>
<td>Fitting centre adjacent to primary amputation wards</td>
<td>3.57</td>
<td>52.4</td>
<td>Yes</td>
</tr>
<tr>
<td>Restriction on component available</td>
<td>3.19</td>
<td>33.3</td>
<td>Yes</td>
</tr>
</tbody>
</table>

* Items that reached consensus
5.4 Overall Results

From a list of 125 items, 66 were identified as important or useful to the prosthesis prescription process, as an important outcome (n = 13), an important predictor (n = 19), or item useful to consider as affecting optimal use of the prosthesis (n = 34). Of the 66 items which reached consensus, 44 were identified previous to the study and 22 were proposed by the participants in the study. Fifty-eight items were excluded. One item, Gender, reached consensus on Unimportance. The rest of the items had mean ratings ranging from 2.48 – 4.19 and percentage agreements ranging from 9.5% - 87.0%, though those items with mean ratings >4.0 or >80% agreement had negative ratings. The full final means and percentages of these items are in the Tables 5.4 to 5.19 below.

Table 5.4: Outcomes that reached consensus

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Improved quality of life</td>
<td>4.92</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Regaining independent movement (that is, movement without help of other people)</td>
<td>4.85</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Regaining sense of freedom</td>
<td>4.73</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Self-reliance</td>
<td>4.73</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Walking with safety</td>
<td>4.73</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Balance when walking</td>
<td>4.69</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Living at home rather than in care facility</td>
<td>4.62</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Comfort while walking and sitting</td>
<td>-</td>
<td>4.70</td>
<td>4.90</td>
</tr>
<tr>
<td>Capability and competence when using the prosthesis</td>
<td>-</td>
<td>4.43</td>
<td>4.71</td>
</tr>
<tr>
<td>Meeting individual needs of the service user</td>
<td>-</td>
<td>4.57</td>
<td>4.71</td>
</tr>
<tr>
<td>Community access and improved socialisation (avoiding isolation)</td>
<td>-</td>
<td>4.22</td>
<td>4.52</td>
</tr>
<tr>
<td>Participation in valued activities</td>
<td>-</td>
<td>4.39</td>
<td>4.48</td>
</tr>
<tr>
<td>Return to previous hobby or work</td>
<td>-</td>
<td>4.35</td>
<td>-</td>
</tr>
</tbody>
</table>
Table 5.5: Outcomes that did NOT reach consensus.

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>Mean</th>
<th>% agreement importance</th>
<th>Negative Rating? &lt;3</th>
</tr>
</thead>
<tbody>
<tr>
<td>User has knowledge and understanding of prosthetics</td>
<td>4.05</td>
<td>71.4</td>
<td>No</td>
</tr>
<tr>
<td>Minimising use of walking aids</td>
<td>3.95</td>
<td>76.2</td>
<td>yes</td>
</tr>
<tr>
<td>Normalisation of gait</td>
<td>3.95</td>
<td>84.7</td>
<td>yes</td>
</tr>
<tr>
<td>Tolerating limitations in speed etc</td>
<td>3.90</td>
<td>81.0</td>
<td>yes</td>
</tr>
<tr>
<td>Meeting established rehabilitation goals</td>
<td>3.87</td>
<td>82.6</td>
<td>yes</td>
</tr>
<tr>
<td>Not relying on a wheelchair</td>
<td>3.57</td>
<td>52.2</td>
<td>yes</td>
</tr>
<tr>
<td>Not being obviously disabled</td>
<td>3.38</td>
<td>52.4</td>
<td>yes</td>
</tr>
<tr>
<td>Meeting the expectations of health care providers regarding walking and physical ability</td>
<td>3.13</td>
<td>39.1</td>
<td>yes</td>
</tr>
</tbody>
</table>

Table 5.6: Age and Illness Predictors that reached Consensus

<table>
<thead>
<tr>
<th>Age and Illness Predictors</th>
<th>Avg. Rating 1</th>
<th>Avg. Rating 2</th>
<th>Avg. Rating 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Renal disease/Dialysis</td>
<td>-</td>
<td>4.26</td>
<td>-</td>
</tr>
<tr>
<td>Joint-related conditions or illness</td>
<td>-</td>
<td>4.13</td>
<td>-</td>
</tr>
<tr>
<td>Visual impairment</td>
<td>-</td>
<td>4.13</td>
<td>-</td>
</tr>
<tr>
<td>Decline of functional ability due to age or illness</td>
<td>4.08</td>
<td>4.09</td>
<td>-</td>
</tr>
</tbody>
</table>

Table 5.7: Age and Illness Predictors that did NOT reach consensus

<table>
<thead>
<tr>
<th>Predictors: Age and Illness</th>
<th>Mean</th>
<th>% agreement importance</th>
<th>Negative rating? &lt;3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respiratory illness</td>
<td>3.74</td>
<td>69.5</td>
<td>yes</td>
</tr>
<tr>
<td>Coronary illness (heart-related illness)</td>
<td>3.74</td>
<td>69.5</td>
<td>yes</td>
</tr>
<tr>
<td>Reason for amputation (trauma V. illness/disease)</td>
<td>3.52</td>
<td>56.5</td>
<td>yes</td>
</tr>
<tr>
<td>Many operations or amputation before fitting</td>
<td>3.52</td>
<td>60.9</td>
<td>yes</td>
</tr>
<tr>
<td>Age</td>
<td>3.04</td>
<td>34.8</td>
<td>yes</td>
</tr>
</tbody>
</table>
Table 5.8: Physical Condition Predictors that reached Consensus

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Condition of the residual limb/stump</td>
<td>4.54</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Condition of contralateral limb (remaining leg condition, may also be amputated)</td>
<td>4.50</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Residual limb pain (stump pain)</td>
<td>4.42</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Ability to don and doff prosthesis if carers not available</td>
<td>-</td>
<td>4.35</td>
<td>-</td>
</tr>
<tr>
<td>Severity of pain experienced (phantom pain, joint pain, residual limb pain)</td>
<td>-</td>
<td>4.22</td>
<td>-</td>
</tr>
<tr>
<td>Current physical ability</td>
<td>4.15</td>
<td>4.04</td>
<td>-</td>
</tr>
<tr>
<td>Residual limb length/amount of limb below joint</td>
<td>-</td>
<td>4.04</td>
<td>-</td>
</tr>
<tr>
<td>Range of motion</td>
<td>-</td>
<td>4.00</td>
<td>4.00</td>
</tr>
</tbody>
</table>

Table 5.9: Physical Condition Predictors that did NOT reach consensus

<table>
<thead>
<tr>
<th>Predictors: Physical Condition</th>
<th>Mean</th>
<th>% agreement importance</th>
<th>Negative rating? &lt;3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical ability previous to amputation</td>
<td>4.00</td>
<td>78.2</td>
<td>no</td>
</tr>
<tr>
<td>Contractures</td>
<td>3.96</td>
<td>87.0</td>
<td>no</td>
</tr>
<tr>
<td>Strength</td>
<td>3.95</td>
<td>85.7</td>
<td>no</td>
</tr>
<tr>
<td>Feeling in residual limb</td>
<td>3.81</td>
<td>76.2</td>
<td>yes</td>
</tr>
<tr>
<td>Stamina</td>
<td>3.71</td>
<td>66.6</td>
<td>yes</td>
</tr>
<tr>
<td>Other pain (e.g. back or hip pain)</td>
<td>3.70</td>
<td>65.2</td>
<td>no</td>
</tr>
<tr>
<td>Ability to stand on one leg</td>
<td>3.52</td>
<td>42.8</td>
<td>no</td>
</tr>
<tr>
<td>Phantom limb pain</td>
<td>3.39</td>
<td>39.1</td>
<td>yes</td>
</tr>
<tr>
<td>Gender</td>
<td>1.96</td>
<td>0.0</td>
<td>yes</td>
</tr>
</tbody>
</table>

Table 5.10: Psychological and Social Predictors that reached Consensus

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Determination to walk</td>
<td>4.50</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Social support</td>
<td>4.46</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Motivation in rehabilitation setting</td>
<td>4.46</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Optimistic outlook/positive thinking</td>
<td>4.42</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Feeling in control of the situation</td>
<td>4.27</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Attending clinic regularly/returning for more fittings</td>
<td>4.19</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Avoiding acknowledging the situation</td>
<td>3.92</td>
<td>4.13</td>
<td>-</td>
</tr>
</tbody>
</table>
### Table 5.11: Psychological and Social Predictors that did NOT reach consensus

<table>
<thead>
<tr>
<th>Predictors: Psychological</th>
<th>Mean</th>
<th>% agreement importance</th>
<th>Negative rating? &lt;3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enthusiasm for rehabilitation</td>
<td>4.00</td>
<td>78.2</td>
<td>No</td>
</tr>
<tr>
<td>Ability to learn</td>
<td>3.96</td>
<td>78.3</td>
<td>yes</td>
</tr>
<tr>
<td>Previous lifestyle and routine</td>
<td>3.90</td>
<td>80.9</td>
<td>no</td>
</tr>
<tr>
<td>Body Image issues</td>
<td>3.86</td>
<td>77.3</td>
<td>no</td>
</tr>
<tr>
<td>Memory ability</td>
<td>3.78</td>
<td>69.6</td>
<td>yes</td>
</tr>
<tr>
<td>Anxiety</td>
<td>3.73</td>
<td>72.7</td>
<td>no</td>
</tr>
<tr>
<td>Suffering from Post-Traumatic Stress Disorder</td>
<td>3.70</td>
<td>69.5</td>
<td>yes</td>
</tr>
<tr>
<td>Depression</td>
<td>3.70</td>
<td>56.5</td>
<td>no</td>
</tr>
<tr>
<td>Seeking help from others</td>
<td>3.65</td>
<td>60.9</td>
<td>yes</td>
</tr>
<tr>
<td>Learning disabilities</td>
<td>3.62</td>
<td>57.2</td>
<td>no</td>
</tr>
<tr>
<td>Addiction problems (e.g. alcoholism, drug addiction)</td>
<td>3.55</td>
<td>50.0</td>
<td>yes</td>
</tr>
<tr>
<td>Psychiatric disorder</td>
<td>3.48</td>
<td>57.8</td>
<td>yes</td>
</tr>
<tr>
<td>Culture/Ethnicity</td>
<td>3.19</td>
<td>28.5</td>
<td>yes</td>
</tr>
</tbody>
</table>

### Table 5.12: Acceptance and Goal-setting Optimising Factors that reached consensus

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Setting achievable goals</td>
<td>4.65</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Making sure expected goals are achievable</td>
<td>4.58</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Returning to work</td>
<td>4.31</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

### Table 5.13: Acceptance and Goal-Setting Optimising Factors that did NOT reach consensus

<table>
<thead>
<tr>
<th>Optimising Use: Acceptance and Goal-setting Factors</th>
<th>Mean</th>
<th>% agreement usefulness</th>
<th>Negative rating? &lt;3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accepting the amputation as part of life</td>
<td>4.10</td>
<td>76.2</td>
<td>no</td>
</tr>
<tr>
<td>Emphasising the positives that have come from amputation</td>
<td>3.90</td>
<td>66.7</td>
<td>no</td>
</tr>
<tr>
<td>Attitude of society to disability</td>
<td>3.76</td>
<td>71.5</td>
<td>yes</td>
</tr>
<tr>
<td>Taking up a hobby</td>
<td>3.67</td>
<td>57.1</td>
<td>yes</td>
</tr>
<tr>
<td>Spirituality</td>
<td>3.38</td>
<td>47.6</td>
<td>yes</td>
</tr>
<tr>
<td>Comparing self to those worse off</td>
<td>2.71</td>
<td>33.3</td>
<td>yes</td>
</tr>
<tr>
<td>Comparing self to those better off</td>
<td>2.48</td>
<td>23.8</td>
<td>yes</td>
</tr>
</tbody>
</table>
Table 5.14: Social Optimising Factors that reached consensus

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Family accept the amputation</td>
<td>4.38</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Family understand limitations of user</td>
<td>4.19</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Family accept and understand the expected potential of user</td>
<td>4.19</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Establishing/Continuing romantic relationships</td>
<td>4.12</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Ease of getting about in public (ramps, uneven surface etc.)</td>
<td>-</td>
<td>4.39</td>
<td>-</td>
</tr>
<tr>
<td>Supportive work environment</td>
<td>-</td>
<td>4.30</td>
<td>-</td>
</tr>
<tr>
<td>Specific movements needed for job/leisure/home life aided by prosthesis</td>
<td>-</td>
<td>4.26</td>
<td>-</td>
</tr>
</tbody>
</table>

Table 5.15: Social Optimising Factors that did NOT reach consensus

<table>
<thead>
<tr>
<th>Optimising Use: Social Factors</th>
<th>Mean</th>
<th>% agreement usefulness</th>
<th>Negative rating? &lt;3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Place of residence</td>
<td>3.62</td>
<td>57.2</td>
<td>no</td>
</tr>
<tr>
<td>Self-consciousness with prosthetic in social situations</td>
<td>3.48</td>
<td>57.1</td>
<td>yes</td>
</tr>
<tr>
<td>Type of job</td>
<td>3.33</td>
<td>47.6</td>
<td>yes</td>
</tr>
<tr>
<td>Over-protective family</td>
<td>3.24</td>
<td>47.6</td>
<td>yes</td>
</tr>
<tr>
<td>Receiving disability allowance/benefits from the state</td>
<td>3.24</td>
<td>38.1</td>
<td>yes</td>
</tr>
<tr>
<td>Employment status</td>
<td>3.14</td>
<td>78.1</td>
<td>yes</td>
</tr>
<tr>
<td>Education level</td>
<td>2.86</td>
<td>19.0</td>
<td>yes</td>
</tr>
<tr>
<td>Earnings</td>
<td>2.67</td>
<td>9.5</td>
<td>yes</td>
</tr>
</tbody>
</table>

Table 5.16: Prosthesis Optimising factors that reached consensus

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Having a comfortable prosthesis fit</td>
<td>4.96</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Confidence in walking ability and using prosthesis</td>
<td>4.85</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Feeling the prosthesis has become part of the user’s own body</td>
<td>4.46</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Understanding changes in the residual limb/stump and managing them</td>
<td>-</td>
<td>4.35</td>
<td>-</td>
</tr>
<tr>
<td>Fear of falling due to loose prosthesis</td>
<td>3.92</td>
<td>4.26</td>
<td>4.33</td>
</tr>
<tr>
<td>A shrinking residual limb (stump)</td>
<td>4.00</td>
<td>4.26</td>
<td>4.29</td>
</tr>
</tbody>
</table>
Table 5.17: Prosthesis Optimising factors that did NOT reach consensus

<table>
<thead>
<tr>
<th>Optimising Use: Prosthesis factors</th>
<th>Mean</th>
<th>% agreement usefulness</th>
<th>Negative rating? &lt;3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Understanding prosthetic maintenance and function</td>
<td>4.05</td>
<td>71.4</td>
<td>yes</td>
</tr>
<tr>
<td>User has knowledge and understanding of prosthetics</td>
<td>4.05</td>
<td>71.4</td>
<td>No</td>
</tr>
</tbody>
</table>

Table 5.18: Service Optimising factors that reached consensus

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Limb alterations done in reasonable time</td>
<td>4.88</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Multidisciplinary support (many different professions involved in helping the prosthetic user)</td>
<td>4.77</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>A returned leg is usable and altered properly for the user</td>
<td>4.77</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Patient and prosthetist relationship</td>
<td>4.73</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Limb alterations done on-site</td>
<td>4.73</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Suitable walking space in fitting centre to test legs</td>
<td>4.69</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Amount of time allocated to fitting process</td>
<td>4.65</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Entrance to building suitable for wheelchairs and prosthetic walking</td>
<td>4.65</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Patient involvement in prosthetic choice</td>
<td>4.54</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Choice in components of the limb (e.g. not restricted to a certain manufacturer)</td>
<td>4.42</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Available transport for users who cannot drive</td>
<td>4.35</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Accountability for service (e.g. complaints service available)</td>
<td>4.35</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Communication between private-contracted prosthetists and public service employees in same fitting centre</td>
<td>4.27</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Sufficient time spent on different surfaces with walking training (e.g. slopes, grass, gravel etc.)</td>
<td>-</td>
<td>4.74</td>
<td>-</td>
</tr>
<tr>
<td>Access to all members of Multidisciplinary team if needed</td>
<td>-</td>
<td>4.52</td>
<td>-</td>
</tr>
<tr>
<td>Use of trial periods outside of clinic environment for new fittings</td>
<td>-</td>
<td>4.35</td>
<td>-</td>
</tr>
<tr>
<td>Access to active user group/support group</td>
<td>-</td>
<td>4.30</td>
<td>-</td>
</tr>
<tr>
<td>Use of check sockets (see-through sockets to check fit on residual limb)</td>
<td>-</td>
<td>4.22</td>
<td>-</td>
</tr>
</tbody>
</table>
Table 5.19: Service Optimising Factors that did NOT reach consensus

<table>
<thead>
<tr>
<th>Optimising Use: Service Factors</th>
<th>Mean</th>
<th>% agreement usefulness</th>
<th>Negative rating? &lt;3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prosthetist who speaks same language as user</td>
<td>4.19</td>
<td>75.2</td>
<td>no</td>
</tr>
<tr>
<td>Enough space to deal with many people</td>
<td>3.81</td>
<td>61.9</td>
<td>yes</td>
</tr>
<tr>
<td>Privacy in fitting rooms</td>
<td>3.67</td>
<td>52.3</td>
<td>yes</td>
</tr>
<tr>
<td>Fitting centre adjacent to primary amputation wards</td>
<td>3.57</td>
<td>52.4</td>
<td>yes</td>
</tr>
<tr>
<td>Choice in fitting services available in area/country</td>
<td>3.57</td>
<td>47.6</td>
<td>yes</td>
</tr>
<tr>
<td>Restriction on components available</td>
<td>3.19</td>
<td>33.3</td>
<td>yes</td>
</tr>
</tbody>
</table>

5.5 Discussion

The aim of this study was to create a consensus from a panel of experts on what are the most important outcomes of lower limb prosthetic prescription, the most important predictors in prosthetic prescription, and the most important factors in optimising the use of lower limb prostheses. This was done successfully using an eDelphi study. In total, 66 items were identified as important to the process of using and prescribing lower limb prostheses. These shall now be discussed in more detail in relation to their specific subheadings: Outcomes of Prosthetic Prescription, Predictors of Prosthetic Prescription, and Factors to Consider in Optimising Use of the Prosthesis.

5.5.1 Outcomes of Prosthetic Prescription

In total, 13 items were identified as important outcomes of prosthetic prescription. These were, in order of rated importance: Improved quality of life, Comfort while walking and sitting, Regaining independent movement, Regaining sense of freedom, Self-reliance, Walking with safety, Capability and competence when using the prosthesis, Meeting the individual needs of the service user, Balance when walking, Living at home rather than in care facility, Community access and improved socialisation, Participation in valued activities and Return to previous hobby or work.

Many of these outcomes are physical in nature and are typical of what would be expected of a user of prosthetic technology, for example, if unable to walk with
safety and balance, it would be inappropriate for a user to use a prosthesis. Other outcomes, such as capability and competence, as well as comfort, are achieved by combining the efforts of the rehabilitation team with those of the user to create the best possible match of prosthesis to the user. This involves making sure that the prosthesis is fitted well for comfort, and also making sure that the user can manage the prosthesis in terms of physical ability (i.e. the components are suitable for the users’ abilities) and in terms of care and application (i.e. can use the prosthesis without causing damage to themselves or the componentry). Physical outcomes of prosthesis use are commonly identified in the literature, with a large number of measures dedicated specifically for performance and activity limitations (Miller and McCay, 2006), for evaluating interventions and to potentially establish predictors of prosthetic outcomes.

However, there were also a number of outcomes identified as important which were psychosocial in nature. These outcomes are key to rehabilitation, for example, improving quality of life is often noted as an outcome of rehabilitation medicine (Fuhrer, 2000). However, there is difficulty in understanding how QOL is operationalised within the prosthetic setting, due to the large amount of QOL measures that have been used in the literature (Gallagher and Desmond, 2007), though it seems from this study that QOL could in many ways be related to the other outcomes identified as important. Outcomes such as self-reliance, a sense of freedom, and improving socialisation would all be considered as improving a person’s QOL. The importance of these particular outcomes in the data might in fact indicate what experts in lower limb prosthetic prescription, including users of the technology, consider to be the important aspects of QOL, and also indicates the importance of accepting the new self with the amputation. Certainly the outcomes mentioned relate to helping a person regain their sense of self, such as participation in valued activities and returning to work or a previous hobby. Bishop posited a model called ‘Disability Centrality’ (Bishop, 2005a, Bishop, 2005b) which is based on the fact that quality of life is determined by different domains having different
levels of importance for every individual, and that disruption of the more important domains by CID has an effect on QOL. This model is similar to the work of Charmez (1983), who instead uses former identities rather than domains, as the area that needs to be changed to adapt to the differences arising from CID to improve quality of life.

Quality of life has a strong connection to adjustment to CID (Bishop, 2005a). By regaining a sense of self and adjusting to the amputation, individuals with amputations are more likely to avoid suffering with mental health illness and have a better quality of life (Engstrom and Van de Ven, 1999). There are a number of measures currently used to measure QOL in amputation literature, such as the TAPES (Gallagher and MacLachlan, 2000a), PEQ (Legro et al., 1998) and Orthotic Prosthetic Users Scale (OPUS) (Heinemann et al., 2003), and do so by measuring a number of different domains such as activity restriction, well-being, social burden and general adjustment to the amputation. The validity and reliability of these scales are still being tested and verified through use in the clinical setting, though have had promising results in previous studies (Gallagher and MacLachlan, 2000a, Legro et al., 1998), indicating that QOL as an outcome in amputation and prosthesis use is close to reaching measurement.

The outcome of ‘Community access and improved socialisation’ relates closely to the new understanding of disability through the ICF framework: participation, defined as a person’s involvement in a life situation, is considered one of the most important outcomes, and is conceived as the result of the interaction between a person’s disease, body structure and function, and activity performance; and personal characteristics and environmental context (Jette et al., 2005). Participation incorporates basic activities essential for survival but also included roles and activities necessary for well-being and self-development (Rochette et al., 2006). This is in contrast with older concepts of disability which would take function as the most important outcome measurement of rehabilitation. In this study it is clear that
function still plays an important role in prosthetic outcomes, though the emphasis on the psychosocial as important outcomes indicates that rehabilitation is no longer just concerned with the physical.

Of the outcomes which did not reach consensus, some were close to being included. Outcomes such as Meeting established rehabilitation goals, and Normalisation of gait are clearly still important within the rehabilitation setting, though from comments left as part of the survey, some users placed less importance on these items:

“I think there is a lot of pressure on amputees to look 'normal' and not consider themselves as disabled. There is little emphasis on challenging the negative attitudes we encounter, instead there is an attempt to 'normalise' us. It is ok to be disabled.”

“Therapist goals are not necessarily those of the user.”

These views explain why items which are considered important outcomes in the general amputation literature, such as gait characteristics, did not reach a consensus of importance in this study: the inclusion of service users as experts indicates that service providers do not always choose the same things as important that users do. This finding has implications for how rehabilitation is conducted, with more emphasis needed in including the individual within rehabilitation research. As client participation and client-centred focus are also central features in the ICF, there is a clear indication of the direction in which rehabilitation research needs to progress in order to achieve optimum outcomes. For a direct example of this, ‘Meeting the individual needs of the service user’ was deemed more important that ‘Meeting established rehabilitation goals’. These two concepts are very similar, but the first has a more client-centred approach to care, whereas the second implies that goals are set by service providers rather than users.

The outcomes identified as important in this also study indicate how including prosthetic users within the prescription process changes the outcomes which are
important to measure. It has become more important to understand and measure the
effect of the prosthesis on the individual’s life rather than to simply measure its
effect on the individuals walking ability. Previous research on outcomes has been
more focused on clinical outcomes rather than outcomes which affect the individual
in their own personal context, i.e. how it affects their daily living, their work life,
their family life etc., which can devalue and disregards important human and social
outcomes (Heinemann et al., 2006).

Unfortunately it is more difficult to measure this type of effect rather than
comparing the differences in walking tests in the fitting centre. There are, as yet, no
universally recognised standardised instruments for measuring QOL in amputation,
for measuring self-reliance, participation or community integration. However, if
optimal outcomes are to be achieved it is clear that is it preferable to look at the
effect of the prosthesis in a more holistic fashion than to just looking at functional
gains. It is then important to ascertain from previous research just which measures
are the most suitable to be used within the prosthetic prescription setting for
measuring these outcomes and to also incorporate patient-reported measures in this
context due to the importance of the patients’ opinion on their own outcomes.

5.5.2 Predictors of Prosthetic Prescription
There were 12 important physical predictors of prosthetic prescription identified in
the data when the age and illness predictors are considered alongside the physical
condition predictors. In terms of age and illness, the most important predictors were
Renal disease/ Dialysis, Visual impairment, Joint-related conditions or illness and
Decline in functional ability due to age or illness. Clearly all of these conditions
would affect prescription, mainly for ensuring the user’s safety and ability to walk
before providing a prosthesis. The affect of Decline due to age and illness is an
interesting factor for predicting prosthesis prescription, as it does not necessarily
affect the initial prosthesis fitting after amputation, but will affect the interaction
between the user and the prosthesis as the user ages, with the possibility of having to
change a prosthesis in order to accommodate for decline in the individual. This means that while it is predictive of prosthesis prescription, it may be more relevant after the initial fitting. This is interesting as age in itself was not considered an important predictor of prosthesis prescription. It is clear then that age and illness in themselves will not preclude someone receiving a prosthesis but that it is someone’s functional ability, regardless of age or illness that will determine prescription. Certainly as age increases, so does the likelihood of developing problems with vision and joint-related illnesses. This may affect prosthetic mobility and encourage a change in componentry over the lifetime of a prosthesis user, but may not be relevant at the original presentation for prescription.

Physical condition predictors of prosthesis prescription were identified that were not related to age. These were Condition of the residual limb, Condition of the contralateral limb, Residual limb pain, Ability to don and doff the prosthesis alone, Severity of pain experiences, Current physical ability, Residual limb length, and Range of motion. Of these predictors, four relate to the condition of the lower limbs, indicating the importance of having residual limbs that are healthy and pain-free before prosthesis fitting, as well as a contralateral limb that is strong enough to aid ambulation, either with a bilateral amputation or with a full remaining limb. These findings are similar to those of previous literature (Smith et al., 1999, Esquenazi, 2004, Brunelli et al., 2006), although generally with training and physiotherapy in rehabilitation it is unlikely that these factors could not be overcome for an individual to use a prosthesis.

The other, more general physical condition predictor factors are again common among the prosthetic literature in predicting prosthetic prescription (Gauthier-Gagnon et al., 1999, Kurichi et al., 2007, Gailey et al., 2002), though it is not usual to see severity of pain, as identified in this study, considered as a predictor rather than the presence of a specific (i.e. phantom, residual limb, back or hip) pain. Taking the severity of the pain, rather than its presence, as a predictor is probably
more reflective of the prescription process. A person with phantom limb pain would be provided with a prosthesis as long as the pain is not so severe as to affect walking.

There were also physical predictors of prosthetic prescription which were close to meeting consensus. Items such as Physical ability previous to amputation, Contractures, Strength and Stamina are ultimately important for predicting prosthesis prescription, and have been identified as predictive of prosthetic use in previous literature (Munin et al., 2001, Taylor et al., 2005). However, they do not preclude prescription, and are commonly directly targeted in the rehabilitation setting so they can be improved with physiotherapy and training over time. Physical ability previous to amputation is also important to consider, though again it would not necessarily predict prescription as being a useful starting point for rehabilitation training. Essentially these items may have not reached consensus as while they are important for the initial training needed before given a prosthesis, they should not prevent someone outright from receiving a prosthesis due to their capacity to be improved in the rehabilitation process.

The fact that many of the above physical factors can be changed and improved with rehabilitation and training indicates the importance of psychosocial factors as predictors of prosthetic prescription. If a person has psychosocial factors present in their situation which encourage involvement in rehabilitation, there may be a greater chance of improving the physical predictors of prosthetic prescription. A list of seven important psychosocial predictors was generated. These were Determination to walk, Social support, Motivation in rehabilitation setting, Optimistic outlook/positive thinking, Feeling in control of the situation, Attending clinic regularly/returning for more fittings, and Avoiding acknowledging the situation.

Determination to walk as an important predictor of prescription is not unusual, as it seems that if a person is determined to walk with a prosthesis, they will do so to at least some degree. However, unlike motivation which is a common predictor of
outcome in the rehabilitation literature, determination to walk has not been looked at in previous studies. Motivation has often been cited as an important factor in rehabilitation (Resnick, 1999, Sabin, 2005, Grindley and Zizzi, 2005) although there are some difficulties related its conceptualisation (Maclean and Pound, 2000). The inclusion of both Determination to walk and Motivation as important predictors indicates how personal factors can play a role in the rehabilitation process, but there is a caution due to the difficulty in measuring these factors: determination and motivation do not have their own specific measures. Recently though, the Hopkins Rehabilitation Engagement scale has been developed to measure participation in rehabilitation, which could arise from determination and motivation to rehabilitate. Furthermore, engagement in rehabilitation is surely the main effect expected from determination and motivation to rehabilitate. Research has shown it to be a valid and reliable measure of engagement and is related to intermediate–term outcomes (Kortte et al., 2007), though more research is needed before it can be universally used. This approach of measuring engagement in rehabilitation may prove more useful than trying to ascertain an individual’s motivation or determination to walk due to the lack of a concrete definition underlying each concept.

In terms of coping, it was clear that having an optimistic outlook and feeling in control of the situation were importance predictors of prosthesis prescription, suggesting that knowing a person’s coping strategies can prove useful. This was also further cemented by ‘Avoiding acknowledging the situation’, considered a maladaptive coping strategy for long-term stressors such as acquired disability, also being considered important by the Delphi study. From these responses it appears that a mixture of problem-focused (feeling in control of the situation) and emotion-focused (having and optimistic outlook) approaches are needed to deal with the amputation and the subsequent rehabilitation. This is similar to findings from other studies which indicate that positive coping strategies facilitate psychological adjustment to amputation (Oaksford et al., 2005, Dunn, 1996). Similarly, avoiding acknowledging the situation has been found to be strongly associated with
psychological distress and poor adjustment (Desmond and MacLachlan, 2006b). Other research has indicated that denial and avoidance are the coping strategies that are mainly used by those with trauma-related lower limb amputations (Sjodahl et al., 2004), indicating that interventions relating to coping strategies in rehabilitation may be useful in optimising use. Coping Effectiveness Training, which aims to improve coping approaches in patients with cognitive behavioural theory (CBT), has been found to be successful with persons with spinal cord injuries, with a decrease in anxiety and depression at a 6-week follow up in comparison to no change in a control group (Kennedy et al., 2003). Similarly, the Promoting Amputee Life Skills (PALS) Self-Management intervention, which aims to improve outcomes after limb loss by using CBT-based interventions on coping skills and cognitive restructuring techniques, has been shown to improve outcomes for those with amputations over those who engage only in support groups (Wegener et al., 2009).

Social support was also included as an important psychological predictor for prosthesis prescription. In terms of predicting prosthesis prescription, it would be useful to know that family and friends are available to help the user if they have trouble putting on the prosthesis, or are available to help if the individual falls. Prescription for those who are at risk for falling or have trouble putting on the prosthesis, may be more likely if they have a support network available than if they do not. Other research has found similar support for social support as a predictor of higher mobility scores with a prosthesis (Williams et al., 2004) and higher levels of perceived QOL (Asano et al., 2008). However, as mentioned previously in the focus group discussion, it is not enough to simply identify if someone has a support network around them, but to understand what effect that support network has on the person’s rehabilitation process. There is the possibility that support network could influence rehabilitation and QOL negatively in terms of reducing self-reliance and self-esteem. As such, a way to identify the specific types of social support would prove helpful as a predictor of prosthetic prescription. As noted in theory, it may be relevant to differentiate between the quality of the social network as opposed to the
quantity (Williams et al., 2004), as well as the type of social support offered. Emotional support, such as concern, empathy and affection, may be more advantageous in a rehabilitation setting than offering tangible support that is, resources to help with the situation. Tangible support can result in feelings of inadequacy and indebtedness (Newsom and Schulz, 1998), but in some cases may also be necessary. Therefore, it is important for the individual prescribing the prosthesis to understand the potential influence, positive or negative, of social support on the user. If a positive influence, it could help make a case for providing a prosthesis, and if a negative influence, it may require providing information to the social network on how they can best help the individual.

Of the psychological items which did not reach consensus, it was particularly surprising that Ability to learn did not emerge as important as it has been shown in previous research to predict prosthetic rehabilitation (O’Neill, 2008). However, it appeared that many of the items were considered important in relation to the individual, such as Depression and Anxiety, but that if these were treated and handled well as symptoms of amputation in rehabilitation, then there is no reason why a person would not be able to use a prosthesis. Suggestions included extra time to get used to the rehabilitation process for those with Anxiety, and making sure staff are prepared to deal with these psychological issues to prevent further problems. This was the similar feeling in relation to cognitive deficits: if patients with these issues are given enough extra training and attention during rehabilitation it is generally suitable to provide them with a prosthesis. Previous research has shown that if given extra time and attention in rehabilitation, patients with cognitive deficits can achieve function with a prosthesis (Barnes et al., 2004). It is clear then that to improve prosthetic prescription, rehabilitation needs to be tailored to accommodate for each specific individual and their specific needs.

These findings indicate the most important predictors of prosthetic prescription, but looking at the items which did not make consensus, it may be useful to consider
some of these as optimising prosthetic prescription rather than predicting it. It is clear that some of these items are not predictive of receiving or not receiving a prosthesis, but that they may be important to take into account in the prescription process. These factors may not be initially overcome in rehabilitation, but over a longer period of time and in an outpatient setting.

5.5.3 Optimising Use of the Prosthesis

There were a number of subheadings under the Optimising use category which will now be addressed. In the acceptance and goal-setting category, only 3 factors were identified as useful to consider in terms of optimising use of the prosthesis: Setting achievable goals, Making sure expected goals are achievable and Returning to work. The first two items, while similar in wording are slightly different. The first refers setting goals both in and out of rehabilitation that are achievable, the second refers to making sure users’ expectations on what they can achieve are correct and not based on false information.

Goal-setting research indicates that failures in goal-setting are related to not measuring the person’s personal goals and not including a sufficient range of goal difficulty levels, among other things (Locke and Lantham, 2002). Previous findings also indicate that if there is a discrepancy between the anticipated rate of progress toward goal attainment and the actual rate of progress, there will be a change in affect, either positive or negative (Siegert et al., 2004). This indicates the need to set goals according to patient wishes, but also according to what is achievable at a given moment in time. The use of Goal Attainment Scaling (GAS), which identifies the important goals for individuals, as well as their difficulty, has been found to be somewhat effective with persons with amputation in rehabilitation (Rushton and Miller, 2002). Another study has also shown that patients’ perspectives of the result of lower limb amputation are hugely variable (Matsen et al., 2000) suggesting that this approach to goal setting, along with information for patients on what is potentially achievable, may improve outcomes.
While Returning to work has already been identified as an important outcome of prosthetic prescription, it was also considered useful in optimising prosthetic use. It is considered useful as a goal in helping a person to reconnect with their old self and to feel driven to rehabilitate. Returning to work has been associated with better health experiences (Schoppen et al., 2001a), lower intensity of phantom pain, and higher levels of daily prosthesis use (Whyte and Carroll, 2002). Furthermore, those with amputations have greater job satisfaction than those in an able-bodied control group, despite experiencing more health problems and difficulties with function in the workplace (Schoppen et al., 2002). These finding further cement the idea of returning to work as an important optimiser of prosthesis use, and also as an important outcome of prosthesis use due to its ameliorating effects on health status.

As many persons with amputations have difficulty in returning to their previous workplace, especially if in manual-labour based employment (Burger and Marincek, 2007), it has been suggested that encouraging changes in job type and increased education in rehabilitation could prove helpful in returning a patient to work (Schoppen et al., 2001b). Considering the positive effects returning to work has on the individual, this should be encouraged as an intervention in rehabilitation.

Of the factors that did not reach consensus, it was unexpected that ‘Accepting the amputation as part of life’ did not. Not many comments were left from those who rated it negatively, with the only relevant comment stating:

“A mark of maturity is accepting oneself—physically, emotionally, economically, intellectually. Amputation should not change this basic concept.”

The above comment seems to indicate acceptance of the self is a necessary part of human life, with or without an amputation. However, while insinuating persons should be able to accept themselves with or without the amputation as long as they are a mature person, it does not definitively state that acceptance of the amputation does not affect outcome. Importantly, no one rated the items as not useful to consider, and the reason the item did not reach consensus was because it had <80%
agreement on usefulness, despite having a mean >4.0. Furthermore, other factors in this study, such as avoiding acknowledging the situation, optimistic outlook and social support, which have been linked to prosthesis use due to their affect on acceptance of the amputation (Dunn, 1996, Desmond and MacLachlan, 2006b), made consensus. Certainly there is a large amount of data within the amputation, AT, and CID literature that would suggest that personal acceptance of a condition or disability is an important factor in improving outcomes, improving engagement in rehabilitation, and using an assistive device or prosthesis (Gauthier-Gagnon et al., 1998, Heinemann and Pape, 2002, Wielandt et al., 2006, Livneh, 2001, Desmond and MacLachlan, 2002). As such, the failure of ‘Accepting the amputation at part of life’ to reach consensus may not indicate that this process is unimportant, so much as the processes which lead to acceptance are considered more important. This may potentially be due to the fact that these processes are easier to understand and as concepts, and as such are easier to influence in the rehabilitation setting for a positive effect.

In the Social factors which optimise use of the prosthesis, seven items reached consensus, which were: Ease of getting about in public, Family accept the amputation, Supportive work environment, Specific movements needed for job/leisure/home life aided by prosthesis, Family understand limitation of user, Family accept and understand the expected potential of user and Establishing/Continuing romantic relationships. This list is an interesting one due to the variety of different domains noted as important to optimising prosthesis use. Firstly, it is important to consider public spaces and the ease of navigating them with a prosthesis. If the user cannot get about easily in public wearing the prosthesis, they will be unlikely to use it often as it will infringe on everyday life. Similarly if specific movements for work or leisure, activities which aid interaction with others in society, are facilitated by the prosthesis, this may potentially increase use of the prosthesis, a finding that has been previously identified in the literature (Gauthier-Gagnon et al., 1999). Furthermore, the affect of wider society on social interaction
has been touched upon before in the literature, especially in terms of disability theories. Current conceptualisations of disability, such as the ICF, have found that society plays a role in creating disability. Society exacerbates impairment as it is created for persons who are unimpaired, therefore making it more difficult for those with impairment to function within it. Disability is then conceptualised as arising from a lack of participation in society rather than from impairment alone: a person is disabled not because they have an impairment, but because society is not structured to accommodate that impairment so that person can participate fully in society. This then indicates that a lack of participation in society increases disability. If the prosthesis helps increase participation, and the surrounding environment such as at work is supportive to the use of the prosthesis, disability may be reduced for the individual, and prosthesis use becomes central to that reduction.

Having a supportive work environment as a potential optimiser of prosthetic use further establishes how the social environment affects use. If it is supportive, the work environment is more conducive to the return of a person after an amputation, which has been identified as an important goal and outcome for prosthesis use. The improvement of support within the work environment has been previously stated as important for those who wish to return to work (Burger and Marincek, 2007, Schoppen et al., 2002). As this study has highlighted the importance of this return to employment for the prosthetic user, it is clear that these improvements can be essential to the well-being of the individual.

The role of the user’s family on prosthetic use was considered useful to identify in prosthesis prescription as the input of the family in terms of acceptance and understanding of the amputation, and the limitations that come with it, are potentially influential on rehabilitation outcomes. The specific role of the family in prosthesis use has not been examined previously in the amputation literature though it is clear that it can have an effect from the results of this study and the previous focus group inquiry. These findings are obviously related to the social support
literature previously mentioned, and also highlight the need to involve close family members, who would be a source of social support, in the rehabilitation process. Information needs to be available for these families on how to aid their relative as well as on what is to be expected from the rehabilitation process. Overall, understanding how to mediate the relationship between the family and the service user for a positive effect would be beneficial in improving outcomes for the user.

The importance of continuing or establishing a romantic relationship is again closely related to social support, as married people with amputations also reported significantly higher levels of life satisfaction than unmarried patients (Nielson, 1991) and those who are divorced or separated has an increased risk of depressive symptoms by almost 100% compared to a person who is married or partnered (Darnall et al, 2005). Further to this, being involved in a romantic relationship will also have an effect on sexual esteem. Sexuality is an important component of identity and self-concept, with satisfaction with one’s sexual relationships with others found to be predictive of overall QOL in persons with limb loss (Walters and Williamson, 1998) and sexual activity has also been found to be a consistent predictor of depressive symptomology (Williamson and Walters, 1996). The presence of an intimate relationship may therefore have ameliorating effects on an individual’s life.

There may however be difficulty in establishing newer sexual relationships as a person with a visible amputation (Geertzen et al., 2009), indicating the need to address this topic in rehabilitation for those without partners. A study by Ide et al. (2002) however found that individuals had never talked to a service provider about sexual issues, suggesting a lack of ease from both parties in tackling the subject matter. This may be something that changes with time, due to the increasing acceptance in society of discussing sexual matters. However, it may potentially be more useful for users to talk to other users about sexual matters. As seen from the focus group inquiry, older users were able to inform discussion on relationships
from their own experiences as a prosthetic user, and pass on advice in that way. They may be more comfortable in doing this than a service provider without personal experience.

The remaining social optimising factors were not close to making consensus. Interestingly, the majority of these factors were demographic in nature, such as earnings and employment status. While these have been found to be associated with prosthesis fitting rates and use rates in the literature (Ephraim et al., 2006, Pezzin et al., 2004), it is clear that the experts in this panel did not consider them as having an effect on optimising use. The difference in opinion highlights how wider demographics in large studies may indicate certain trends, but that these trends are not necessarily taken into account or considered influential in an individualised setting. Of course it is possible that eventually a person will end up following the previously reported influences of demographics, but it would be unreasonable to base the potential for outcome on these factors as they reflect trends rather than relationships.

Prosthesis factors were also rated as having an effect on optimising prosthesis use. The factors in this category which made consensus were: Having a comfortable prosthesis fit, Confidence in walking ability and using prosthesis, Feeling the prosthesis has become part of the user’s own body, Understanding changes in the residual limb and managing them, Fear of falling due to a loose prosthesis, and A shrinking residual limb. Again the importance of comfort is highlighted in this study, as not only an important outcome, but an important factor in optimising use of the prosthesis. Previous research has indicated similarly, with socket comfort affecting quality of life (Hagberg and Branemark, 2001, Asano et al., 2008) and is also strongly associated with general satisfaction, freedom from frustration, and walking distances (Matsen et al., 2000).
Comfort with the prosthesis can also aid the transition to feeling that the prosthesis has become part of the user’s own body (Murray, 2004). Embodiment of the prosthesis, as it is labelled, is a recently recognised phenomenon in amputation literature, and indicates that persons with amputations can achieve positive outcomes from the use of the prosthesis. The embodiment of the prosthesis will aid the user to optimise their outcomes as it leads to decreased awareness of the limb when walking, so concentration is not solely focused on walking, and further can lead to the prosthesis being a source of perceptual information which in turn will aid walking on different surfaces (Murray, 2004). Clearly there are positive effects which arise from embodiment, and it would prove useful to study this phenomenon and how it can be encouraged within the prosthetic service setting.

The shrinking residual limb as an important factor in optimising use is unusual, though makes sense when considered with how an individual understands the changes in their residual limb and how to manage those changes. The shrinking residual limb will affect the fit of the prosthesis, but if the individual expects this change, and knows how to manage the shrinking, the negative affect on the socket fit can be ameliorated. The importance of user knowledge here is interesting, as two items which did not make consensus in this category are related to the maintenance and function of prostheses. It was clear from some answers that it is not necessary or even advantageous for users to understand the fundamentals of the prosthetic components as long as their prosthetist is able to do their job. Thus it is apparent that some knowledge is required on the part of the user to be able to optimise their outcomes, though the knowledge base does not need to be as extensive as that of the prosthetist. Certainly literature on AT user recommends the provision of information to users so that they can become informed, demanding and responsible consumers of AT (Andrich and Besio, 2002). If healthcare is to become more focused on including patient choice and perspectives, it is important that these choices are informed.
The previous factors indicate the importance of a well-fitting prosthesis and the influence of changes in the residual limb on the fit. It follows on that confidence in walking ability, and fear of falling due to a loose prosthesis will all be affected by these above factors. Confidence in walking ability and a fear of falling due to a loose prosthesis are essentially opposites of each other, with the former unable to exist with the latter. Balance confidence has been studied previously and found to be associated with mobility capability, mobility performance and social activity (Miller et al., 2001b), so clearly will affect outcomes. This finding then reinforces the notion of perfecting the fit of the prosthesis. Factors which are related to an increase in the risk of fear of falling include having fallen in the last 12 months, and having to concentrate on each step while walking (Miller et al., 2001c), two factors which are ameliorated with a better prosthesis fit.

The last sub-heading in the optimising prosthesis use section was Service factors. A long list of factors which are essential to running a good service, and which will in turn affect prosthesis use, was created by means of consensus. The factors were: Limb alterations done in reasonable time, MDT support, A returned limb is usable and altered properly, Sufficient time spent on different surfaces when walking training, Patient/prosthetist relationship, Limb alterations done on-site, Suitable walking space in fitting centre, Amount of time located to fitting process, Entrance to building suitable for wheelchairs and prosthetic walking, Patient involvement in prosthetic choice, Access to all members of MDT if needed, Choice in components of the limb, Available transport for users who cannot drive, Accountability of service, and Communication between private –contracted prosthetists and public service employees in same fitting centre.

This list is extensive, but can be separated into a number of sections. Firstly, there are certain standards that are needed within the fitting centre building to encourage users to return to fittings, as well as provide an adequate place to train. This includes providing transport for those who cannot drive, wheelchair accessibility,
different surfaces for training on, as well as enough space to walk to test the limb. It is also preferable for alterations to be done on-site, rather than sent to another fitting centre, so that changes can be made quickly and accurately for the individual. These may seem like essential components of any prosthetics service, though from the focus group inquiry it is clear that not all available services provide all, if even any, of the above. A lack of these facilities may leave users unhappy with fittings and the service, meaning they are less likely to avail of it when problems occur.

Secondly, delivery of care is also identified as important in optimising prosthesis use. To increase use, prosthesis users need to be involved in the process, by being offered choice in components and also in developing a relationship with their prosthetist. Other studies have highlighted the importance of the above, especially the choice of the patient (Van der Linde et al., 2007, Geertzen et al., 2002, Sjodahl et al., 2008). This may also be helped by increasing the time spent in fittings with users. Further to this, the delivery of care should also not be dependent on whether the service provided is publicly-funded or is contracted out to a private manufacturer. Restriction can occur in both cases, either due to funding, or due to restrictions to components made by one manufacturer, or restrictions on the MDT available to each user. This study highlighted how communication between private and public staff working within the same service must be improved to meet the needs of the patient so that private prosthetists can refer to public-employed physiotherapists, doctors, clinical psychologists, occupational therapists or nurses, and vice versa, if there is a need to do so. This is not something that has been previously reported in the literature, but clearly needs to be discussed more openly among those who work in settings which involve private and publicly employed personnel.

To improve delivery of care, an accountability of service is also needed. If service providers are not made accountable for their actions, it may become difficult to operate a service to the highest standard at all times. This finding is more relevant to privately-hired employees as public services will generally have an operative
complaints service or even department, available. Improving the service involves responding to these complaints and while it is hoped that all service providers would deliver care to their utmost ability, it is clear from the focus group inquiry that this is not the case in all fitting services. Having accountability for care ensures that users not only receive the best care, but also offers assurance to users that they can demand high standards from their services.

The importance of these service factors is to increase the standard of care for service users, which should increase satisfaction with the prosthesis and in turn optimise use. If service is always offered to the highest standard, then there is less likely to be physical problems which affect use, such as socket comfort. Further to this, if the service is satisfactory, users will be more likely to return for adjustments if they need them rather than assuming that the service cannot help them. This in itself will help users to get the most out of their prostheses.

As can be seen from the data, it was easier for service factors to reach consensus as evidenced by the amount identified as useful to consider. This may be due to the concrete nature of their effect, and the greater potential to implement these factors into the service setting over other interventions. Furthermore, many of these factors are standard for running a good service, so it is necessary for them to be a part of the fitting centre in order to offer the best service.

Previous research has indicated how service can be improved and which areas need to be addressed through using the SERVQUAL and other measures, but this research has indicated that service is actually an integral part of the rehabilitation process which plays a role in optimising the use of the prosthesis. Improvement therefore is not just necessary to create greater satisfaction with the service, but also affects the way an individual engages in prosthetic rehabilitation, and potential affects how an individual will do with their prosthesis depending on the delivery of care within the initial fitting process and follow-up appointments. This means that a larger
emphasis must be placed, in both research and within the fitting service itself, on improving the delivery of service if optimal outcomes are to be achieved. Recognition of the impact of service on outcomes by service users and providers in this study suggests that those running and using the service are aware of its importance and this now needs to be reflected in the research and practice.

5.5.4 Strengths and Limitations
There were strengths to this study. Firstly, by conducting the surveys online it was possible to collate the information from users and create surveys easily. Further to this, invitations and reminders for the survey could be sent by email so notification of delivery was immediate, and it was possible to contact experts from a number of different countries to take part. Having experts from a number of different countries meant that a wider base of knowledge could be accessed. As prosthetics as a field tends to have universal truths, having experts from different service perspectives is unlikely to have affected the data negatively, and instead led to findings being more accurately representative of wider knowledge. The study was also unique in its approach to using the Delphi in the amputation literature by identifying outcomes, predictors and optimising factors and including psychosocial factors within the study, and also by including users as experts within the field. By including user perspectives, answers were generated that may not have been without them, especially within the outcomes section, if only service providers has been surveyed. Including the opinion of services users was important to this study as it further emphasised the importance of user opinion in the prosthesis prescription process.

Despite this, there were still some limitations to the Delphi study. The main limitation was the misunderstanding regarding the rating of factors which optimise prosthetic use. That items could be rated as useful even if they had a negative effect on optimising use was not well communicated to the participants and could have potentially impacted on whether some factors made consensus, despite efforts to correct the problem. However, any factors which were seen to have a positive effect
were clearly identified and made consensus, so the impact of this misunderstanding may not be too detrimental.

There was also the potential to conduct more rounds of the Delphi to further clarify some of the results or to potentially change the wording of some items. However, another round of inquiry may have lead to further drop-outs from participants, which was not advisable. Most previous Delphi studies have been conducted with three rounds or less so it was concluded that three rounds would be adequate for this survey as long as each items was rated at least twice.

5.6 Conclusion

In all, the Delphi study delivered a list of the most important factors to consider within prosthetic prescription and rehabilitation. This is the first time consensus has been sought on the most important outcomes, predictors and factors which optimise prosthetic prescription and use. Furthermore, this is the first time that outcomes, predictors and optimising factors have been looked at from a physical, psychological, social and environment perspective.

A list of the most important outcomes to consider in prosthetic prescription, for both prosthetic providers and users is needed within the amputation literature to improve the delivery of service, improve research within the area and to evaluate different interventions and prosthetic devices. The list of the most important predictors of prosthetic prescription created in this study will contribute to standards of care within this setting. It is understood that it is impossible to create and standard interventions for all due to the individuality of prosthetic prescription, but it is hoped that this approach creates a standardised way to determine which interventions are best used with each individual. This list indicates which factors will affect the potential of each prosthetic user. It is hoped this list will best direct those in the fitting service as to whether an individual will be able to complete rehabilitation and avoid non-use of the prosthesis, and also to which types of prosthetic components
should be used with the individual so they will avoid under-use of the technology but also have the opportunity to achieve their potential best outcomes.

By also generating a list of other factors which will potentially impact on optimising the use of the prosthesis, this study has highlighted how a large number of factors influence the use of the prosthesis as well as the rehabilitation of the prosthetic user that are not predictive of prosthetic prescription. Establishing the importance of these factors indicates how the service can be tailored to improve the outcomes of those with prosthetic limbs, be it through offering interventions for family members or improving the fitting centre facilities. While previous research has often commented on the outcomes and predictors of prosthetic prescription, identifying the factors which are useful to consider as having an effect on prosthesis use is essentially making explicit implicit knowledge from service providers. Having a list of these factors solidifies their importance within the fitting setting and encourages further research in this area to tailor interventions and measures for these factors.
Chapter 6 - Study Conclusions

The aim of this research was to explore ways to optimise lower limb prosthetic prescription and use by identifying and gaining a consensus on 1) the most important outcomes of prescription, 2) the most important predictors of prosthetic use, and 3) the most important factors which have an effect on optimising use of the prosthesis. Through the research process these aims have been achieved and will now be discussed.

In the Repertory Grid study it was apparent that prosthetic prescription needs to include the input of the prosthetic user. The values and meanings that prosthetic users place on the different technologies they are offered may affect the way they interact with and use that technology, either in a positive or negative way. By knowing these preferences we can tailor the prescription process appropriately. Furthermore the study also highlights how progress in prosthetic technology needs to take into account user preferences so that high-tech technology advances reflect user preferences.

The focus group and interview study highlighted the importance of psychosocial outcomes in prosthetic rehabilitation, as well as their importance in predicting and optimising prosthetic prescription and use. It also ensured that other important outcomes, predictors and optimising factors, psychosocial, physical or service-related, were also identified. By identifying these factors it is clear that there are a number of ways, especially in terms of service provision, that the prosthetic prescription service can be improved to address the needs of the user and increase satisfaction with the prosthesis.

The Delphi study furthered the results from the focus groups and interview study by gaining a consensus on the most important outcomes, predictors and optimising factors for prosthetic prescription and use. By narrowing the results in terms of
importance, the remaining factors are more applicable to the clinical setting and can become the focus of prosthetic rehabilitation, fitting and research in order to optimise outcomes, improve delivery of service, improve research within the area and improve quality of life for prosthesis users.

There are a number of strengths to this study. Firstly, the sample used, from the Repertory grids to the Delphi surveys, included a wide range of different professions from a wide number of different countries, making sure that all aspects of prosthetic care, especially within a Westernised model of healthcare, were included. Having participants from different countries meant that more considered experts in the field, regardless of nationality, could be included in the study. Those working within prosthetics tend to share knowledge internationally, through journals and conferences, to ensure that standards are always being raised and advances shared with others in the field, and this study, by being cross-national, continues this practice. The study also included service user input throughout to make sure that the research remained client-centred. This inclusion of service users also meant that a new approach to presenting data could be achieved by combining the user and service provider data in the focus group study to compare and contrast findings.

This however was not the only novel approach used in this study. There are currently no other studies in the lower limb amputation literature which have used a Delphi study for identifying outcomes of prosthesis use from a psychosocial perspective, and no other studies in the literature that use a Repertory Grid approach when examining lower limb prosthetic prescription. The use of these techniques therefore offered a unique way to approaching the issues of outcomes and predictors in prosthetic prescription. The mixed method approach has given further understanding to the reasons behind the importance of certain outcomes and predictors. Furthermore, this study included factors that were physical, psychological, social and environmental in nature, a range of different domains that have not been addressed altogether within one study. By using this approach it is
hoped that this study addresses all the facets of rehabilitation which have a bearing on prosthesis prescription and use, rather than confining the findings to a specific field.

The use of a mixed methods methodology was also a strength to this study as it gave the opportunity to examine the research problem using the best methods available. Combining quantitative and qualitative research also can reduce all the weaknesses associated with each approach while also emphasising the strengths. It was also possible to explore the research question (repertory grid, focus groups and interviews) and confirm and gain a consensus on the data (Delphi study) in the same study.

There were also limitations to this study that could be addressed in future research. One of the main drawbacks to the study was the absence of a perspective from persons with an amputation who choose not to wear a prosthesis. Due to the fact that they do not wear a prosthesis, this group of people are not availing of prosthetic services, are not known to those in the services and are therefore difficult to recruit. Having a greater understanding of and knowing why people choose not to wear a prosthesis would provide an alternative perspective on outcomes and their predictors. Some people may make an independent lifestyle choice that they do not wish to wear a prosthesis irrespective of its functionality and a responsive service, whereas others may choose not to wear a prosthesis because they are dissatisfied with it. This then presents an interesting area into which future research could investigate. There were also limitations regarding the methods used. Although there are many advantages to using a Delphi, the Delphi survey was long and this may have contributed to participant drop-out. It may have been preferable to have divided the Delphi into a series of shorter surveys to encourage a higher participation rate.

6.1 Outcomes of Prosthetic Prescription
From the review of the literature of prosthetic prescription it was clear that there still remains much uncertainty about what exactly are the most important outcomes to measure in lower limb prosthetic prescription, or the outcome measures that should be used. This study identified outcomes which are important to both the user and the service provider to improve the prosthetic prescription process. The outcomes identified did not just include physical outcomes, but also outcomes that were psychosocial in nature.

Of the outcomes considered important to measure, there were none that have not previously been identified as an outcome of prosthetic prescription. However, some of these may not have been directly assessed as relevant to prosthetic prescription rather than being items to be rated as part of a larger disability index, such as the Barthel Index for measuring self-reliance. Interestingly, although widely evaluated within the amputation literature, mobility levels were not considered an important outcome. Throughout the focus groups and the Delphi, greater importance was placed on the psychosocial outcomes of the prosthesis, such as self-reliance and quality of life, rather than functional gains, such as not being in a wheelchair or normalisation of gait. This finding indicates the importance of recognising that psychosocial outcomes can be as important as physical ones in an area of healthcare where improved physicality is one of the main aims of technological advances and research. Thus advances in the technology, while offering greater gains in mobility and improvement in gait, are not as important as re-introducing independence into an individual’s life after being incapacitated after the amputation. For instance, one of the service providers in the interview process noted how prosthetic users often thought that their first prosthesis was the best one. This was not because of the make, weight or comfort, but due to the gains they got from the prosthesis in terms of independence.

Interview 4 (prosthetist): I wish I had a pound for every time I heard someone say they loved their first leg, that’s it’s the best leg you ever gave them...a lot of people remember that as something good years to come. And I wonder if that’s because that’s the one that got them up and going
The focus group also showed that independence, even on small things such as being able to go to the toilet unassisted, was valued by prosthesis users. This finding then shows that small gains in functionality have significant psychological outcomes. Considering the importance this study places on psychological outcomes, this finding highlights how the provision of a prosthesis to an individual who will only achieve small functional gains may in fact hugely improve a person’s life.

Placing importance on psychosocial gains and comfort has recently become more central to the delivery of healthcare. When a number of different options are available for treatment of a specific illness or condition, it becomes important to ascertain which treatment will be most effective, but also how the treatment will impact on the patient’s quality of life (Anderson, 2001). The results of this study indicate that this approach may also be appropriate with prescribing prosthetic componentry, or even when deciding if the provision of a prosthesis, and large amount of rehabilitation that is associated with its use, would be suitable for an individual.

Furthermore, this approach emphasises the importance of treating users of prosthetic technology as individuals, and insuring that interventions and prosthetic components are applicable to the person as a whole rather than just physically. As seen from the Repertory Grid study, understanding how a person reacts psychologically to different prosthetic options could prove useful in preventing the non-user of prosthetic technology and improving outcomes.

As prosthesis prescription aims to have a holistic approach to prescribing technology, a definitive list of the important psychosocial outcomes to measure insures that this approach is considered standard and applicable to all individuals. To date there has been no consensus on the outcomes that need to be measured in prosthesis prescription, with a wide number of different factors measured within the research literature, as well as within the actual rehabilitation setting (Deathe et al., 2002).
Furthermore outcomes measured within the rehabilitation setting tend to be based on the functional rather than the psychosocial, as demonstrated in the interview data:

Interview 8 (physiotherapist): Well I think the best measure of outcome is quality of life. We don’t do that though! We measure mobility. Em, we should measure QOL.

This is not to indicate that psychosocial outcomes are not considered in prosthetic use; there are measures available which measure different psychosocial outcomes, such as the TAPES, PEQ, and PGI. However, until now there was no consensus on which of these factors it was important to measure as part of rehabilitation, and as such these measures are not universally used within the rehabilitation setting. This research has created a consensus on the most important outcomes to consider in prosthetic prescription, which includes these psychosocial outcomes, a move which hopes to encourage the inclusion of psychosocial outcomes within the rehabilitation setting and within the prosthetic research field.

The identification of important outcomes is essential for evaluating services. If there are expected outcomes to reach it is easier to assess the delivery of service, the progression of persons through amputation, and also any innovations which may occur within the sector; there is a basis upon which to evaluate the effect of new technology or new interventions within prosthetic rehabilitation in order to improve the service, and a basis upon which to evaluate different services in relation to each other. Having outcomes set can only improve the service as it stands and sets goals for research within the area.

Knowing the outcomes of prosthetic prescription also makes it easier for users to apply for reimbursements from third–party institutions. By providing substantiation for why certain prosthetic components are chosen, or why prosthetic components would need to be changed for an individual, it makes it easier for service providers to justify the expense of changes (e.g. if there is the potential to improve a persons independence by providing them with more lightweight components). This is
relevant even for publicly funded services as they work from a budget, of which a large investment on components on one individual also needs to be justified.

6.2 Predictors of Prosthetic Prescription

The literature review revealed that predictors in prosthetic prescription are not fully understood, especially when it comes to the impact of psychosocial factors. The focus group and interview data, while also identifying a large number of potential predictors of prosthetic use, also indicated that determining the potential of someone is important to prosthesis prescription. However, there is ambiguity around how this potential is established before prescription occurs. Through the Delphi study a number of physical and psychosocial predictors were identified as important to the lower limb prescription process. The categorisation of these factors as important potentially indicates which factors can be used within rehabilitation to inform what is meant by, and also predict, potential. If service providers are aware of the most important predictors of prosthetic use that they need to address in the fitting process, even in checklist form, it means that the most important areas to measure prior to amputation are always addressed. Doing this may reduce the issues with under-prescribing individuals by providing them with lesser technology than they need and under-use when expensive technology is not fully utilized to its potential.

The predictors considered to be important in prosthetic prescription included a large amount of physical factors. The majority of these however reflected physical items which cannot be remedied within rehabilitation, but have to be taken into account before deciding on prosthetic components or progressing through prosthetic rehabilitation, like renal disease and residual limb pain. Items which have been seen as predictive of prosthetic prescription in previous literature, such as contractures, strength and physical ability previous to amputation did not reach consensus in this study. Unlike the other factors above which cannot be fully remedied in
rehabilitation, it was believed that these factors could be improved upon in rehabilitation and would not preclude prosthetic prescription. Service providers noted that setting up extra rehabilitation and tailoring it to ameliorate these problems would reduce their impact on componentry.

Stamina, motion, strength and balance can all be learned or gained; having them before is good, but not essential.

As such, it was believed that some of the psychosocial factors which would have an effect on rehabilitation engagement, such as motivation and determination, were considered to be more important in predicting prosthetic prescription than some physical factors.

One factor which has not been considered before in the research was that of decline due to age and illness. It appeared from the focus group and interview data that as an individual ages with the prosthesis, it will need to be altered to meet the changing needs of their physicality, inevitably with a ‘downgrade’ in technology so the prosthesis is more manageable for the user as they become weaker with age or illness. This was declared to not only mean a change in prosthesis, but potentially could impact on the individual psychologically. The reasons behind this are as yet unknown, but could potentially be related to feelings of attachment to the prosthesis, issues with using lesser technology, or the change in prosthesis emphasising the aging process. This was recognised as important within the focus groups, interviews and Delphi study, which indicated that further research may be warranted.

The identification of these predictors makes implicit knowledge explicit. Furthermore, this knowledge can then be relayed to service users as well as to service providers. Knowing these predictors makes the prescription process more accessible and tangible to the service user, meaning that they can become more involved in the process. This is especially true of psychosocial factors. Most users would understand the concepts of determination and attending the clinic regularly, and if aware of their potential effect, may be more inclined to improve these aspects
in their own lives if possible. These are aspects over which they have some control, unlike their physical condition after amputation. Feeling in control of the situation was in fact one of the recognised important predictors of prosthetic use, so the provision of this knowledge could also aid in improving prosthetic prescription and fitting.

Gaining a consensus on the important psychosocial predictors of prosthetic prescription also proves useful for those dealing with amputation patients who may not have access to a psychologist. Knowing these factors may make it easier for those working in rehabilitation to make a case for individuals who may not be fully suitable in terms of functionality, to go forward with prosthetic prescription. As time and money are important resources in healthcare, these predictors help add legitimacy to basing functional recovery decisions on psychosocial factors as well as on functional factors.

6.3 Factors Which Optimise Prosthesis Use

It was also necessary, from a review of the literature and also from analysis of the focus group and interview data, to identify other factors which may affect the use of the limb but do not predict prosthetic prescription. Factors which affected optimising the use of the prosthesis will not specifically predict the prescription of the prosthetic limb, but will have an effect on whether the limb is worn and used to the optimum of its potential. The identification of these factors indicates how optimal use of the prosthesis can be encouraged: by putting interventions in place to deal with factors which may have a negative effect on prosthesis use, or encouraging the factors which have a positive effect, such as the inclusion of the family in the rehabilitation process.

Distinguishing this group as ‘Factors which Optimise Prosthetic Prescription’ had not been previously done. Many of these factors have been previously studied in relation to prosthetic use and their effect, but not in terms of how they can be
addressed within the fitting centre setting to improve outcomes. By doing so this study has indicated health care providers can play a large role in optimising prosthetic use and avoiding under-use of prosthetic technology by identifying these factors and setting up appropriate interventions.

For example, when the focus group data was analysed it became apparent that the delivery of the service could affect how individuals use their prosthesis, indicating that service is an integral part of the rehabilitation process. Poor service impacted on care and also affected whether an individual would return to the service for adjustments and further fittings. It was clear then that certain standards need to be set to optimise the outcomes with the prosthesis, and optimise the satisfaction users had with the service. Currently the British Society of Rehabilitation Medicine has laid out a number of standards and guidelines for amputee and prosthetic rehabilitation in Great Britain. These guidelines and standards are thorough and applicable to the British model of health service provision under the NHS. There is also the Commission of Accreditation of Rehabilitation Facilities (CARF) which accredits facilities internationally, but to mainly Western societies. It provides accreditation after an inspection and survey of facilities though does not appear to enforce these standards after accreditation is provided. It may therefore be advantageous to create standards that may be applicable to a number of health service models and to encourage each limb fitting centre or health care service to ensure that certain standards are met and monitored at all times. Furthermore, that they are met in all services offered by a facility, including outpatient and home care. Setting up complaints services and having clear accountability will aid to ensure that standards are always met.

This is also an issue that arose in relation to delivery of care, where it is clear that there is greater need to establish monitored professionalism and audits of care in the prosthetic provision sector. That is not to say that all those within amputation services are intentionally operating without professionalism, but from the focus
group data it is clear that some services and service providers are not monitored to ensure standards are continually met and this has had a detrimental effect on the people who are in their care. Furthermore, if all persons working within the area are obliged to follow a code of conduct in their work practice, and the similarities in these among the different professions working in prosthetic rehabilitation are highlighted, the potential differences and problems that occur from outsourcing work in the public sector to private contractors may be overcome. That is, if all persons within the prosthetic setting recognise they have the same goals, standards and ethics, with the user’s welfare the most important issue, there may be fewer issues with communication between the two different sectors. This may also involve greater involvement of contracted prosthetists in pre-prosthetic rehabilitation, and greater involvement of the MDT in post-prosthetic rehabilitation, potentially in team meetings to discuss patient care. There is currently no research which looks at the experience of privately contracted workers in the public sector or which examines the communication between the public and private employee. Addressing this problem is relevant to patient care and should be further examined in research and within the fitting-centre setting to find a solution.

The importance of the effect of family on optimising prosthesis use was also evident from this research. Previously the effect of the family on prosthesis use has been looked at in terms of social support. This research shows how the psychological comfort of the family with the amputation and the family understanding the prosthesis fitting process, may influence how the person with the prosthesis will progress. These findings indicate a need to include the family within the process of prosthetic fitting. However, due to the potential negative effects of social support on rehabilitation, recognised in the literature and in this study, the appropriate role of the family in rehabilitation needs to be established and promoted. The large amount of data generated with regards the family over the entire study again indicates that further research which looks at the specific role of the family in prosthetics and how to improve outcomes would be beneficial.
In all, this research further emphasises an approach to prosthetic prescription that is based on client-centeredness and individuality. From the Repertory Grid data, and also within the focus groups, interviews and Delphi study data, it was clear that the role of the patient as an individual needs to be emphasised within the prescription process. The Repertory Grid highlighted how different individuals evaluate their prosthesis and have differing views on the prosthetic technology that is available, the focus groups and interviews explored how current practice is aimed at client-centeredness, and the Delphi established a number of factors as important to prosthetic prescription and use that concern catering towards the individual, such as the importance of setting goals to the individual, meeting the individual needs of the service user, and patient involvement in prosthetic choice.

Offering care that is tailored to the individual is important then for prosthetic prescription to optimise outcomes. However, it is also difficult to stress individuality in treatment in the context of contemporary health services. Practitioners have less time with patients, are encouraged to hit targets in service provision and have to stay within a budgeted system. This means that all considerations in care need to be put through cost/benefit analysis before being implemented. This is why this research, by reaching a consensus on the most important outcomes, predictors and factors which optimise use, is useful to healthcare. It facilitates a focused client-practitioner interaction and maximises the opportunity to gain important information on goals important to the user, and the user’s personal feelings towards using various prosthetic components. This research therefore has not created a single intervention that is applicable to everyone, but instead has completed the first step in standardising the way of identifying which interventions or components a person needs depending on their individual evaluations.
6.4 Implications

In the widest sense, this research has indicated through its findings that the most applicable model of health for prosthetic prescription is that of the Biopsychosocial model. The findings in this study highlight the importance of the psychological and the social in a field that is primarily associated with function, adding more support for the use of this approach in healthcare. Previously in prosthetics there has been comparatively little literature addressing the psychosocial than that which looks at physical factors. Furthermore, within the MDT in prosthetic care, it is unusual to find a psychologist working within a fitting centre facility. This research has highlighted that while the physical factors are clearly important for prosthetic rehabilitation, including a psychosocial approach is essential to optimising outcomes. The focus groups and interviews indicated how a psychologist is an important asset to the fitting process, and the Delphi study showed a consensus on the importance of a number of psychosocial outcomes, predictors and optimising factors in prosthetic rehabilitation.

It is also clear from this research, which indicates that a wide range of factors influence prosthesis use, that disability is not a result of impairment alone, but of a number of different factors including the physical, social and personal. This research therefore purports that the most applicable model of disability that currently exists is the ICF as it takes into account physical, social and personal factors which can impact on disability and is currently the only approach to do so. Furthermore, the ICF is now becoming widespread within healthcare and rehabilitation, and as such it is important for prosthetics to fit into this wider viewpoint. Notwithstanding this, the ICF is not fully applicable to prosthesis prescription due to missing fundamental detail in regards specific aspects of amputation, such as residual limb length, and not addressing relevant psychological factors such as feeling in control of the situation.
In terms of psychological theory, this research has further supported the Buffering Effect Hypothesis of social support that is, the presence of social support helps ease stress by being a mediating presence, as opposed the Main effect hypothesis, which states the mere presence of social support will have an effect on well being. It is clear from this data that while having family and friends to support you is beneficial, is the type of social support that is given, rather than just having an extended social network, which has an effect on how someone will do.

This research has also offered some support for using the Theory of Planned Behaviour as a way to predict prosthetic rehabilitation, as posited by Callaghan et al. (2004). They stated that by identifying in rehabilitation patients a number of behavioural outcome expectancies (attitudes), normative influences (subjective norm), and items which affect perceived control, it would be possible to predict prosthetic use. This study found that perceived control was predictive of prosthetic prescription, as well as subjective norms (such as the family) having an influence on optimal prosthesis use. Attitudes relating to outcomes were also identified as important, like Determination to walk found to predict prosthetic prescription. These findings in all show how attitudes and beliefs can have an effect on prosthetic prescription and use, and give further support to looking at the TPB as a relevant theory within the field of prosthetic provision.

However, this research also raised some issues with the idea of motivation as a concept in rehabilitation. While motivation is commonly used as a concept within the literature, it may be more beneficial to measure motivation in terms of engagement in rehabilitation, including other factors such as determination and enthusiasm, rather than as a lone concept which has an effect on prosthesis use. It would be impossible to abandon motivation as a concept altogether as it is ‘so deeply ingrained in the thinking of rehabilitation professionals’ (Maclean and Pound, 2000, p.505). It may also be unwise to do so as it a useful concept in rehabilitation due to it being inextricably linked with goals-setting theory (Siegert and Taylor,
Goal-setting is an essential aspect of rehabilitation that could potentially be lessened as a concept if the theory underlying it was rejected (Siegert et al., 2004).

In terms of models for prescription, the MPT model for AT prescription was supported by this research. From the findings it appears likely that it is important to take into account the salient characteristics of the assistive technology itself; the characteristics of the environment and the situations in which the technology is to be used; and the relevant features of the individual’s personality, temperament, and preferences that may have an effect on the use of the technology. Certainly all of these factors are seen to affect the prescription and use of a prosthesis according to this research. The assessment process used is client-centred and makes a point of identifying barriers to AT use but also interventions to ameliorate them, an approach which is recommended in this study. This research not only identifies aspects specific to prosthetic prescription and use but also builds on what is put forward by this theory by showing that service itself will impact on the prescription of the limb and how the prosthetic service needs to be aware of its own impact on patient outcomes as well as the many other factors addressed in the MPT model. This could be in terms of what is offered by the service in terms of MDT support, how the delivery of service is conducted (Are goals set with user input? Are repairs done speedily and properly?), and what facilities are available within the centre.

There are also implications for future research in this area. It would be advantageous to take the findings from this study in relation to outcomes and make it practical for the prosthetic provision setting. Firstly, this would involve identifying valid and reliable outcome measures relating to those identified in the study that are currently used or available to use in practice and subsequently to recommend those that are most appropriate to use in practice. Recently research has begun in the development of the Patient-Reported Outcomes Measurement Information System (PROMIS) which aims to develop a way of measuring outcomes that are applicable to the individual in a more standardised and efficient
way using Item Response Theory and Computerised Adaptive Tests (Rose et al., 2008). This approach creates item banks on concepts from existing measures which are used to measure the different relevant traits, and then the ability to pick and choose the relevant item banks for an individual e.g. if QOL is an important outcome for an individual, an item bank created from the current measures of QOL will be applied to the individual. Only the most informative items relevant to the individual from the item bank will be used to cut down on response burden. It is hoped that this approach will make it easier to compare outcomes in different settings and will revolutionise the way in which outcome measurement in conducted in the clinical setting. The outcomes of this study would be greatly served by this project due to the large amount of outcome measures which currently exist in prosthetic provision: The PROMIS database potentially provides an appropriate way to measure an outcome identified as important in prosthetic prescription, and also make the result more comparable to other settings. However, it should be noted that this project is only being developed and is currently only in the stage of being piloted.

It would also be useful to compile the predictors of prosthetic prescription for use as a screening tool in the clinical setting. Having such a tool could guide those without knowledge of relevant predictors to recommend someone for prosthetic rehabilitation training. For example, those in the primary hospital setting could be asked to build a case for an individual to progress to rehabilitation and eventually receive a prosthetic if they had a tool which directed them on the important predictors to assess previous to rehabilitation. This measure could indicate if it would be worth putting hospital resources towards the rehabilitation of an individual, or if hospital resources would be wasted by a failure to rehabilitate. This measure could help to make a case for those who may not initially meet criteria for prosthetic rehabilitation due to physical factors, but who psychosocially could potentially rehabilitate to use a prosthesis to some extent. This tool could also direct a service provider on where more evidence is needed before making a decision about
rehabilitation, be it through using a questionnaire, medical history, or referral to gain this extra knowledge. As the findings of this study show, even small gains in independence from prosthetic mobility are appreciated so a means by which to predict this, using physical, psychological, social and environmental factors, could potentially make a big difference to an individual’s quality of life.

Certainly the next step for research will involve establishing how these outcomes, predictors and optimising factors are currently used in practice, but also to establish what interventions are currently used, if any, to improve these outcomes and also to enact an effect on the predictors and optimising factors. By doing this it will be possible to ascertain if there are any gaps in the knowledge as it stands and where further research interests can be directed. In terms of service-related factors, this may involve addressing current practice and improving the areas recommended by the Delphi as important in optimising prosthetic use.

It would also be beneficial to further define how some of the more ambiguous psychosocial factors, such as motivation and social support, can be utilised in prosthesis prescription for optimal outcomes. Clearly there are issues surrounding how each one is measured, and also how each is operationalised, meaning that their use in the clinical setting is currently based on subjective evaluation rather than an objective measure. It may actually be more practical, because of the variability in theory available, to address how these factors impact specifically on prosthetic rehabilitation and use to develop a prosthetic specific measure rather than a measure based on theory that is applicable to a wider amount of settings.

**6.7 Conclusion**

By gaining a consensus on the most important outcomes of lower limb prosthetic prescription, predictors of lower limb prosthetic prescription, and factors which optimise the use of lower limb prostheses, this study has made a definitive step in the direction of improving prosthetic prescription. The knowledge gained from this
research will aid those working within the prosthetic fitting setting to prescribe prosthetic technology with greater accuracy and to address the important outcomes for the user of the technology for better results. This study has highlighted that even in a functionally-dominated research field, it is still important to be aware of the psychosocial impact of impairment and the technological interventions created to reduce that impairment. This research has indicated how psychological comfort can play a role in prosthesis satisfaction that needs to be taken into consideration. Standard issue components with less functionality gains were found to improve quality of life and psychosocial outcomes were considered just as important, if not more important, than functional gains. This research indicates that service providers need to consider the importance of psychosocial factors within prosthetics prescription and use. It is not necessary for them to know and understand the theory underlying why these factors are important, but to rather to realise the importance of user input and opinions within the fields of prosthetics and the potential psychosocial factors at play.

In a research field where advancing expensive technology that is available only to a select minority is encouraged, the findings of this study suggest that this may not be the most appropriate way to approach research and development in prosthetics. It may prove more beneficial to the lower limb amputation population as a whole, and more cost-effective to those prescribing it, for research to focus on the advancement of prescription and fit to optimise functional and psychosocial outcomes for the majority of users, rather than developing high-tech components for the functional gain of a few. If advancement in the prosthetic field is user-driven rather than based on technological advancement as currently espoused by rehabilitation engineers, the result may mean an increase in user satisfaction and quality of life rather than small gains in functionality from expensive prosthetic components.
References


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CAMPBELL, S. M., HANN, M., ROLAND, M. O., QUAYLE, J. A. & SHEKELLE, P. (1999) The effect of panel membership and feedback on ratings in a two-
round Delphi survey: Results of a randomised controlled trial. *Medical Care*, 37, 964-968.


LIVNEH, H. & ANTONAK, R. F. (1997) Psychosocial Adaptation to Chronic Illness and Disability, Gaithersburg, MD, Aspen.


MCNEILL, H., DEVLIN, M. & PAULEY, T. (2008) Outcomes of patients transitioning from unilateral transtibial amputation to bilateral transtibial


reintegration of people with lower limb amputation. Archives of Physical Medicine and Rehabilitation, 82, 1425-1431.


