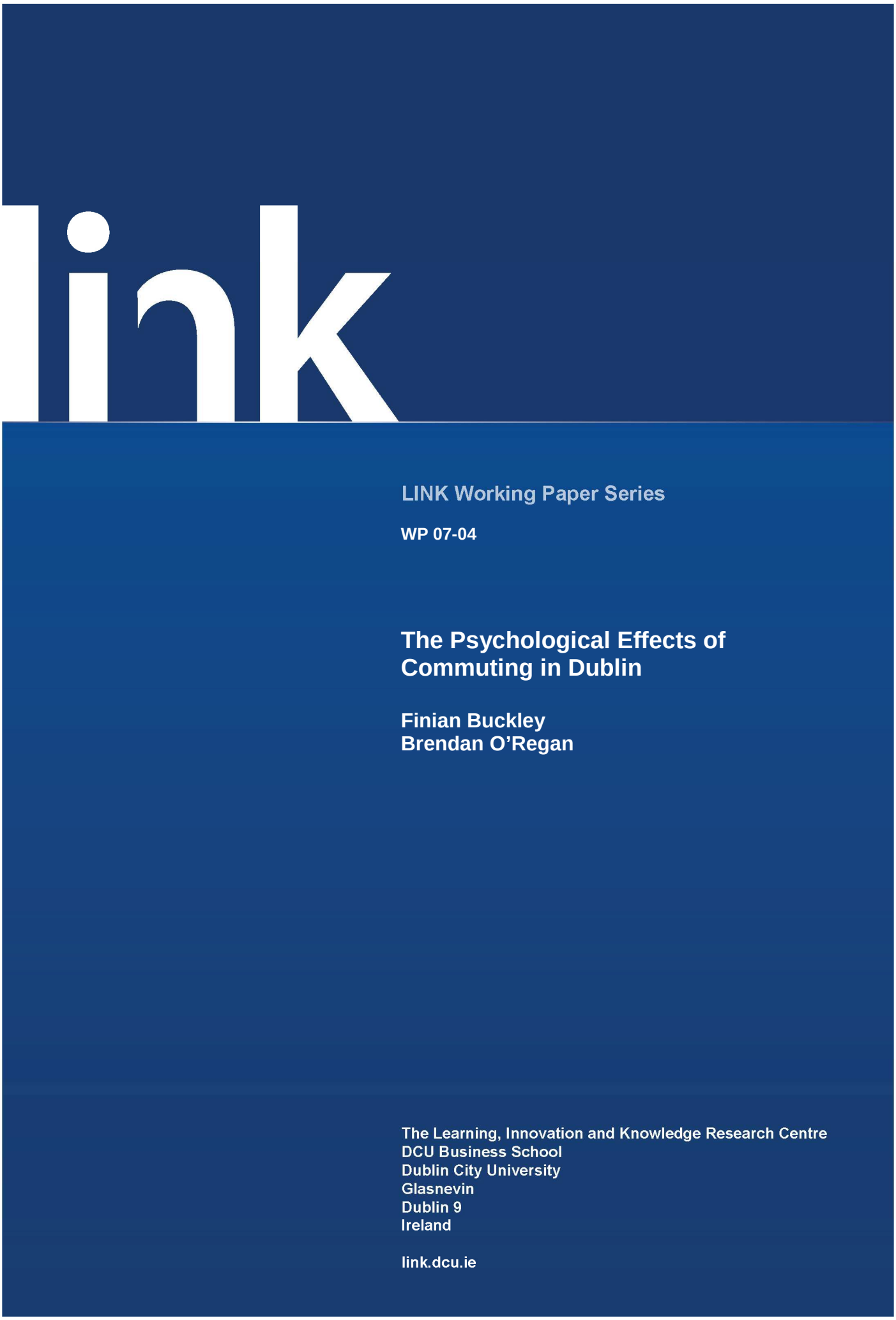

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The Psychological Effects of Commuting in Dublin

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The Psychological Effects of Commuting in Dublin

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ABSTRACT

The study involves an investigation of the problems that commuters in Dublin face everyday, and attempts to shed further light on our understanding of how individual differences (e.g., gender & perceived control) moderate the effects of commuting in terms of the individual's stress and mood outcomes. Four modes of transport were investigated; those who commuted to work by car, bus, train, and walking. The survey sample was 187 worker-commuters employed in a number of banks located in Dublin's IFSC. The study indicates that nearly 80% of respondents reported their daily commute as a stressful experience, those who travelled by train-Dart experienced highest levels of stress and most negative moods on reaching their workplace. They were followed by car and bus commuters with walkers reporting least stress and most positive moods. The level of experienced impedance impacted on levels of stress with commuters who had experienced a high impedance commute recording higher stress and more negative moods than those who had a less eventful commute. Some gender differences were also recorded.

Key Words: Commuting, Work Stress, Mood, Dublin

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INTRODUCTION

Although commuting has been described as "a plague that affects modern man" (Koslowsky, et al., 1995), the problems associated with a daily work commute are not new. Evidence exists which suggests that horse-drawn carriages in ancient Rome and 19th century Europe and America encountered congested conditions due to urbanization (Smerk, 1974). Yet it is surprising to find that so little systematic research has been conducted on the effects of commuting on commuters and the organizations at which they work.

At an individual level, studies have shown that the prolonged effects of commuting stress on the individual include cardiovascular problems such as increased heart rate, increased blood pressure, and also problems with the back (e.g., Evans and Carrere, 1991; Pietri et al., 1992). There is even a link between commuting to certain types of cancer (Robinson, 1991). But perhaps the more obvious effects on the individual are tiredness, mood swings, and loss of concentration (e.g., Gulian, et al., 1990; Hennessy, Wiesenthal, and Kohn, 2000).

The effects of commuting problems on the work organization include lateness, absenteeism, increased turnover, lower employee performance, and increased costs due to employees absent from work (e.g., Kowslowsky, 2000). In 2001, Eurostat conducted a European wide survey and concluded that work-related stress accounted for more than a quarter of all two-week absences. In the UK, the confederation of British Industry stated that 200 million days were lost through illness in 1998, costing a staggering $10.2 billion to industry. This in turn can cause considerable disturbances to productivity, creativity, and competitiveness.

It should also be noted that if the individual effects of stress carry-over into the working domain, they can also carry-over into other domains of an individual's life such as their home environment, making it increasingly difficult for individual's to find a work-life balance (So, Orazem and Otto, 2001).

COMMUTING IN DUBLIN

With 40% of the Irish population residing currently in the greater Dublin area and with the projected growth to reach over 50% by 2040 (CSO, 2002) the on-going pressure on transport infrastructure is significant. Dublin Transport Office statistics confirm that between 1991 and 1997, the number of cars on the road in Co. Dublin increased by 34% resulting in increases in commuting times of up to 134% from suburbs such as Lucan to the city centre (DTO, 1997). Comparative research has shown that Ireland tops the car usage league with the average car in Ireland traveling 24,400 km per annum which is 70% higher than France and Germany and 50% higher than Britain and most surprising, 30% higher than the USA (Bannister and Berechman, 1999).

Bus Eireann has highlighted that increased traffic congestion in Dublin had led to significant difficulties for its buses adhering to published timetables. The company also suggested that the severe traffic congestion is actually costing them €18 million

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annually (CIE, 2001). Iarnrod Eireann has reported that annual train passenger journeys has increased from 18.8 million in 1995 to 24.3 million in 2002 on DART and suburban services in Dublin (Iarnrod Eireann, 2003).

Impedance and Commute Stress

Evidence does exist which indicates that commuting can lead to elevated stress levels particularly where the commute is impeded in some fashion (e.g. Shaeffer, Street, Singer and Baum, 1988). That is, when the journey takes longer than expected because of some factor which slows the travel speed down and prolong the commute time. Typical examples might be broken or malfunctioning traffic lights or an accident during a car commute, or line maintenance or signal failure on rail commute. Such impedance can have a variety of physiological and psychological and behavioural impacts including, increased blood pressure (Simonson et al., 1968), back problems (Kelsey et al., 1984), absenteeism (Novaco et al., 1990), lower concentration levels on arrival at work (Schaeffer et al., 1988).

Perceived Control

Stress research has long noted that an individual's level of perceived control of a situation can have a significant impact on levels of experienced stress (e.g. Karasek, 1979; Johnson et al., 1991: Theorell, 1997; Evans & Carere, 1991). Effectively, the more control one feels one has and the more predictable a situation is the lower the levels of experienced stress. This model is also proposed for the commuting experience suggesting that being able to predict the duration of the commute and being in control of the situation should keep stress levels manageable but not being able to predict and control the commute can have negative stress outcomes (Koslowsky et al., 1995).

Research Questions

Building on the current research reviewed above the study set about to test a series of research questions and specific hypotheses relating to commuting experience in Dublin. As there were no previous studies of the psychological effects of commuting in Dublin the research set to answer some fundamental questions regarding the commute experience as well as investigating some deeper psychological concepts underpinning the daily work commute.

The following are the questions the research sought to illuminate:

1. Which modes of commute transport result in elevated levels of stress and negative moods?
2. What do commuters see as the major contributory factors to a stressful commute experience?
3. Are there significant differences between high impedance and low impedance commuters in terms of stress and negative moods experienced?

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4. Do men and women record similar commute experiences?
5. Does commuter Perceived Control of the trip, impact on experienced stress and negative mood?

THE STUDY

Participants

A self-report questionnaire was designed and distributed to 292 participants in three separate financial service companies located in the IFSC area of Dublin's city center. Of these 187 valid questionnaires were returned, representing a response rate of 64% As eight respondents used a mix of moped and or bicycle and did not attain cell size sufficient for statistical testing they were not included in much of the testing leaving a sample of 167 for the majority of the study's hypotheses. The average age of the participants was 28 years and they were predominately male (57.2%). It was recognised that an IFSC sample would be a predominantly young educated population working in a new service industry located in Dublin City Center. The researchers choose to use such a sample rather than attempt a global representative population of Dublin workers. The full breakdown of the sample population by commute type and the numbers in high and low impedance subgroups are displayed in Table 1 below.

Four Modes of Transport

The four modes of transport investigated in the study were car, bus, train-Dart, and walking commuters. While other forms of transport were represented such as cycling to work, they were of very small numbers in the sample and were not significant.

Self-Report Questionnaire:

The questionnaire was divided into four sub-sections. The first section gathered biographical data such as age, gender etc. Participants were also asked to identify their most frequently used mode of transport when commuting to work, along with the time taken (in minutes) and distance (in kilo-metres) of an average commute. Following the model designed by Stokols et al. (1978), the time and distance variables would be used to calculate an average speed for the commute. From the data a median is calculated for each mode of transport, with commuters travelling above the median classified as low-impedance commuters and commuters that travelled below the median being classified as high-impedance commuters. This method is frequently used in commuting studies (Schaefer et al., 1988), to establish a differentiation between the levels of commute impedance. Table 1 displays the results of the impedance calculation identifying the numbers in each subgroup.

In the second section of the questionnaire participants were asked a single question rating their level of perceived stress on a typical commute to work using a seven-point scale. More detailed sources of stress for each mode of transport were requested as subjects were asked how often they encountered twelve obstacles on

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their daily commute to work, e.g. traffic congestion, difficult weather etc. Each obstacle was rated on a seven-point scale and the instrument was adapted from one previously used by Koslowsky & Aizer (1996). The coefficient alpha for this measure in the study was 0.84.

The third section required participants to identify their level of perceived control as it relates to commuting on a seven-item scale, previously developed by Koslowsky and Aizer (1996). For example, how much control an individual felt they possessed over the speed or conditions in which they traveled. The coefficient alpha for this measure in the present study was 0.89.

The final section of the questionnaire required participants to complete a mood index. This consisted of seven bipolar scales (tense-relaxed; friendly-irritable; happy-sad; tired-energetic; carefree-burdened; intolerant-tolerant; contented-frustrated), and scores could range from seven to forty-nine, with higher scores indicating a more negative mood upon arrival at work. The mood index was developed by Novaco et al. (1990) to investigate the home/environmental consequences of commuting impedance on subjects (coefficient alpha of 0.86). The coefficient alpha of the instrument in this study was 0.89.

Finally, while the outcome variables of mood and stress were dealt with separately in the study, they were also combined to create a new variable 'level of annoyance'. The coefficient alpha of this variable was 0.90 in the study.

Pilot Study

After a pilot study involving 15 commuters the questionnaire was further refined the and presentation enhanced. The questionnaires were delivered to participants at their workplace along with a letter explaining the aim of the research study. The data analysis were then carried out using a series of tests on SPSS such as Independent T-Tests, Chi-squared tests, ANOVA's, and MANOVA's.

RESULTS

The numbers reporting in each commuting mode and the breakdown of the population into High and Low Impedance subgroups are displayed in Table 1.

[Insert Table 1 about here]

As walkers recorded consistent 'speed to work averages' the concept of impedance did not apply to them in this study so all walkers were grouped as low impedance.

Overall Commute Stress Experience

Overall, 79% of those who commute to work feel the daily trip makes them feel stressed to some extent, and over 80% identifying stress of some form as a result of the commute experience.

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[Insert Figure 1 about here]

Research Question Results

1. Mode of Commute and Stress-Mood Outcomes

The first objective of the research was to establish which mode of transport reported the highest levels of stress and most negative moods when arriving at work. Table 2 below outlines the average level of stress and negative moods experienced by each commuter mode grouping.

[Insert Table 2 about here]

Reviewing the Stress results first, it is clear that train-Dart commuters reported highest levels of commute stress, well ahead of car commuters in second position and bus commuters considerably less stressed. Statistical analysis revealed that no significant difference exists between car and public transport commuters but train-Dart commuters did report significantly higher levels of experienced stress than their fellow public transport users on buses ($t=2.96$, $df= 101$, $p<.01$). Walkers clearly reported lowest experienced stress levels, considerably lower than all other commuting modes.

The mood results reflect the stress findings with train-Dart commuters reporting most negative mood on arrival at work. This was again followed by car commuters in second position but only marginally more negative than bus commuters. Again the difference between train-Dart commuters and their colleagues traveling by bus was statistically significant ($t=2.7$, $df = 101$, $p< .01$).

A more detailed review of the mood index results identifies more clearly the differences in arrival state of the different commute participants. Commuters who walk to work perceive a significantly lower level of stress and better moods on arrival at work than any other form of transport. All walker mean scores on the mood index were <3.5, indicating positive moods (see Table 3) whereas train-Dart, car and bus commuter recorded scores >3.5 indicting more negative moods on arrival at work.

[Insert Table 3 about here]

The below the bar (i.e. positive mood) mean scores of walkers are no surprise as daily exercise in the form of brisk walking is considered a contributory factor to enhanced physical fitness and thus well-being and some would view the activity as a potential coping strategy when experiencing stress in various life domains.

2. Factors which Elevate Commute Stress

The research sought to gain a deeper understanding of principle causes of stress for each mode of transport. Each participant was asked how often they encountered

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twelve obstacles using a seven point scale, where 1 = hardly ever and 7 = always. The results delivered considerable insights on the factors which contribute to the stressful experience of that commute (Table 4).

[Insert Table 4 about here]

It is notable that the most stressed commuters (train-Dart) score crowded and cramped conditions on their commute as significant contributors to the stress of the journey. On a seven point scale a mean score of 6.7 and 6.6 respectively indicate a high frequency of these complaints. Dirty and the perceived lack of hygiene of carriages also scored highly for train-Dart commuters (5.9). Car commuter identified a high frequency of experiencing traffic congestion (6.0) on their daily commute and scored 'fellow motorist who do no abide by rules' and too any traffic lights as the next highest contributing factor to the stress of their commute (5.1). Bus commuters, third on the stress list, identify cramped and crowded conditions as adding to their stress/annoyance scores (5.5 and 5.4 respectively) where as the least stressed walkers mentioned a combination of dirty and cracked pavement (5.0), street noise levels (4.8) and inclement weather (4.4) as contributory factors to whatever stress levels they recorded.

These results give clear insights on the reason for train-Dart commuters reporting highest stress levels as they report repeatedly facing crowded and cramped conditions in carriages they regard as unhygienic.

3. High-Impedance Commuters Stress and Moods

The significant correlations between various commuting indices (i.e. distance, time, and average speed) and both stress and mood suggest that increased exposure to commuting impedance is associated with increased levels of stress and negative moods.

[Insert Table 5 about here]

It comes as no surprise that a commuter who endures longer commuting times and distances experiences higher levels of stress and more negative moods. But the positive correlations between the speed of the commute and negative outcomes was expected to be the inverse of the reported results. It appears that overall, the faster the commuter travels the more negative the reaction, and this contradicts previous findings (Novaco et al., 1990). Further analysis revealed no significant relationship between speed and perceived levels of mood or stress for commuters by car or train, but a significant negative relationship existed for both perceived level of stress and mood for bus commuters. This result requires further focused research.

A fundamental premise of the research project was that that high-impedance commuters would be significantly more annoyed (i.e. more stressed and in worse

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moods), than low-impedance commuters. This was found to be the case for car, $F(2,23) = 6.382$, $p < 0.05$, and bus commuters, $F(2,53) = 24.977$, $p < 0.001$. Interestingly, train-Dart commuters report similar levels of stress (high) in both impedance conditions. This result is interesting as on average train-Dart commuters spend the most time in transit (50 minutes compared to an average of 41 minutes in this study) and travel the farthest distances to work (18 Km compared to an average of 10Km). One explanation for this may be that commuters who travel by car or bus to work are exposed to the public road system, and therefore have the potential to occasionally travel in low-impedance conditions, i.e. in light traffic conditions perhaps during school holidays. In contrast, train-Dart commuters are unable to differentiate between high- and low-impedance conditions, as conditions remain constant all year round, and thus perceive every journey in a similar light (recall they cite their daily commute as crowded, cramped and dirty and spend more time in these condition than any other commute mode). However, these explanations are speculative and require further directed research.

Further analysis revealed that high-impedance public transport commuters (Bus and Train-Dart) were significantly more annoyed than high-impedance car-commuters upon arrival into work (Bus = $F(2,38) = 10.3$, $p<.001$; Train-Dart = $F(2,39) = 6.7$, $p<.05$)**.**

To add further insight on the impact of negative commute experiences on participants' life decision the survey asked commuters whether their commute experience impacted on their thoughts about residence and work location (Table 6). Participants were asked if their commute experience ever led to them reconsidering , a) changing their job, or b) changing their residential location. Table 6 further explores the responses by comparing those who experience high impedance with those experiencing low impedance.

[Insert Table 6 about here]

The findings show that high impedance commuters record greater consideration of changing job as a result of their commute experience than do low impedance participants notable so for car and train commuters ($v = 3.2$, $df=1$, $p<.05$ and$v = 4.5$, $df=1$, $p<.05$). Worth noting is the fact that high impedance train-Dart commuters would not consider changing residence (8%) as a solution to the commute problem, indicating that they are happy with where they live but would actively reconsider their job (80%) because of the commute. This finding may provide some insight into the problems facing workers attempting to find the optimum home-work balance in terms of achieving a positive quality of life.

4. Gender Differences

In terms of the moderator variables, past studies have shown that women experience more negative moods and greater stress as a result of commuting than their male

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counterparts. The study replicated these previous findings (t =2.0, df =185, p<.05) although closer analysis of the means indicates that there is little difference by gender across stress scores in most modes of commuting with the exception of walking (1.5 versus 3.0).

[Insert Table 7 about here]

The mood indices also recorded a significant difference between male and female arrival states (t=2.4, df = 185, p<.05) with female commuters recording more negative moods than their male counterparts. However, closer review of the means indicates that little difference exist across commute modes except again for walkers.

One possible explanation for this could be that women walker may regard walking with somewhat more anxiety than their male counterpart as it may put at risk their personal safety more than other commute forms. All other forms of commuting provide safety elements, i.e. the ability to lock car doors, or the perceived security of travelling in numbers on public transport. Women walkers may feel a little more isolated and thus vulnerable to external threats from unsolicited interference from others, harassment or even attack. Two factors should be remembered when attempting to explain these data; the location of the IFSC within the city and the potential route walkers may be have to take; and the stress score recorded are still lower than any other transport mode and the attention is drawn to the difference between male versus female scores (perhaps the focus should be on why male walkers record such low mean stress scores).

5. Perceived Control

The study predicted that participants with a higher level of perceived control during their commute would experience lower levels of stress. Overall, a significant negative correlation was reported between perceived control and stress (rho = -.43, p<.01) indicating that as perceived control increases the level of stress experienced decreases but by mode of commute analysis revealed that in fact only train-Dart commuters possessed this negative correlation (rho = -.30, p<.05) and no significant negative relation pertained for any other commute modes. This negative relationship also existed for train-Dart commuters only in the high-impedance sub- sample (rho= -.53, p<.05). In periods of low-impedance, only car commuters who reported a significant negative correlation (rho = -.92, p<.05).

By examining which aspects of the commute the subject fails to control, we gain a better understanding of the problems faced by commuters. For train commuters, 98% felt they had little or no control over noise, 94% over conditions of travel, 96% over the speed of travel. Overall, 90% of train commuters felt they had little or no control over the difficulties involved in their commute to work. These results are particularly relevant as train commuters spend the most time in transit and travel the farthest distances as mentioned earlier.

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DISCUSSION AND CONCLUSION

The research study attempted to shed light, for the first time in Dublin, on the psychological effects of commuting. In specific it attempted to investigate whether different modes of commute had different impact on commuter stress and mood. It also sought to identify the primary factors within each commute mode which contributed stress reactions and negative moods. Beyond these surface indices the research reviewed the impact of impedance on the affective outcomes of the commute experience and also looked at the mediating influence of gender and perceived control on the experience.

Clearly the sample surveyed for the purposes of this research found their commuting experience to be stressful to a greater or lesser extent (79%). Drawing a league table of those most stressed by the commuting experience highest scores were recorded from train-Dart commuters, ahead of car drivers, next those using busses and finally least stressed were walkers. Train-Dart commuters were significantly more stressed than their colleagues commuting by bus. The mood index results were reviewed they indicated again that train-Dart commuters reported most negative moods on arrival at work, with car commuters next, followed by those using buses and finally walkers reporting positive moods on arrival. These results are somewhat different from those reported by Koslowsky et al (1996) where car commuters reported highest stress levels. Given the impact of excavations for the proposed light rail system along Dublin's principle arterial routes right through 2003 it was expected that a similar result would pertain for the current study. The unexpected appearance of train-Dart commuters at the top of the stress and annoyance scores suggests that a city specific problem maybe manifesting.

Closer review of the obstacles commuters reported as contributing to their levels of stress indicated that train-Dart reported a much higher experience of deleterious conditions than reported from other commute modes. The extraordinary scores (6.7 out of possible 7) for crowding and cramped conditions implies that this is a serious and significant issue for those using train-Dart to commute to work each day. These two issues and lack of perceived hygiene of the carriages were also recorded by bus commuters but did not reach the same level of intensity of those commuting by train-Dart.

Further evidence added a more complete understanding of these findings as it appeared that train-Dart commuters travel longer distances each day and spend more time commuting than other commuting modes (50 minutes and 18kms as against 46 minutes and 12kms for Bus-Car). It has long been recognised that the crowding of personal space (proxemics) can result in experienced stress (Hall, 1974) and it may be that Dublin train-Dart commuters are being subjected to prolonged invasion of their personal space each day during their commute. It is possible to surmise that the reason bus commuters do not report such high levels of stress is that their commute is typically shorter (9 kms), faster and not as susceptible to gross over crowding, thus not prolonging the 'invasion of personal space' experience.

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These results are not isolated to Dublin as other research (e.g. Punpuing & Ross, 2001 research in Bangkok) has reported similar results but they are typically associated with public transport in non-western economies.

Car commuters did not report the same levels of stress or negative mood as their train-Dart colleagues but they did, unsurprisingly, identify traffic congestion as the primary factor effecting their overall state. This was well ahead of 'too many traffic lights' and 'other drivers who break the rules' in terms of factors which add to their stress.

The other result of note from this section of the study is that walking commuters did not report any negative moods on arrival at work (all other commutes modes recorded negative mood) but actually reported positive arrival moods with relaxed and tolerant and contented being characteristic of their mood state.

The study has shown that overall commuters who are impeded on their commute to work suffer negative effects as they suffer greater stress levels and more negative moods states. When asked whether the daily commute experience would impact on their considering a job change, a significant proportion of high impedance commuters reported in the affirmative with a staggering 80% of train-Dart users agreeing. The fact that the vast majority of high impedance commuters rejected the idea of changing residence as a solution to the commute experience indicates that they are happy with their place of residence but it is their job location which they would like to review. This reflects some Dutch research which suggests that the interplay between optimum living location and daily work commuting distance is a complex predictor of contentedness (Rouwendal and Meijer, 2001).

The expected gender differences accrued in the present study with female commuters recording more negative commute moods and stress but these difference can be almost entirely explained by the massive differences between the genders in the walking mode. Women walkers recorded much higher stress levels (although significantly lower than any other commute mode) and more negative moods than their male counterparts. In effect the most startling result here is not the elevated stress levels of women walkers but the extremely low scores of the male walkers (a mean of 1.5 on a 7 point scale) more than 50% lower than male commuters in all other commute modes.

While the openness of the walking environment may explain more elevated female stress levels (no protection, fear for safety, lack of security numbers etc) why males would record such low stress levels and positive moods after walking is somewhat of a mystery.

Perceived control also played a part in the overall commute model, with lower levels of perceived control of the commute being associated with higher stress experience. This was especially so for the beleaguered train-Dart commuters who cited lack of control over travel conditions, noise and travel speed as major contributors to this lack of control.

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In Context

The growth in the greater Dublin area over the last decade has seen the birth of a great many new housing estates. In many cases, the infrastructure to support these new communities is not yet in place, e.g. the town of Gorey, in Co. Wexford, is considered part of the Dublin commuting belt, but as yet there is no daily train service serving Dublin, forcing commuters into cars and buses. There is a real need for planners and legislators to proactive plan for the future, understanding the residence-work-commute models which predict housing spread in urban and semi-urban areas and to functionally influence the provision of supporting infrastructure (So et al., 2001).

The sample surveyed in the current research clearly identified the train-Dart commuter as the most stressful and uncomfortable commute mode. It is clear that the current rail infrastructure cannot cope adequately with the numbers seeking to use rail at peak times. Anecdotal evidence form the media suggests that rail commuting at peak hours is just not an option for individuals with disabilities, pregnant women, or those who perceive themselves as infirm. The message is that the morning rush hour rail commute is only for the young, fit and those with a strong stomach.

While recognising these complaints the future may be brighter. By December 14th 2003 Iarnrod Eireann promise significant increases in urban rail carriage numbers indicating that some morning trains would have increased capacity of over 40%. These improvements reflect the consciousness of the rail providers that the current demands require significant extension of capacity a service (see, http://www.irishrail.ie). These positive and timely developments will be enhanced even further with the opening of Dublin's light rail system (LUAS) in the coming years hopefully consigning the daily congested , crowded and grubby rail commute to realms of history.

Given the evidence which exists indicating the diminished performance of stressed employees (as result of negative commute experience), organisations should consider the establishment of 'mobility management plans' to facilitate workers needs and subsequently reduce costs from worker ill-health and absenteeism. A mobility management plan consists of a package of measures put in place by an organisation to encourage and support more sustainable travel patterns. These might stretch from flexible working practices to employee assistance programmes (EAPs) through to teleworking from home. The strict adherence to the traditional model of work time and work design (founded in era of the industrial revolution) would not appear to be sympathetic with contemporary non-work roles and expectations.

The implications of the present study also highlight the importance of commuting from a community perspective. With commuting times and distances continuing to increase, the Dublin city planners must not only consider the current transport difficulties solely in monetary terms, but must begin to consider the damage to people's health and standard of living. The impact of commuting is far-reaching into other domains on a person's life, not least into the family and working environments. Professor Kevin Leyden (2003) has studied how the design of communities impacts

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how people move about and their choice of transport. He believes that many suburbs in the United States are designed so that individuals are car dependent and suggests that physical activity is being "engineered out of our lives". The consequences of such an environment include increased car congestion, pollution, increased fuel consumption, increases in the number of traffic accidents, possible weight gain through lack of exercise, and other health problems. There is also the fear of social isolation if one cannot drive in a car-dependent environment.

As Ireland today is a much more complex society than in past times, the search for a balance between the working and home environment is becoming ever more important in people's lives. While the home and work environments for most individuals are unpredictable and rarely remain stable, the transition between the two environments should be managed effectively to provide individuals with a safe and stress-free passage between the two.

Study Limitations

There were a number of potential limitations on this study which should be highlighted. The data was collected using self-report measures which have the potential of inflated covariation among study variables. This stated, it should be remembered that stress, mood, and perceived control are only meaningful if obtained from the actual subject.

A second limitation was whether the impedance concept has been most usefully operationalised, is open to question. Although the term impedance is used to mean a behavioural constraint, the present study has not operationalised the concept behaviourally. Consequently, observed stress effects might be due to properties of the distance- and time- defined impedance conditions other than this proposed behaviour-constraining characteristic. Future investigations could have a clearer definition of impedance to include behavioural indices and validation of the impedance condition (Novaco et al. 1979).

A third limitation was the small sample size, which limited the impedance differentiation of subjects. A larger sample size would have enabled a third category of impedance, i.e. high-, middle-, and low-impedance. Perhaps the third impedance category, would have led to greater clarification and differentiation in the results. The limited sample size also precluded the power to engage in more powerful statistical manipulation and modelling, thus restricting the depth of analysis possible.

Finally, the links between the residential, commuting, and occupation domains are suggested in the study, however the study does not investigate the reciprocal impacts of residential and job variables on commuting stress. The understanding of commuting stress will greatly profit from the analysis of inter-domain transfer effects, whereby the psychological consequences of environmental conditions in one life domain (home, commuting, work, or recreational) transfer to another, either positively or negatively (Novaco et al, 1990).

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Future Research

Commuting on public transport was found to be a cause of annoyance for some commuters compared to commuters who travel by car. Therefore future research should investigate in more detail some of the environmental stressors experienced when commuting on public transport such as crowding, and travelling in unclean surroundings, and how this impacts on stress and mood.

While female commuters proved to react more negatively to men in this study, future studies should incorporate family roles affect the outcome variables. Traditional family roles perceive the female as being more involved in household duties e.g. dropping kids off at school, and these extra responsibilities may result in increased stress for women. But in Ireland today, perhaps these roles are not so easily defined and therefore further examination is required.

This study examined only the morning commute to work. Future studies could examine how the evening commute affects individuals life, both in performance in work prior to departure and also how the commute affects their family life and other life domains.

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TABLES AND FIGURES

Table 1: Breakdown of Commuters by Transport Mode and by High and Low Impedance Experience

Mode of Transport	Commuter Numbers	Male	Female	Low Impedance Group	High Impedance Group
CAR	23	15	8	9	14
TRAIN-DART	50	26	24	25	24
BUS	53	26	27	29	25
WALK	53	36	17	53	-

Table 2: Levels of Stress and Mood reported by each Commute mode

MODE OF TRANSPORT	STRESS MEAN *(Standard Deviation)*	MOOD MEAN *(Standard Deviation)*
Train-DART	4.2 *(1.5)*	4.4 *(1.0)*
Car	3.6 *(1.2)*	3.9 *(0.9)*
Bus	3.4 *(1.5)*	3.9 *(0.7)*
Walk	1.9 *(1.3)*	3.0 *(1.1)*

Stress measure: 1= very low stress levels to 7 = very high stress levels
Mood measure: 1= positive mood to 7 = negative mood

Table 3: Mean Mood Index scores by Commute mode (<3.5=Positive. >3.5=Negative)

Mode	Relaxed-Tense	Friendly-Irritable	Happy-Sad	Energetic-Tired	Carefree-Burdened	Tolerant-Intolerant	Contented-Frustrated
Walking	2.7	3.1	3.2	3.3	3.1	2.8	3.0
Train-Dart	4.1	4.4	4.0	4.6	4.7	4.3	4.3
Car	3.6	3.7	3.6	3.8	4.0	4.1	4.3
Bus	3.6	3.5	3.9	4.5	4.0	3.7	4.0

Table 4: Top Three Commuting Obstacles as experienced by Commuters for each mode of Transport (Mean score in brackets, standard deviation in italics)

TRAIN-DART	CAR	BUS	WALKING
1. Crowding (6.7, *0.6*)	**1.** Traffic Congestion (6.0, *1.53*)	**1.** Crowding (5.5, *1.4*)	**1.** Dirty/Broken Pavements (5.0, *1.8*)
2. Cramped Conditions (6.6, *0.8*)	**2 & 3** = Too many Traffic Lights (5.1, *1.4*) Drivers who break rules (5.1, *1.5*)	**2.** Cramped Conditions (5.4, *1.4*)	**2.** Noise levels (4.8, *1.9*)
3. Dirty carriages (5.9, *1.4*)		**3.** Lack of Hygiene (5.1, *1.4*)	**3.** Weather (4.4, *1.1*)

Note: The scale used measured across a continuum: 7= Always experience this obstacle to 1= Never experience this obstacle.

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Table 5: Spearman Correlations for Stress and Mood with Commuting Indices

Index	Stress	Mood
Commute Distance (in Km)	0.45*	0.45*
Commute Time (in minutes)	0.55*	0.55*
Speed (in Km / Mins)	0.24*	0.25*

* Correlations significant at p<.01

Table 6: Commute experience impact on Reconsidering of Work or Home location

	Consider Changing Job because of Commute?		Consider Changing Residence because of Commute?	
LOW IMPEDANCE	**%YES**	**%NO**	**%YES**	**%NO**
Train-Dart	60	40	32	68
Car	44	56	68	32
Bus	28	72	31	69
Walk	19	81	15	85
HIGH IMPEDANCE				
Train-Dart	80	20	8	92
Car	57	43	29	71
Bus	75	25	42	58

Table 7: Commute Stress and Mood differences by Gender (Means and St. Dev.)

Mode of Transport	STRESS		MOOD	
	Male	Female	Male	Female
Car	3.6 *(1.1)*	3.5 *(1.6)*	3.6 *(1.0)*	4.0 *(0.7)*
Bus	3.5 *(1.5)*	3.2 *(1.5)*	3.8 *(1.0)*	4.0 *(0.7)*
Train	4.3 *(1.3)*	4.2 *(1.7)*	3.8 *(0.8)*	4.3 *(1.3)*
Walk	1.5 *(0.7)*	3.0 *(1.6)*	4.4 *(0.7)*	3.6 *(1.5)*

Stress measure: 1= very low stress levels to 7 = very high stress levels
Mood measure: 1= positive mood to 7 = negative mood

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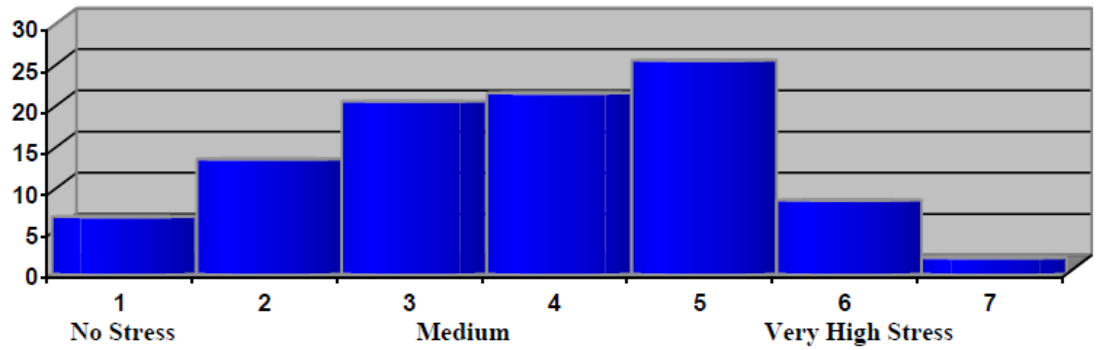
Figure 1: Levels of Stress reported as result of Commute (full population N=187)



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