A Psycholinguistic Exploration of Focus of Attention in Second Language Learning Based on Recent Research Findings from the Field of Motor Skill Learning

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Declaration

'I hereby certify that this material, which I now submit for assessment on the programme of study leading to the award of Doctor of Philosophy is entirely my own work, that I have exercised reasonable care to ensure that the work is original, and does not to the best of my knowledge breach any law of copyright, and has not been taken from the work of others save and to the extent that such work has been cited and acknowledged within the text of my work.

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Abstract

Clare Kelly-Coll: A psycholinguistic exploration of focus of attention in Second Language Learning based on recent research findings from the field of Motor Skill Learning.

Significant findings from motor skill learning research provide evidence that focus of attention (FOA), induced through instruction, impacts on performance and learning (Wulf, 2007). External FOA instructions, which direct focus to the effect of actions, enhance performance compared with internal focus instructions which direct focus towards the body. The objective of this explorative study is to investigate whether FOA as operationalised in the Wulf model can be transferred and replicated in the context of second language learning (SLL). Two cross-linguistic studies were conducted to investigate the effects of focus instructions on two sample populations comprising a total of 140 adult L2 learners of English. The experiments, run on E-Prime, involved grammaticality judgements and vocabulary learning conducted under practice and test conditions. Subjects were assigned to one of three instructional groups: baseline, internal or external-focus and accuracy and response times were analysed. The findings indicate that attentional focus impacts on SLL learning differentially with regard to practice and test conditions, task complexity, number of language trials and learner proficiency. Other results reveal no significant differences between the groups but a significant statistical difference as a function of type of task. This research raises important questions which merit further investigation regarding the possibilities and limitations of transferring empirical research models.

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Abbreviations

ACT*:	Active Control of Thought
ALM:	Audio-Lingual Method
AOS:	Apraxia of speech
CALL:	Computer Aided Language Learning
EMG:	electromyography
ESL:	English as a second language
EUROSLA:	European Second Language Acquisition Association
FOA:	focus of attention
Fonf:	focus on form
FMRI:	Functional Magnetic Resonance Imaging
INV:	inversion (e.g., as in word inversion)
L1:	A speaker's first language or mother tongue
L2:	Second Language
ML:	Motor Learning
N:	number
NTL:	Neural Theory of Thought
RT:	reaction time (e.g. measurement of response time)
SIL:	A speech analysis tool created by SIL (Summer Institute of Linguistics, U.S.)
SLA:	Second Language Acquisition
SLL:	Second Language Learning
SPT:	Sound Production Treatment
TBL:	Task-based learning
TLU:	Target-like usage
TPR:	Total Physical Response
UG:	Universal Grammar
VF:	verb final (e.g. the verb is in final position in the sentence).

Chapter 1: Introduction to focus of attention in second language learning and motor learning

Considerable research in sport science and motor learning has established that different foci of attention induced through instructions impact on performance and learning (see Wulf and Prinz, 2001 for a review). In particular, over the past decade, Wulf (2007a; 2007b) has demonstrated the positive effects of instructions inducing an external focus of attention in a variety of motor skill areas including balance, golf, tennis, basketball and acrobatics. These findings extend to different learner groups and to other areas such as occupational therapy and speech. The relevance of this research model is currently being investigated in more diverse fields, e.g. music and surgical education (Wulf, 2007b).

The implications of this growing body of research and the predictions thereof have not yet been tested in the field of second language learning (SLL). The first objective of this research study is to investigate how external-focus principles, as operationalised in the Wulf model, can be transferred. The second objective is to test the model empirically and to discuss the findings within the context of current SLL research. It is argued that focus of attention (FOA) is a critical variable in the learning process and a crucial factor to be considered in both L2 learning and teaching. It is hoped that the findings presented here will further the discussion on the possibilities and limitations of transferring research models and add to current SLL research by introducing a novel approach to studies on focus of attention and second language (L2) learning.

In this chapter, the theoretical framework of the research will be presented which provides the bulwark for this argument favouring the transfer of the principles adopted in a motor learning research model to SLL. First, the underlying learning processes in both fields of learning will be presented and juxtaposed. Recent studies from sport psychology and more particularly, motor learning (ML) will be reviewed in order to present the background for the language experiments presented in subsequent chapters. The role of attention and instruction in the development of automaticity in SLL will be discussed by looking at current empirical research in the field. This discussion highlights the importance of instruction and attention in the learning process and the validity of the argument that further research is warranted. In the first section, the general research framework will be introduced identifying the key concepts to be discussed in more detail in the remainder of the chapter.

1.1 The Research Framework

The research framework includes both the conceptual background to the research question and the two pillars upon which it rests, namely, second language and motor skill learning (Section 1.2). The conceptual background is derived from cognitive science and recent cognitive approaches to SLL, which postulate that all types of human learning share common ground. Levelt (1977) proposes that foreign language learning should be considered under human performance theory, i.e., the study of skills and attentional processes. His theory proposes a “third way” (Levelt,1977: 54) of approaching language learning issues leading away from the debate on whether language is learned through imitation (e.g. the theory held by behaviourists) versus Chomskyan views propounding the existence of Universal Grammar (UG) in a separate faculty of the mind (Chomsky, 2006). This third way constitutes a shift in approach which embraces other areas of human learning thus is more influenced by general cognitive approaches (Ellis, 1998, 2001; Hulstijn, 2002; Long and Doughty, 2003; DeKeyser, 2001, 2007):

Human learning involves the use of cognitive resources such as perception, analysis, understanding and problem-solving for all types of human activity.

> Under the rubric of cognition fall such diverse human activities as recognizing a friend's voice over the telephone, reading a novel, jumping from stone to stone in a creek, explaining an idea to a classmate, remembering the way home from work, and choosing a profession. Cognitive processes are essential to each of these activities; indeed, they are essential to everything we do. (Osherson and Lasnik, 1990: xi)

As pointed out above, cognitive processes are utilized for all types of knowledge and information including language learning. Birdsong (1994) highlights the importance of decision-making in L2 learning - for instance, language learners make use not only of linguistic but also experiential knowledge to make decisions regarding grammaticality. Thus L2 learning is predicated upon a whole battery of cognitive resources which are shared with other areas of learning and knowledge. In this 'third' view of SLL, the learning process is considered to be akin to other learning processes and as such is consistent with skill acquisition theories.

1.1.1 Skill acquisition theory

The learning process involved in the acquisition of any human skill entails a transition from attentive to automatic mode (Anderson, 1982, 1983; McLaughlin *et al.* 1983; Hulstijn and Hulstijn, 1984, 2002; Logan, 1988; Segalowitz and Segalowitz, 1993; Towell and Hawkins, 1994; Ellis, 1998; DeKeyser, 2001). In this view, SLL is considered to be a complex task with a hierarchical structure similar to other tasks which comprise sub-tasks and sub-sub-tasks. Lower level tasks become automated through practice and stored in long-term memory yielding the availability of attentional resources in short-term memory for new or more complex plans (Levelt, 1977; McLaughlin *et al.* 1983, McLaughlin, 1987; DeKeyser, 2001; Hulstijn, 2002).

> To learn a second language is to learn a *skill*, because various aspects of the task must be practiced and integrated into fluent performance. This requires the automatization of component sub-skills. (McLaughlin, 1987: 133)

Anderson (1982) claims that his model of cognitive skill acquisition applies to all areas of human learning, including the higher-level mental processes involved in language learning. This model[1] includes two major stages: an initial declarative stage (e.g. knowing what to do) followed by a procedural stage (e.g. knowing how to do it); these stages are further sub-divided to include an intermediary or associative stage in which knowledge is partly declarative and partly procedural. Anderson's model integrates the representation of information in memory (e.g. *schemas*) as well as the mental processes or productions involved in all complex cognitive tasks. Automaticity is attained when declarative knowledge becomes proceduralized – i.e. fluency in L2 (Bialystok, 1994). When an automatic process is disrupted, there is a return to conscious processing and an awareness of detail, e.g., a slip of the tongue and slips of action (Hammond, 1987 cited in Masters, 1992).

Automaticity, a ubiquitous phenomenon, is the end result of a process of automatization (DeKeyser, 2001) which involves conscious processes (e.g. slow and effortful) gradually becoming automatic or automatised (e.g. fast and effortless). In terms of learning, automaticity in SLL is part of a wider frame of reference, which concerns attention and effort in skill acquisition (Segalowitz, 2003) as well as the important component of practice

[1] Anderson instantiated the cognitive skill acquisition model of learning in a computational system denominated Active Control of Thought (ACT*).

(DeKeyser, 2007). O'Malley *et al.* (1987) provide a vital link between these information processing theories of learning (i.e. McLaughlin et al. 1983, McLaughlin, 1987) and more specifically, Anderson's cognitive skill acquisition theory. They argue that traditional linguistic approaches fail to address the central role of mental processes thus isolating language learning as being different from other types of learning: "[…] mental processing plays a central role in all learning and is the basic mediating variable for influences on learning that are external to the learner, such as task characteristics and complexity, or internal influences such as developmental level, ability, or motivation" (O' Malley *et al.*, 1987:288).

A further link between cognitive approaches and SLL is provided by Towell, Hawkins and Bazergui's (1996) four-year longitudinal study based on Anderson's model. This study provides empirical evidence that fluency results from the proceduralization of different kinds of knowledge such as syntax and lexical phrases. The distinction, in Anderson's model, between declarative knowledge (e.g. knowing about language in the form of grammatical rules) and procedural knowledge (e.g. knowing how to use language in real-time), is regarded as a useful explanation for SLL (O' Malley *et al.*, 1987, Krashen, 1994, DeKeyser, 2007). As for ML, Masters (1992: 344) identifies the similitude between Anderson's declarative 'explicit encoding of knowledge' stage with controlled processing and the procedural 'implicit encoding' stage with automatic processing.

Further to this argument on skill acquisition, language learning can be considered as a skill similar to other skills such as typing, learning how to drive, etc., because it invokes the power law of practice. The power law postulates that all kinds of learning follow a downward slope - increments in the rate of learning occur most exponentially at the outset and then taper off (Newell and Rosenbloom, 1981). This shift also presupposes that the amount of improvement decreases as practice increases (Ellis and Schmidt, 1997). This law has become the benchmark prediction for all theories of skill acquisition including lexical decision making (Anderson 1982) as well as other more general areas related to language learning (Segalowitz and Segalowitz, 1993; Ellis and Schmidt, 1997, Ellis, 2001; DeKeyser, 2001 and 2007). The findings of an SLL study conducted by Segalowitz and Segalowitz (1993) confirm that improved L2 performance involves faster reaction times coupled with less variability. Automaticity, therefore, is not just a question of speed up (e.g. a quantitative change), but equally involves a qualitative change in terms of less variability in performance. Variability is characteristic to both fields studied here - learners vary in their ability to progress from one learning stage to the next, reverting to previous stages, backsliding and restructuring (McLaughlin, 1987, 1990; Gass and Selinker, 2001, Wulf, 2007).

Other models and theories of learning will be discussed in the next section - these models also constitute general cognitive approaches to learning *albeit* with greater emphasis on the role of memory.

1.1.2 Memory-based theories

For Logan (1988: 493) learning involves: "single-step direct-access retrieval of past solutions from memory", and is a function of attention. All exposure to input leaves a trace in memory and automaticity occurs when retrieval of an instance from memory is faster than working out an algorithm. Novices learn by algorithms, i.e. rules on how to perform each task. In this view, language fluency is based on retrieval of ready-made exemplars from memory as opposed to the computation of rules. Whilst information theorists (McLaughlin *et al.* 1983; Schmidt, 1990) argue that resource limitation (e.g. attentional resources) restricts second language learning, Logan emphasises that the limitations of early learners – in any skill - are constrained by lack of knowledge. Skehan (1998), on the other hand, proposes dual-mode processing which includes both exemplar-based and rule-based learning, to explain learner development in SLL. Skehan's theory is determined to a large extent by the age factor in learning. As we grow older, our ability to extract meaning becomes more effective, less based on form and more based on "lexical modes of communication" (Skehan, 1998: 4). This approach, in my opinion, provides an apt explanation for SLL development which includes "the use of a rule-based system in economical and parsimonious performance and a memory-based system which provides fast access" (Skehan, 1998:4). Another view is proposed by connectionist theories of learning.

Sokolik (1990) explains that although rules are omnipresent in human cognition, learning can and does occur without the use of rules based on the fact that the structure of the human brain constitutes a highly interconnected system. For connectionists, language is not localized to specific parts of the brain (e.g. Broca's area or Wernicke's area which are both located in the left hemisphere of the brain: Zurif, 1990; Vasić, 2006), but, instead relies on neural networks throughout the brain area. Connectionists argue that brain damage to one area, e.g. speech, is due to a broken connection rather than language being specialised to that area. The system works in a parallel fashion – as opposed to serial – which explains to some extent the speed of human cognition in real-time:

> […], information or knowledge is coded by a specific pattern of activity distributed over a set of low-level featural nodes or *units* (analogous to neurons in the brain). A processing model might comprise two or more *layers* of such units. Any two layers can be linked by interconnections of individual units (analogous to synapses) across layers, and activity may be shared between units via these interconnections. The strength or *weight* of connectivity between specific pairs of units varies, and thus the degree to which activity is shared between pairs of units also varies. (Sokolik, 1990: 688)

Ellis and Schmidt (1997) provide evidence that L2 acquisition of morphology can be accurately simulated in connectionist models. In a picture-naming task involving artificial words, the effects of frequency and regularity had a notable effect on subjects' (n[2] = 7) accuracy and reaction times. They also replicated the same study using a computational model and found that learner performance (whether human or modelled) followed a similar pattern invoking the power law of practice. In a follow-up study on recall and grammaticality, the researchers showed that short-term memory is a significant predictor of long-term memory recall. They conclude that grammatical proficiency can be better understood by examining the processes of acquisition - all intake[3] contributes to the "perception-learning" cycle – rather than simply the end result. Furthermore, they claim that general associative learning results in the formation of language chunks which can be subsequently accessed as a basis for making grammaticality judgements[4], as opposed to the need for a specific language learning faculty (Ellis and Schmidt, 1997: 164).

Ellis (1998) claims that language is learned through a build-up of simple processes into more complex processes:

> […] simple learning mechanisms, operating in and across the human systems for perception, motor-action and cognition as they are exposed to language data as part of a communicatively-rich human social environment by an organism eager to exploit the functionality of language, suffice to drive the emergence of complex language representations. (Ellis 1998:657)

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[2] 'n' = number of subjects.
[3] Sharwood Smith (1994) provides an apt analogy distinguishing *input* from *intake. Input* is akin to the goods presented to the customer in a shop, *intake* is what the customer buys.
[4] Grammaticality Judgements involve language learners (or other category of subjects) choosing whether to accept a sentence as grammatical or not. This is a research tool used extensively in psycholinguistics and will be discussed in Chapter 2.

According to Ellis (2001:38); "[…] language is cut of the same cloth as other cognitive *processes*, but […] is special in terms of its cognitive *content*". For Ellis (2001), language learning involves sequence learning - learners practising L2 words, automatically and implicitly obtain knowledge of sequences and frequencies; thus, the learning process is for the most part unconscious and implicit.

Other models inspired by cognitive theories include the neural theory of thought (NTL). NTL theorists are interested in how language and thought are related to other neural systems, including perception, motor control, and social cognition (Bailey *et al*., 1998, Narayanan, 1997). For example, Lakoff and Johnson (2003) suggest that the motor cortex of the brain contains a map of the body:

> Neuronal clusters throughout the body "project" (that is, are connected) to neuronal clusters in the motor cortex, with neuronal clusters adjacent or nearby on the body projecting to neuronal clusters adjacent to or nearby the corresponding clusters in the motor cortex. (Lakoff and Johnson, 2003: pp.256 - 257)

Evidence in the form of computer simulations reinforce these proposals; for example, Narayanan (1997) devised a computational model in order to investigate the relationship between verbal aspect (e.g., English progressive tense and present perfect) and the sensory-motor primitives involved in the action of walking. In this study, the act of *walking* is broken down into sub-actions of many individual X-schemas such as enabling, inception, in-process, completion, suspension and resumption. According to Narayanan (1997), verbal aspect is grounded in these sensory motor primitives. He hypothesised that sensory-motor controllers are directly coded into neural circuitry and that other cognitive processes such as language, use the very same circuitry or map. It is not within the scope of this study to discuss this work further as it is more relevant to neurolinguistic aspects of SLL, nevertheless, NTL is worth mentioning as it offers interesting insight into the concept of how different human skills, i.e. speech and walking, may share the same neuronal and procedural foundations as mentioned previously.

The definition and origin of linguistic knowledge as well as the contentious debate regarding the language faculty, innateness and access to Universal Grammar, which are important to SLL research, are nonetheless beyond the scope of this investigation. In any case, it is possible that cognitive approaches to SLL can reconcile both Chomskyan principles and connectionist models to explain SLL (Hulstijn, 2002). The various learning theories presented here, although different in approach and emphasis, converge in terms of dealing with learning as a general cognitive mechanism in which the development of automaticity plays a key role. As mentioned in the introduction, SLL theorists are increasingly looking towards psychological and neural-based explanations with a view to gaining further knowledge about language learning processes. As Ellis pointed out:

> […], researchers are never going to understand language by studying it in isolation, in the same way that one could never properly understand the game of soccer by investigating only the patterns of movement of the ball, or chess by analysing the interactions of just the white pieces. (Ellis 1998: 656)

Furthermore, cognitive theories provide credence to the argument that research models of learning adopted from other fields may have important implications for SLL research.

The other two dimensions of the research framework are introduced in the next section, namely, the fields of second language learning (SLL) research and motor learning (ML).

1.1.3 Second language learning research

Today, most of the world's population can speak more than one language and for many people, particularly in developing countries, these languages are learned in an informal way, i.e. are 'picked up'[5]. Contrary to general perceptions, especially in English-speaking countries, monolinguals are a world minority – a species in danger of extinction, according to Cook (2008:2). For practical reasons, SLL research has been mainly concerned with formal language learning (i.e. learning in the classroom) and the vast majority of studies are on the learning of English as an L2 (ESL). These trends are changing somewhat with an increasing number of studies relating to other languages such as Spanish, Japanese and lesser-used or minority languages (Cook, 2008).

Second Language Learning[6] (SLL) research is concerned with the learning of any language some time after the first language (L1) or mother tongue has been acquired. SLL, for the purposes of this study, refers to both learning a second language (L2) in the country in which the language is spoken as well as foreign language learning, for instance, learning L2 French in Ireland. The field is concerned with the processes and issues related to learning an L2 encompassing a wide range of issues including learning an L2 (with or without instruction), internal factors which influence learnability, learning techniques and strategies, examining the differences and similarities between child and adult learning processes, bilingualism, looking at the social, environmental and cultural influences on learning, investigating language loss and attrition to gain insights into language

[5] This is commonly referred to as naturalistic learning in SLL literature.
[6] SLL is the preferred term used here as opposed to Second Language Acquisition (SLA) because it more clearly reflects the focus on process as opposed to final state.

development, and a recently introduced dimension - heritage language acquisition[7] (Montrul, 2008), etc.

Psycholinguistics is based on the fields of psychology and linguistics. The objective of psycholinguistic research is to bring together the research techniques utilized in psychology (e.g. measuring subject response times to language trials designed to test underlying psychological processes) and linguistics (e.g. using the tools of linguistic analysis to classify and explain experimental results). Psycholinguistic research is more concerned with language in use than language as a system (Aitchison, 1998). It is not specifically concerned with SLL - although SLL is within its sphere of interest – and represents a much broader field encompassing language development (e.g. first language) and impairment.

An important dimension of SLL research is the study of learner interlanguage development (Bialystok and Sharwood Smith, 1985). The term 'interlanguage' was coined in 1972 by Selinker to denote a learner's independent language system (Cook, 2008). This system is independent of the L1 and L2 but at the same time, influenced by both; it is dynamic and is based on the learner's own rule system. A learner's interlanguage is in a constant state of change, especially at the initial and intermediary stages of L2 learning. For example, a learner's decision about the acceptability of L2 constructions – i.e. grammaticality judgements - is based on how fast they can access and retrieve this knowledge. The decision may be based on explicit knowledge of rules or the triggering of a pattern familiar to the learner, or an implicit sense of correctness based on interlanguage knowledge or exposure to the L2. As the learner proceeds through the stages of acquiring an L2, the knowledge base or interlanguage expands, is

[7] Heritage Language Learners are individuals whose heritage language has become, for various reasons their L2. For example, the children of immigrants or a large portion of the Irish population could be included in this definition vis-à-vis the learning of Gaelic.

modified and ideally becomes assimilated to an increasing degree to the L2. Being able to access and retrieve this information in an effective manner is therefore imperative to progressing in an L2. The pathways or ways in which knowledge is accessed and retrieved, for example, can be facilitated and enhanced or interrupted and blocked by different factors, including, in my view, FOA.

Mitchell and Myles (1998), summarise the goals of SLL research as being firstly, to find out more about SLL processes and how the mind works and secondly, to provide useful insights for both teachers and learners. In general terms, SLL is a research field which has a reciprocal relationship with general linguistics, applied linguistics, language pedagogy and didactics. The linguistic approach to SLL gives importance to language as a linguistic system, i.e. it is chiefly concerned with the science of describing language and language structures, and is therefore concerned with property theories. On the other hand, the cognitive approach to SLL examines the mental processes involved in learning and thus gives consideration to transition theories (Hulstijn, 2002; Gregg, 2003). As is evident from the discussion so far, the cognitive approach is adopted in this study.

1.1.4 Summary

To sum up, the research framework is one that supports the contention that the processes underlying language learning are akin to the learning of any complex cognitive skill. This research is based on the assumption that the learning processes underlying second language learning are similar to other types of learning, such as motor learning (ML). This argument is based on the general cognitive models of learning discussed above, as well as theories of automaticity endorsed by several SLL theorists, notably, Ellis, (2001); Long and Doughty, (2003); DeKeyser, (2007); and, Hulstijn, (2002).

It is proposed that investigating SLL from this wider cognitive-based approach is another way of learning more about at least some of the processes involved.

1.2 Introduction to the Experiments on Focus of Attention

Motor skills are those skills which involve "the use of muscles in performing certain skills, from general ones like walking to fine ones like writing and speech" (Steinberg and Sciarini, 2006: 127). For instance, the speech and writing components of language involve the use of motor skills whilst other language dimensions, e.g. learning new vocabulary, use general cognitive skills. The enactment of any motor skill involves both physical and mental components - the physical aspect dominating in some sports (e.g. tennis and rugby), whereas the mental component is heightened for others (e.g. snooker and chess). According to Magill (2007: 407), on a scale from simple to complex[8] motor skills, most of our daily routines would fit into the more complex side of the scale because of the degree of organization, coordination and sub-routines involved in enacting everyday tasks. A distinction between motor skills and skills involving other types of body movement or activity is that they involve voluntary movement (Magill, 2007: 19).

Most sports involve the use of motor skills and general cognitive skills. According to Moran (2004: 176) sport is won in the mind – for instance, when athletes are physically similar, it is their cognitive skills, i.e. their ability to concentrate, which ultimately influence outcomes. The relationship between attention and learning has been highlighted in sport psychology research particularly in terms of developing attentional strategies to facilitate

[8] Complexity is defined as "the amount of information-processing demands that characterize a skill; more complex skills have more component parts and involve more information processing demands than less complex skills." (Magill: 2007:407).

concentration. Gallwey (1975) advised tennis players to concentrate on the seams of the ball during play in order to improve concentration levels. Baumeister (1984:618) claims that “choking” occurs in sport when an individual attends “consciously to his or her internal process of performance”. Similarly, Singer (1986) discusses the detrimental effects of self-focused attention in comparison with attention to an external cue (e.g. target); he presents a five-step approach based on awareness and non-awareness strategies in concentration. For example, for optimal performance, it is recommended that performers not “think of anything about the act itself or the possible outcome” (Singer, 1988: 56).

Masters (1992) identifies “an inward focus of attention” as one cause of failure in sport which affects highly automatised motor skills. He defines this type of focus as occurring when “an attempt is made to perform the skill by consciously processing explicit knowledge of how it works” (Masters, 1992:343). “Deautomatization” is another term used to describe what occurs when actions are reinvested with attention or a subcomponent of the skill is isolated or focussed on. In a golf experiment, Masters (1992) hypothesised that subjects would be less likely to fail under pressure (i.e. resulting in deautomatization) when they have less explicit knowledge of the skill. To test the hypothesis, forty subjects were assigned to either an explicit learning condition (e.g. with explicit instructions) or an implicit learning group (e.g. a dual-task[9] was administered which involved generating random letters whilst learning how to putt). The findings confirmed that performers are less likely to fail under pressure when they have less explicit knowledge or if the skill has been learned implicitly. Although, in a more recent study, Maxwell *et al*. (2000) found no significant difference between subjects learning how to putt in golf under explicit and implicit conditions, they conceded that excessive use of verbal instruction during skill acquisition is unnecessary and hampers

[9] The rationale for the dual task was to place more demands on short-term memory capacity so as to reduce the ability of the subjects to gain explicit knowledge.

performance. They stress the negative impact of reinvestment, i.e. the "[…] tendency to introduce conscious control of a movement by isolating and focusing on specific components of it" (Maxwell *et al*., 2000:113).

The present study is a model-driven exploration of attentional focus based on Wulf's extensive studies in motor learning research. Wulf (2007a) initiated this line of research in motor learning — external versus internal focus of attention — to challenge traditional approaches to instruction which focus on correctness and the use of conscious control in the performance of skills. The role of instruction has been more or less ignored in ML research and sport literature (Wulf *et al.*, 1998, 2007). Instructions are generally given before and during practice and frequently include information on correct placement of the body (e.g. adapting the correct posture for putting in golf or serving in tennis, or how to hold a racquet or other implement), timing of movement, rules, and so forth. Instructions, focussing on correct body placement, are classed as internal-focus instructions in the Wulf model as they entail detailed conscious processing of the act. By contrast, external-focus instructions direct attention towards the effects of the performer's movements; for instance, in the case of a golf swing, the possible 'effects' include the club motion, the trajectory, the landing point and the final position (Wulf and Prinz, 2001: 656). The objective of external-focus instruction is to bypass or at least shorten the first conscious stage of learning (Wulf, 2007a, 2007c).

The concept of external focus is not new. Wulf *et al.* (1998:170) trace it back to William James (1890) and his theory on control of action in which it is postulated that remote effects are more important than the action itself:

> It would seem indeed that we fail of accuracy and certainty in our attainment of the end whenever we are preoccupied with much ideal consciousness of the means. We walk a beam the better the less we think of the position of our feet

> upon it. We pitch or catch, we shoot or chop the better the less tactile and muscular (the less resident), and the more exclusively optical, (the more remote) our consciousness is. Keep your *eye* on the place aimed at, and your hand will fetch it; think of your hand, and you will very likely miss your aim. (James, 1890: 520)

Thus the remote effects refer to the results of an action which are distant or occur subsequent to the action and are, at the same time, related to the action. This is an important point, as the interpretation of what constitutes an external-focus must involve an instruction which is both remote and task-related. Wulf (2007a) proposes that the constrained action hypothesis provides an explanation for the benefits of adopting an external focus; i.e., consciously controlling movement constrains or freezes the motor system by disrupting automatic control processes:

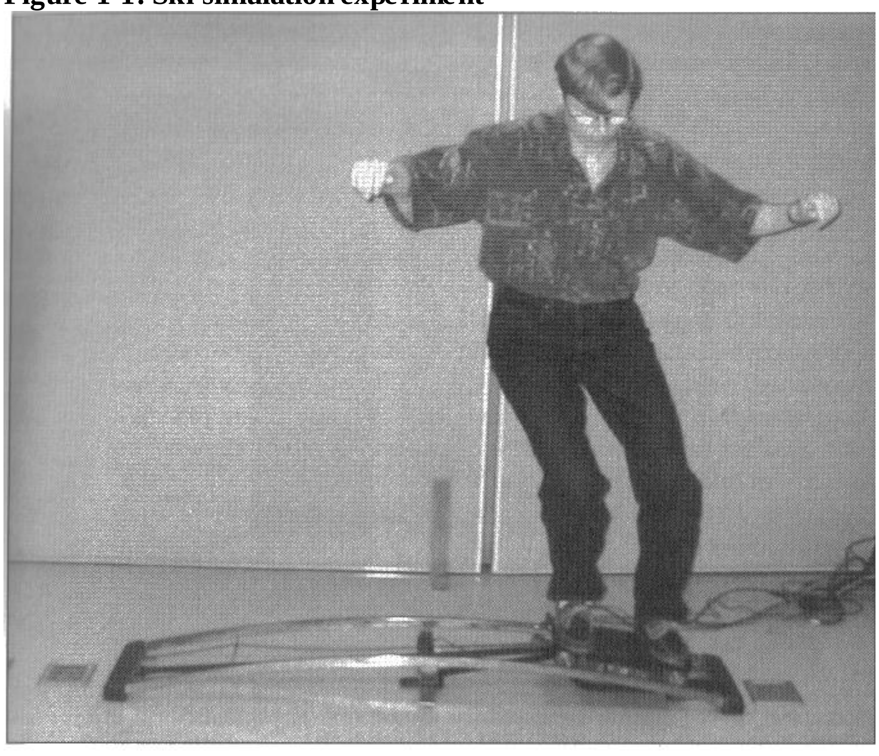
> - Focussing on one's movements (i.e. adopting an *internal focus*) constitutes conscious intervention into control processes that would "normally" regulate movements effectively and efficiently. That is, trying to actively control those movements disrupts automatic control processes.
>
> - Focusing on the movement effect (i.e. adopting an *external focus*) promotes a more automatic type of control. It takes advantage of unconscious and reflexive processes and allows them to control our movements to a greater extent. As a result, performance and learning are enhanced. (Wulf, 2007a: 114)

The findings of a considerable number of studies (over 50 according to Wulf, 2007b) provide robust evidence that external-focus instructions result in enhanced performance (i.e. facilitating automatic processes) whilst internal-focus instructions cause an interruption to the learning process resulting in comparatively poorer performance (e.g. more conscious processing). Some of the relevant studies are selected for the review.

1.2.1 Review of empirical research in motor learning

Using a ski-simulation task, Wulf *et al.* (1998) conducted an experiment in which participants (n = 33) were randomly divided into three groups with each group performing the same task under different instructions: the internal-focus group were instructed to direct attention to their feet; the external-focus group were to focus on the wheels of the platform directly under their feet, and the baseline group were given no instructions relating to either their feet or the platform. Data were collect over two days of practice and a retention test on day three - subjects completed a total of 22, 90-second trials. Subjects were instructed to create a slalom-like movement – back and forth - on a platform (see Figure 1-1).

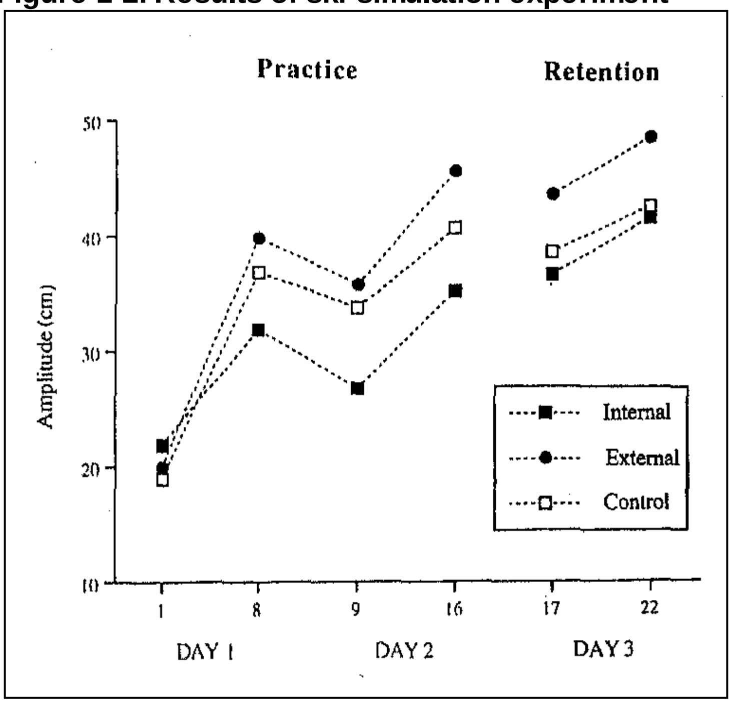
Figure 1-1: Ski-simulation experiment



(*Source*: Wulf, 2007: 9)

Wulf *et al*. (1998) explain that the characteristics of expertise are larger movement amplitudes and later weight shifting (from outer to inner foot) than in the case of non-experts. Thus the three groups were instructed to produce large amplitude[10] movements on the platform with the focus groups being given specific focus instructions, i.e. focus on the outer foot (internal) versus focus on exerting pressure on the outer wheels of the platform (external). In both focus conditions, additional information, which was directly related to expert performance, was provided to the subjects - the focus was either with reference to body movement or to movement of the apparatus. By contrast, the baseline or control group were simply instructed to make slalom-like movements on the platform with as large an amplitude movement as possible. The results of the experiment are depicted in Figure 1-2:

Figure 1-2: Results of ski-simulation experiment



(*Source*: Wulf *et al.* 1998: 173)

The three groups demonstrate marked improvement as a result of practice regardless of the treatment group they were assigned to. During the initial trials the internal-focus group perform best but their performance is quickly

[10] The maximum deviation of the platform from the centre was 55cm. Subjects completed a total of 22, 90-second trials.

matched and surpassed by the other two groups. By the end of Day 1, for example, the external-focus group demonstrate better performance in terms of the amplitude of the slalom movements produced. By the end of Day 2, the internal-focus group had not reached the level of performance attained by the external-focus group after one day of practice. The enhanced performance of the external-focus group is evident throughout the two days of practice and reflected in a significantly higher amplitude score on the retention test on day three. On Day 3, the control and internal-focus group attain similar scores in amplitude as during practice. When the pattern in practice and test results is compared, the internal-focus group attain a slightly higher result in the retention test (e.g. without instruction) than in the practice. Baseline and external-focus groups initially demonstrate lower amplitudes on the first trial in retention compared with the results obtained at the end of practice on Day 2. This slump is also evident during the beginning of practice on Day 2. In the final retention trial, the external-focus group achieve higher amplitudes compared with the practice session whereas the control group retain a similar score when practice and test results are compared.

Other measurements are also applied in the motor learning setting such as degrees of movement frequency (Wulf *et al.* 1998: 173) during practice and retention. The external FOA group attained lower frequencies in this task compared with the other two groups because their amplitudes were larger and therefore each movement cycle took longer. The results for the Wulf *et al.* study (1998) are depicted in Table 1-1 below.

Table 1-1: Movement frequencies (in Hz.) in Experiment 1

Trials	**Baseline**	**Internal-focus**	**External-focus**
Practice 1	.62	.53	**.52**
Practice 8	.44	.46	**.41**
Practice 9	.44	.46	**.41**
Practice 16	.44	.45	**.41**
Test 17	.45	.45	**.40**
Test 22	**.47**	**.45**	**.45**

(Source: Wulf *et al.* 1998: 173)

As is evident from Table 1-1, the external-focus group consistently demonstrate lower frequency of movement compared with the baseline and the internal-focus groups. The internal-focus group remain stable in both retention tests. Differential progress was documented during practice by the end of the first day, (i.e. in terms of greater amplitude in movement and lower movement frequency), with the external-focus group showing greatest improvement. In the test, the external group demonstrated relatively greater amplitudes but similar movement frequency to the baseline group whereas the internal focus group remained stable – i.e. "[…] the degrading effects of the internal-focus instructions seen during practice were not permanent in nature. Yet, those instructions were no more effective for learning than no instructions at all" (Wulf *et al.* 1998:174). The researchers suggest that: "[…] attempts to exert conscious control over processes that would otherwise regulate the movement automatically can actually hamper performance (and learning)" (Wulf *et al.* 1998: 177). The findings of this study thus confirmed their predictions that external focus instructions would be more beneficial to performance (practice) and learning (test). Furthermore, they suggest that giving beginners instructions which are based on expert performance enhances learning.

In a follow-up study (n = 16), comparing an internal and external-focus group (no control) with a different task (e.g. balancing on a stabilometer), the differential effect of instructions was replicated in the test, but not in the practice session. According to the researchers, the differential demands of the two tasks account for these results, i.e. beginners learning how to perform slalom movements may be more sensitive to instructions whilst those balancing on a stabilometer require less use of “cognitive intervention strategies” (Wulf *et al.*: 1998, 177). Wulf *et al.* (1998) highlight the relevance of their findings to the differential effects of explicit (e.g., rule learning) and implicit instruction[11] in relation to motor skills:

> Apparently, unconscious learning processes can be more effective than conscious learning processes. In fact, implicit (unconscious) learning may be particularly relevant in the acquisition of motor skills, because those skills are thought to have important automatic components. (Wulf *et al.* 1998: 177)

Further studies followed to investigate the applicability of the Wulf model to “more real-world skills” (Wulf and Prinz, 2001: 649) in naturalistic settings such as in golf, basketball and tennis. The transfer of the laboratory experiments (i.e. balancing on the stabilometer and ski-simulation) to field-like conditions meant that the external-focus instruction now incorporated the effect of the movement on an implement; for example, the trajectory of the object being hit. In the laboratory experiments, the external-focus was directed at the effect on the board or platform. Although the wording was adjusted somewhat to suit the new conditions, these experiments constitute a replication of the original laboratory experiments in that participant groups either focus on their actions (back swing and racquet-ball contact point in the tennis experiment) or on the action effect (trajectory of ball and landing point).

In the Wulf model, the definition of “external focus” differs from external cue since the objective is not simply to distract the individual (Gallwey: 1982,

[11] This is important since the implicit / explicit dimensions are key issues in SLL research (Section 1.3.2).

Singer: 1986; 1988). A tennis experiment (Wulf *et al.* 2000, cited in Wulf and Prinz, 2001) was designed to investigate the different effects of external cue versus external-focus instructions: subjects were instructed to either focus on the effect of their movements (e.g. the arc of the tennis ball) or to focus on the approaching ball (Singer's external cue). The external-focus group demonstrated relatively better performance illustrating that, "the critical issue was not the external focus *per se* but whether attention was directed to the action effect" (Wulf and Prinz review 2001:651). Similarly, in a more recent study, Wulf and McNevin (2003) provide evidence that preventing learners from focussing on a task[12] did not result in similar benefits as the external-focus instruction.

As mentioned previously, the constrained action hypothesis accounts for why internal-focus instructions result in comparatively poorer performance outcomes (Wulf and Prinz, 2001; Wulf, 2007). Wulf *et al.* (2001) tested the hypothesis by designing an experiment to investigate the degree to which automaticity is relevant to the performance of external-focus groups. In this experiment, three groups were again compared while carrying out a task involving balancing on a stabilometer. A secondary task was added in order to measure probe reaction times (RT) in order to investigate the attentional demands of the added task (finger response to presented stimuli) vis-à-vis the original task of balancing:

> We argued that, if an external focus of attention promotes the utilization of more automatic motor control processes and less conscious control, one might expect performance under these conditions to require less attention and therefore to yield faster probe RTs than performance under internal focus conditions, where relatively more processing activities may be associated with conscious control. (Wulf *et al.* 2001: 1145)

[12] In this experiment involving balancing on a stabilometer, the performance of external and internal-focus groups was compared to a third group who were given a secondary task (shadowing a story presented to them while balancing).

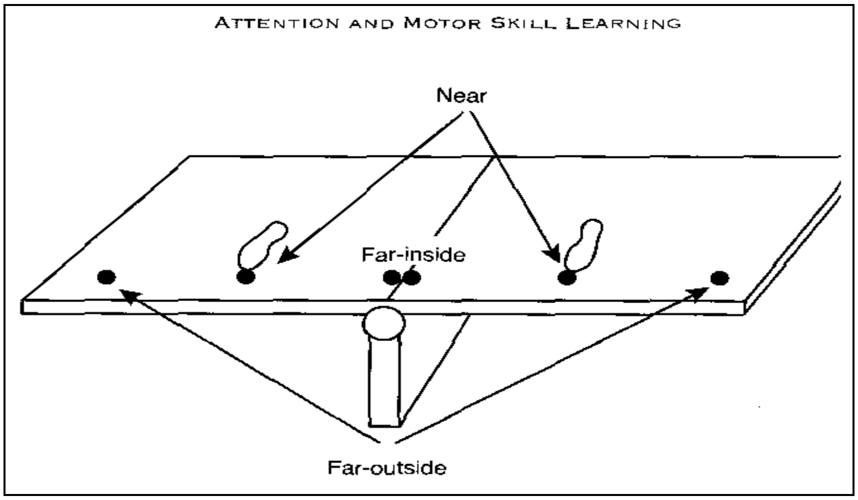
The findings of this study provide empirical evidence for the constrained-action hypothesis since the external-focus group demonstrated a measurable difference in automaticity:

> Presumably, there is a delicate balance between conscious processes and automatic processes that play a role in maintaining stable posture, which can be interfered with or overridden when the participant consciously intervenes in the control process. (Wulf *et al.* 2001: 1152)

Furthermore, in a separate study the researchers discovered that, when given a choice, participants opted to follow external-focus instructions on a balancing task over internal instructions, i.e. focus on markers versus feet (cited in Wulf and Prinz, 2001). This added advantage indicates that the success of the external-focus is also closely related to personal motivation. Another study using a dual-task design (Wulf, McNevin and Shea, 2001) demonstrates that learners who adopt an external-focus have more attentional resources available for other tasks.

McNevin, Shea and Wulf (2001) carried out an experiment comparing performance on the same task (balancing on a stabilometer) with several different markers as the foci of attention, in order to examine the effectiveness of different degrees of external-focus, i.e. more or less external (illustrated in Figure 1-3). They hypothesised that, “a greater distance between the body and the remote effect produced by its movements might further enhance the learning advantages associated with an external-focus and thus identify it as a possible reason for the differential performance and learning benefits seen in previous attentional focus studies” (McNevin *et al.* 2002: 3). Their predictions were confirmed by the findings, thus the group following the instructions relating to the markers at a greater distance from the body were more successful compared with the other instructional treatments.

Figure 1-3: Degrees of internal and external-focus on a stabilometer



(*Source*: McNevin *et al.* 2002: 3)

Totsika and Wulf (2003) investigated the transferability of skills learned under external-focus instructions to other test situations. In an experiment (n = 22) using a pedalo learning task, Totsika and Wulf (2003) devised three different types of transfer tests which differed from the conditions under practice: (a) test under time pressure; (b) test under variation of the skill, e.g. riding the pedalo backwards under speed pressure; and (c) speed pressure accompanied with a dual task (e.g. counting backward in threes). An image of a pedalo is illustrated in Figure 1-4:

Figure 1-4: Image of a single pedalo[13]

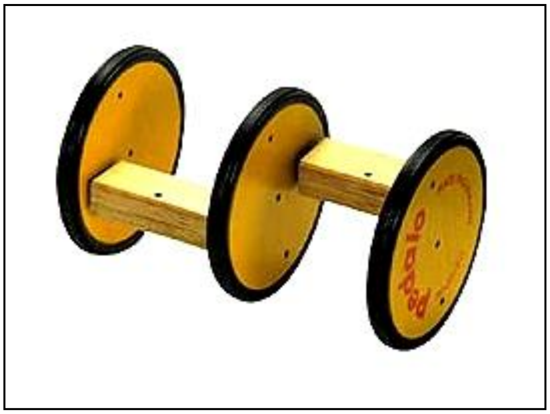
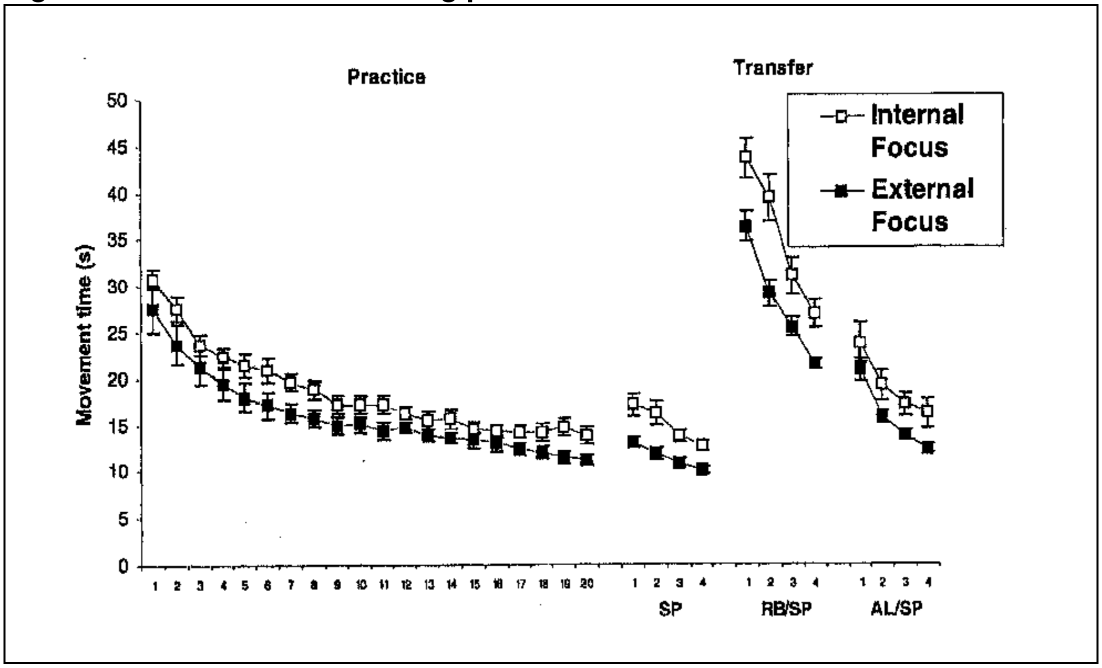


Figure 1-5 illustrates the results from the pedalo study in practice and the transfer tests: riding forward under speed pressure (SP), riding backward under speed pressure (RB/SP), and attentional load and speed pressure (AL/SP).

Figure 1-5: Performances during practice and the three transfer tests



(*Source*: Totsika and Wulf, 2003:223)

[13] Accessed 01 March 2009 from www.googleimages.com

Consistent with the previous study described above, both groups improve during the twenty practice trials and demonstrate faster movement times (MT) at the end of practice. However, the external-focus group attain more speed on the pedalo task from the start of the practice session. Under speed pressure (SP), both groups initially revert back to a slower performance time and reach the same time attained during practice by the end of this first transfer test – again with the external focus group achieving the faster performance. The MTs were considerably longer for the other two transfer tests compared with the practice session and in both tests the external-focus group perform significantly better than the internal-focus group. It is also evident from Figure 1-5, that the benefits of external-focus instructions are greater on the transfer tasks. In addition, the results of the external-focus group demonstrate consistently lower frequency movements indicating increased automaticity in performance.

The experiments described thus far portray the beneficial effects of external-focus instructions during practice and in test situations. These benefits generalize to new tasks supported by the findings in the pedalo experiment. The results of the practice phase were consistent with other findings, i.e. the external-focus group were faster than the internal-focus group (no control group used here). With regard to the first transfer test (a), the external-focus group were comparably faster to the internal-focus group, but, they were not any faster than the speed attained during practice. In the two other transfer tests, the external-focus group also demonstrated faster performance. The group differences were most pronounced in the transfer test (b) demonstrating that external-focus is optimal in learning, both in terms of the task itself and novel situations.

To sum up the findings of the studies discussed so far:

- Instructions inducing an external-focus, i.e., focussing on the effect of the action on the implement or environment, enhance performance and learning – in some cases, the benefits emerge in retention only;
- An internal-focus uses more attentional resources whereas an external focus of attention promotes automaticity;
- Increasing the distance between the action and its effect enhances the learning and performance benefits of the external-focus;
- Distracting or providing external targets for focus does not render the same benefits to learning as external-focus instructions;
- Adopting an external-focus during practice promotes transfer of the skill to novel situations.
- External-focus instructions are motivational since when given a choice, subjects opt for this type of learning instruction;
- Assimilation of instructions is influenced by the complexity of the task and the expertise of the group.

In order to widen the scope of the investigations, Wulf and other researchers extended the research model to other fields and to other profile groups. Some of these experiments are reviewed in the next section.

1.2.2 Focus of attention applied to therapeutic settings

In their review of studies on attentional focus, Wulf and Prinz (2001) draw a comparison between instructions in their own field and instructions in occupational therapy. Occupational therapists frequently work with individuals who need to re-learn skills which have been damaged due to an accident or an injury. The main principle of occupational therapy is giving the individual something purposeful to do. In purposeful activity, a patient's attention is directed towards carrying out a task as opposed to other exercises where attention is directed to movement of a limb.

In Wu *et al.*'s (1994) study (cited in Wulf and Prinz, 2001), they compared participants who were asked to pick up a pencil from a pencil holder and write their names (e.g. a material-based occupation) with participants pretending to do so (e.g. an imagery based occupation) and participants asked to reach forward. Their findings illustrate that the group focussing on a purposeful task outperform the other group. They suggest that this is because the group's focus of attention was on the pencil and what they were going to do with the pencil (external-focus) whereas the other two groups had an internal focus (focus on the body when imagining carrying out the task) or no focus at all (e.g. reaching forward). Although not stated explicitly by Wulf and Prinz (2001: 657), Wu *et al.*'s study could be interpreted as being consistent with the Wulf model.

More recently, McNevin et al. (2000) discussed the importance of external-focus instructions in physiotherapy, as one of three factors that affect the learning of motor skills along with patient-centred control in practice sessions and dyad training:

> Instructing patients to focus on their heelstrikes during gait or on the extension pattern of a limb during a reaching task will probably not lead to any appreciable improvements in movement. Based on the attentional focus research, such instructions will probably not be very effective in bringing about the improvement desired, let alone lead to any permanent changes (learning). However, instructing patients to imagine (or perform) kicking a ball during the terminal swing of a gait cycle or knocking an object off a table during a reaching task might allow the patients to perform the desired movements without concerning themselves with the actions required to produce the motion. The same logic, we believe, explains why the use of metronomes or music during gait training may be beneficial to patients with neurological or musculoskeletal disorders. (McNevin *et al*., 2000: 377)

Landers *et al.* (2005), reported on the benefits of adapting external-focus instructions for patients (n = 22) diagnosed with Parkinson's disease which results in various motor control problems including postural instability. In their experiment, participants were asked to stand on rectangular pieces of paper on a platform. The baseline group were not given any focus instruction; instructions for the internal focus group referred to putting an equal amount of force on the feet; and external focus instructions referred to putting pressure on the rectangles. The performance of the participants was measured under a variety of conditions: eyes open, eyes closed and a sway condition. The results of the experiments show no differentiated advantage of the external-focus in the first two conditions (e.g. eyes open and eyes closed); however, for the most challenging condition, i.e. the sway-referenced condition, the external-focus instruction proved to be most effective. The experiments reported here illustrate the positive impact of external-focus instructions in therapeutic settings.

1.2.3 Focus of attention applied to speech therapy

Wulf (2007) claims that the insights gained from internal/external-focus studies have implications for other fields including speech therapy. Research in speech pathology or aphasia[14] is frequently referred to in psycholinguistics and SLL literature particularly in relation to what occurs when speech or other language areas break down (Aitchison, 1998). In addition, on some levels, it has been found that language learners and individuals diagnosed with a speech pathology face similar obstacles with language and show similar observable phenomena; not only in the domain of speech, but also in comprehension, expression and syntax. For example, Vasić (2006) compared Broca's aphasic patients with children learning their

[14] Dysphasia or Aphasia (US) is the term commonly used to refer to all types of speech disorders.

first language emphasizing the similarities between the two populations in terms of language comprehension deficits.

Crystal synthesizes the features common in all language impairment:

> In every case, we see language to some degree ceasing to function in a **natural, spontaneous**, and **unselfconscious way**, and **drawing attention to itself**, thus becoming a barrier rather than a means to communication. (Crystal, 1987: 264, my emphases, CKC)

Recall that the emphasis in this study is on the comparison of learning processes rather than the actual physical actions involved. A parallel can be drawn here between Crystal's description above and internal-focus instructions which Wulf claims cause a disruption to the natural, automatic flow (of movement), and draw attention to the details of the action. This is not to say that the processes underlying speech pathology are the same as for L2 learners, but that some similarities can be observed and are worth noting. Moreover, the ML experiment involving speech provides the closest point of contact bridging the gap between ML and SLL.

Some of the technological advances already used in speech therapy, such as the visual display devices for hearing-impaired patients, already, *albeit* unintentionally, apply the external-focus model. For example, instructing a patient how to pronounce words based on a visual pattern on a screen can be interpreted as an external-focus instruction compared with directing attention towards lip reading or lip imitation, i.e., an internal-focus. Freedman *et al.* (2005) highlight the predominance of internal focus instructions in the treatment of speech disorders, for instance, in Sound Production Treatment, the focus is on tongue placement.

Freedman *et al.* (2005) replicated the Wulf model in a study relating to the oral and motor system. The objective of their study was to investigate the role of attentional focus in the treatment of individuals with apraxia of speech (AOS). In their study, unimpaired subjects (n = 46) were given two air-filled rubber bulbs – for the mouth and hand - and instructed to squeeze the bulb against the roof of the mouth or the hand alternatively. The internal-focus group focussed on the pressure exerted by the hand or tongue whereas the external-focus group were instructed to focus on the pressure exerted on the bulb. Subjects obtained visual feedback via a computer screen illustrating the pressure burst obtained at each trial. The instructions were read out by the researcher and repeated once a minute. The instructions are illustrated in Table 1-2:

Table 1-2: Instructions during practice

Focus of Attention	Instruction
Internal	"Keep focusing on your tongue/hand; focus on your tongue/hand. Push with your tongue/hand."
External	"Keep focusing on the bulb, focus on the bulb. Push on the bulb.

(*Source*: Freedman *et al.* 2005:7)

The practice trials involved 4 blocks of 10 bursts for hand and tongue. The retention tests took place after 5 days – the first retention test was similar to the practice session and compared subject performance to practice target levels whereas for the transfer test a higher target level was used. In the experiment, subjects were administered a manual (e.g. hand) and oral (tongue) pressure accuracy task. This task involved generating rapid pressure bursts with the hand and tongue alternatively. In this experiment, the main dependent variable for practice and retention was absolute error by contrast accuracy is the dependent variable used in the pilot trials and SLL experiments conducted in this study. Freedman and his colleagues predicted lower absolute errors for the external-focus group compared with the internal-focus group, i.e. subjects adopting external-focus instructions would demonstrate enhanced performance compared with subjects following internal-focus instructions.

Consistent with previous findings discussed in sections 1.2.1 and 1.2.2, the external-focus group demonstrated comparably better performance particularly during the practice trials. In the retention trial, the disparity between the two groups was smaller and more or less equal in relation to hand errors. The benefits of external-focus instructions in this case are more evident during the practice phase than on the test (Figure 1-6). Freedman *et al.* (2005) suggest that, based on the results of the retention (Figure 1-7) and transfer trials (Figure 1-8), the effects of external-focus instructions may be greater in the case of the oral-motor system compared with the limb system. They maintain that further studies are needed to investigate the applicability of external-focus instructions in therapeutic settings involving speech.

Figure 1-6: Errors in practice

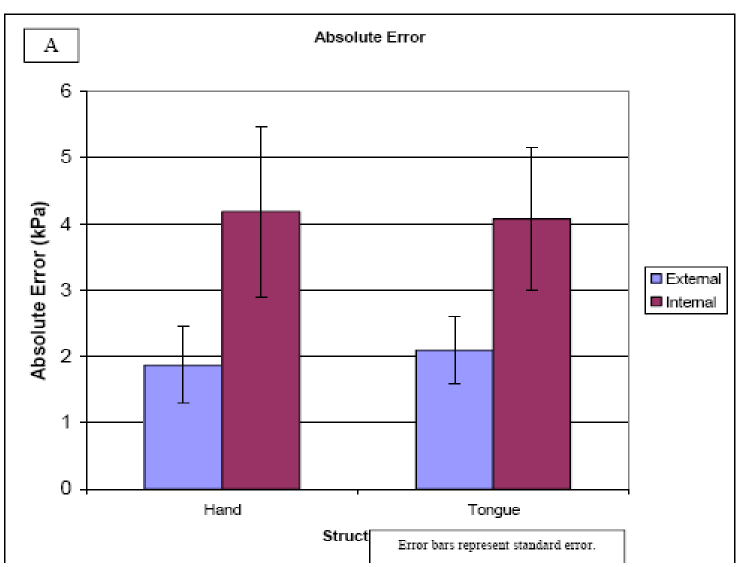
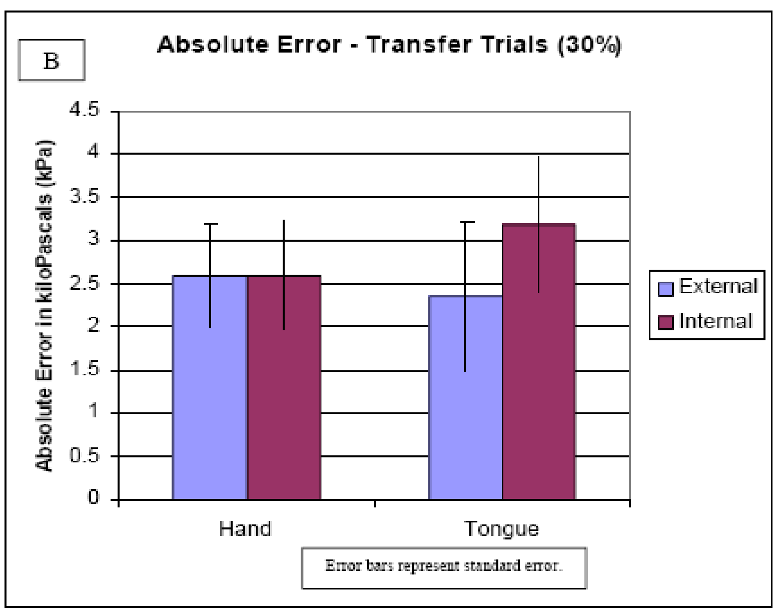


Figure 1-7: Errors in retention

Figure 1-8: Errors in transfer trial



As illustrated in Figure 1-6, the external-focus group demonstrate a lower number of errors during the practice trials in both instances (e.g. hand and tongue). In a within-subject comparison, the external-focus group demonstrate more errors during the test compared with the practice nevertheless, the number of errors is comparatively lower than is the case for the internal-focus group. The internal-focus group, on the other hand, perform comparatively better on the test compared with the practice but their overall scores show comparatively poorer performance in relation to the external-focus group. In sum, the internal-focus group performs better in the test compared with the practice while the external group perform better during the practice trials.

Freedman *et al.*s (2005)[15] study represents the first experiment in which the Wulf model has been replicated in a language environment *albeit* some uses of technology applied to speech therapy already induce an external-focus, e.g.: visual display devices, The results of this study are encouraging as the study itself, although non-speech oriented, provides evidence that external-focus instructions could be used in the treatment of speech disorders. This study provides further evidence to support the Wulf model as well as its transferability to other cognitive skills and in this case, its transferability to the language domain. The recent replication of findings by other teams of researchers adds further credence to the model presented here (Vuillerme and Nafati, 2007).

The results presented above are representative of the general results attained in motor learning research following the Wulf model which are:

[15] See also Maas *et al.* (2008).

- Evidence of the significant benefits of external-focus instructions in ski-simulation, pedalo and oral-facial skills, compared with no instruction or internal-focus instructions;
- Marked improvement during practice of all instructional groups;
- Significant difference between external-focus and internal-focus groups in practice in relation to different types of task;
- Different findings in terms of results on retention tests compared with practice, i.e., in the Wulf et al. (1998) study, the external and internal-focus groups perform better in retention compared with the baseline group; in the pedalo experiment subjects were much faster during practice than on the transfer tests presumably because of the added difficulty involved in the task (i.e. riding whilst counting backwards in threes). In the oral-facial experiment both groups had less errors in the test compared with the practice but the difference between the groups was insignificant in the final transfer trial (hand).

1.2.4 Implications for SLL research

To my knowledge, the implications of the Wulf model for the field of SLL research, have not yet been discussed or tested. The inter-sections between the two fields of study, motor and language learning, are defined by cognitive approaches to SLL and the speech experiment. Moreover, recent ML studies are investigating skills which have a motor skill component and involve higher cognitive skills, such as music and surgery (Mornell, 2007). Therefore, it would seem reasonable to propose that the applicability of the Wulf model to SLL warrants discussion and research.

What appeals most about the ML experiments from the point of view of SLL research, is that the approach entails, in my view, concepts which are directly related and applicable to L2 learning:

(a) Wulf explains that adopting external-focus instructions enhances automatic processing and requires less attentional resources. If this type of focus is found to be applicable to SLL, it will have direct implications not only with regard to the locus of attention, but also for developing fluency;

(b) The adoption of attentional focus is induced via instruction and therefore is central to L2 pedagogical issues;

(c) Wulf contends that the differentiation between results obtained by individuals following internal vs. external FOA instructions is predicated on whether they are primed for explicit or implicit processing. As will become clearer in the discussion in Section 1.3.3, this issue is central to SLL.

The applicability of the Wulf model to phonology, for example, would be the immediate contender as a research question in SLL and indeed, technological resources such as spectrograms and visual voice recorders in CALL[16] packages are already used in some teaching environments (See Blin 2005, for a review). It could be said that the external-focus benefits to phonological aspects of SLL, have already been established to a degree by these applications. But, what of other aspects of language learning such as syntax, morphology and lexis, which do not directly involve the use of motor-skills? Here, the principles of the Wulf model applied to other – more cognitively-demanding – aspects of second language learning are investigated.

[16] Computer Aided Language Learning

1.2.5 Summary

The discussion in the previous section highlighted the relevance of viewing language learning from a wider cognitive approach within a skill-based model comparable to the settings researched by Wulf. In this section, selected studies on attentional focus have been reviewed in order to introduce the theoretical principles and empirical findings derived from the Wulf model. The findings extend to a wide-range of skills tested in diverse environments and provide evidence of the robustness of the model. In this section, the review of a selection of the extensive research exhibiting the benefits of adopting external-focus instructions in different fields and skills, for different groups of learners, has been demonstrated. The findings highlight the important role of the wording of instructions on learner performance in particular with reference to focus of attention. In addition, the findings converge on the beneficial effects of adopting an external focus of attention during the practice dimension of skill learning. Furthermore, by adopting an external-focus during practice, greater benefits are accrued in the learning of the skill as demonstrated in the retention tests and the generalisability of learning to new skills.

The advantage of adopting an external-focus is explained by the constrained action hypothesis which states that internal-focus instructions promote controlled processing of the skill thus hampering automaticity and the systems natural ability to self-organize (Wulf, 2007). Furthermore, it is suggested that external focus instructions enhance automaticity because the wording of the instruction induces implicit learning processes. The findings of these studies are robust in that they extend to different participant groups – beginners, experts, impaired, unimpaired – and to different skills.

To establish where the Wulf model fits in to current SLL perspectives on the role of attention and instruction, a review of recent research is required.

1.3 The Role of Attention and Instruction in SLL

The importance of the role of attention to SLL has been widely acknowledged in the field: (McLaughlin *et al.*, 1983; Tarone, 1985; Gass 1997; Hulstijn and Hulstijn, 1984; Schmidt, 1990, 2001; Tomlin and Villa, 1994; Ellis, N. 2001; See Gass *et al.* 2003 for a review,). Similarly, although learning can and does take place without instruction, the influence of instruction on L2 learning, previously regarded as *prima facia*, has been empirically established in SLL research (Doughty, 1991, Long, 1991, VanPatten and Cadierno, 1993). Both of these issues will be discussed here in turn.

Schmidt (2001) describes attention as the “pivotal point” at which learner-internal and external factors come together. It is not “a unitary phenomenon” (Schmidt, 2001:30) because it comprises a variety of mechanisms: “alertness, orientation, preconscious registration (detection without awareness), selection (detection with awareness within selective attention), facilitation, and inhibition”. Different aspects of the construct have been researched in SLL, for example, attention to form (Hulstijn and Hulstijn, 1984; Vanpatten and Cadierno, 1993; Sharwood Smith, 1991, 1994; Laufer, 2005;); attention to grammar rules (Reber, 1989; DeKeyser, 2001;); the relationship between different subcomponents of attention and learning (Tomlin and Villa, 1994; Simard and Wong, 2001); attention in terms of detection (Leow, 1998, 2002); attention in terms of implicit, incidental and explicit learning (Schmidt, 1990, 2001; Robinson, 1995, 1997a; and Ellis, 2004); degrees of attention and language task (Tarone, 1985), competition between memory, attention and processing in learning grammar and vocabulary (Yang and Givón, 1997), attentional focus (Hulstijn and Hulstijn, 1984; Gass *et al*., 2003) and the relationship between different levels of attention and learning L2 collocations (Fan, 2005). Although the importance of attentional focus has been widely acknowledged, as attested by the range of these studies, according to some prominent SLL theorists, research in this area remains incomplete (Gass *et al.*, 2003). This is certainly true with regard to the approach adopted in this study since no previous studies have investigated attention as defined by the principles in the Wulf model.

In Kaye's (1979) discussion of the features of skills, he explains that all skills are open systems[17] and are therefore malleable and responsive to instruction. Explicit instruction in sport is generally related to correct body placement or reference to rules (Wulf, 2007a), whereas explicit instruction in language refers to correct usage of grammar rules. Instructors, coaches and language teachers, therefore have a crucial role to play in the learning process as they are at the inter-section between the learner and what is to be learned. Instructors and teachers witness learners at different learning stages from the first conscious stage to stages of increasing expertise. As will be evident from the discussion in Section 1.3.2, the approach adopted by the teacher or instructor in terms of instructing learners at different stages, is paramount to the learner's ability to develop the automatic processes necessary for learner development.

1.3.1 Attention in SLL

Automaticity is directly related to fluency – the end goal of L2 learning in most, but not all cases - and the construct of attention plays a prominent role in reaching this goal:

[17] "The solar system is a closed system as are river systems because their movements are controlled by forces acting on them. Government systems, respiratory systems, learning systems, on the other hand, are open as there are alternative ways to govern, breathe and learn available". (Kaye, 1979: 37)

> A problem that can be solved with less attention, or less choice about how attention should be allocated, appears to be solved more fluently or more automatically. (Bialystok, 1994: 161)

For Schmidt (1990), language learners who notice most learn most and those who notice most are those who pay most attention. In the Noticing Hypothesis, he postulates that *input* becomes *intake* only when it is noticed. It is not clear what exactly Schmidt means by paying 'most' attention. In his work, he discusses awareness and paying attention or noticing different aspects of an L2 at different stages of learning. When studying Portuguese in Brazil, for instance, Schmidt noted in his diary that some forms, for example, the longer form used for questions, were present in the input (e.g. of interlocutors). These forms were processed by him at a semantic level but remained unnoticed in terms of form. When he eventually began to notice the forms, he then began to use these forms in output, highlighting "[…] the close connection between noticing and emergence in production" (1990: 141).

Schmidt's position refutes Krashen's (1982) theory[18] (i.e., that language acquisition is unconscious), arguing that language learning is primarily a conscious process. More recently, Gass *et al.* (2003: 509) argue that attention is not sufficient for learning when the input is complex: "complex rules are not immediately apparent from input data; not only does one have to "notice" the rules, but one also has to "understand" them in the sense of figuring them out". The extent to which learning takes place when we are not consciously aware of attending, in other words implicit and incidental learning, is also an important factor and will be discussed in the section on instruction.

[18] For Krashen (1982), exposure to comprehensible input is the prime requisite for SLA.

The findings of a study on second language phonology conducted by Dickerson and Dickerson (1977) depict that Japanese learners of English pronounce /r/ much better in word lists than when reading dialogues and are likewise better in dialogue pronunciation than in free speech. They postulate that variation or style switches (1977: 29) in pronunciation corresponds to the degree of attention paid as a function of the environment in which the phoneme is found. Their findings – an interpretation adopted here - provide evidence that an internal-focus (i.e. focus on the pronunciation within a word list) is more beneficial since when reading the words in a dialogue, the learner's focus may not be on pronunciation, but on the meaning of the text. The aspect of focus, however, was not part of Dickerson and Dickerson's study and it is not entirely clear (based on the article) what subjects focussed on when carrying out their task. Nevertheless, it is interesting to note and interpret these results from the perspective of FOA as the findings of this study suggest that internal-focus instructions may, in fact, be beneficial to SLL with regard to the aspect of L2 phonology as discussed in this article.

The findings of four SLL studies provide very different results vis-à-vis the relationship between attention and learning outcomes in terms of timing and accuracy. These studies highlight the complex nature of the relationship between attention and language learning and other factors which impact on learner development. Hulstijn and Hulstijn (1984) claim that non-skilled speakers, i.e. L2 learners, employ controlled processes and must pay extra attention to rules which slows down planning and execution. They hypothesised that learner performance would be further hindered when required to pay attention to information or when given a time constraint. In a story-telling experiment (n = 32), instruction and feedback during practice focused on manipulating the response behaviour of the subjects.

Phase 1

Four conditions: (2 manipulated variables: time and attention)

1. Information Fast (IF): focus on information + time pressure
2. Information Slow (IS): focus on information – time pressure
3. Grammar Fast (GF): focus on grammar + time pressure
4. Grammar Slow (GS): focus on grammar - time pressure

Phase 2

Subjects were interviewed to ascertain explicit knowledge of rule.

The experiment[19] had a within-subject design and subjects performed differently in response to the four conditions illustrated above. These findings indicate that type of focus impacts on learner performance since focussing on information and focussing on grammar resulted in different performances from the same cohort tested. Focussing on grammar, for example, resulted in learners being more accurate but taking more time to respond[20]. Hulstijn and Hulstijn (1984) found that focus of attention on grammar improved scores but this was dependent upon whether the task involved controlled or automatic processing:

> […] we found that for skills under controlled processing, focusing of attention on grammar helped much more than for skills largely under automatic processing (i.e., the use of INV[21]), since gain scores were higher for VF than for INV. (Hulstijn and Hulstijn, 1984:41)

Tarone's (1985) findings, on the other hand, provide evidence that increased attention to grammar does not result in greater accuracy in performance. In

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[19] The experiment involved a sentence correction test (40 L2 sentences) which measured explicit and implicit knowledge of rules. Learners had to look for errors in sentences and correct them. Half a minute was allowed for correction of each sentence.

[20] This is interesting to note at this stage of the discussion, as it contrasts with the discussion on automaticity in relation to ML (Section 1.2.1).

[21] INV is an acronym for inversion and VF denotes verb final.

a study investigating learner variability as a function of attention, Tarone[22] (1985) hypothesised that the increased focus on grammar would result in more accuracy than in a task involving spontaneous use of language. She hypothesised that a learner's use of the article would differ significantly in an oral exercise compared with a written grammar exercise or indeed, between different oral exercises (e.g. a specific speaking task versus spontaneous speech). Tarone used a grammaticality judgement (GJ), an oral interview and a narrative task in her study and the findings illustrate systematic variability across tasks in some grammatical and morphological forms. The data disconfirmed her hypothesis with regard to some morphological forms, but not others – interestingly, a higher degree of attention focussed on grammar did not result in more accurate performance.

Yang and Givón (1997) conducted a study using an artificial language "Keki" to investigate the effects of using simplified (pidgin-like) input compared with normal (grammatical) input on language acquisition at an early stage. The study was based on Givón's Competition Hypothesis which states that in early L2 acquisition, grammar and vocabulary compete for memory, attention and processing capacity. The researchers hypothesised that learners receiving pidgin input would learn vocabulary more efficiently and catch up with the other group once they commenced grammar input - the other group had a dual task (i.e. learning vocabulary and grammar). Interestingly, learners in the grammar group were significantly faster in reaction times (RT) for all trials which disconfirmed their hypothesis.

More recently, Gass *et al.* (2003) carried out a study on differential effects of attention in three linguistic areas (syntax, morphosyntax, and lexicon) and the interaction between focus type and learner proficiency. In their study, thirty-four adult learners of L2 Italian were randomly assigned to one of two

[22] Tarone's (1985) study of language learner performance variability as a function of task provided the basis for the first pilot trial in grammaticality judgements.

conditions, e.g. with (+) focused attention or without (-) focussed attention. The researchers predicted that focus of attention would have a differential effect depending on the linguistic area studied. For example, focussed attention would have more effect on lexicon and least effect on syntax because it is considered to be more abstract and complex. Interestingly, the evidence from the study proved the opposite to be the case, e.g., + focus of attention had most impact on syntax. Gass *et al.* (2003: 526) conclude that focussed attention is a "powerful mechanism" for learning as in all cases, the groups in the + focussed attention condition performed better than the other group. Furthermore, focussed attention has more of an impact when the language is more complex, i.e. in the case of syntax. However, they also found that learning did take place in the non-focussed group. Contrary to their initial predictions that focussed attention would be more beneficial to learning lexical items, they found for example, that in this area there was the least disparity between the two groups. They suggest that the lexicon "appears to be an area in which learning can take place on the basis of one's own internal mechanisms" (2003: 527).

The studies described in this section provide a picture of how different degrees and components of attention impact on second language learner development. What is evident is the importance and complexity of the construct of attention in SLL and the degree to which the construct has already been researched from different perspectives principally involving the learning of grammar and lexis. Clearly aspects of the construct of attention remain to be researched and introducing external-focus principles to an SLL research model adds a new dimension to the discussion with possible implications for current theories.

The next section is concerned with the role of instruction in SLL as it represents a cornerstone of the Wulf model and is central to this study. A summary of pedagogical approaches to SLL will also be presented in this section to provide a wider frame of reference for theories of instruction. In addition, some empirical studies will be described, in particular on aspects of explicit and implicit learning.

1.3.2 Instruction in SLL

Ideas about teaching and learning are oftentimes not entirely new – according to some, what we have today are simply old ideas cloaked in new terms (Kelly, 1969; Cook, 2008). Foreign languages were formally taught during the Renaissance but very little is known about language teaching methods or practices dating from before then (Kelly, 1969; Steinberg, 2006).[23] There has been, throughout the ages, a pendulum swing between methods which propose more emphasis on grammar versus those which are based on more communicative language learning. Methods are also a product of the purposes for which the language is being learned and how language is viewed in society. For instance, during the Classical period, language learning was part of a broader curriculum concerned with general education in the culture of ethics, logic, philosophy and rhetoric. Some of the more prominent teaching methods are summarised in the next section.

Translation was used in Rome to teach Greek and revived during the Middle Ages and the Renaissance to teach Latin (Titone and Danesi, 1985). It then became part of the grammar-translation method in which grammar is imparted deductively through explicit teaching of grammar rules and vocabulary lists. The emphasis in this style of teaching is on acquiring knowledge as opposed to communicative ability (Cook, 2008), and it provides the quintessential equivalent to internal-focus instructions as discussed earlier with respect to the Wulf model.

[23] Kelly (1969) claims that the first language tutors were Greek slaves - apparently valued as equivalent to ten 'ordinary' slaves!

The direct method evolved in reaction to the grammar-translation method. In this case, the language classroom replicated the environment of first language acquisition, thus, the L2 was used exclusively in the classroom. The Berlitz method is a good example of this method, which was devised for the purposes of business and travel, as is the intensive method (Titone and Danesi, 1985; Cook, 2008) used by the US army in the 1940s. The Audio-Lingual Method (ALM)[24] developed from behaviouristic theories on learning. Imitation, rote memorization, pattern practice and reinforcement constituted its pedagogical ingredients (Titone and Danesi, 1985). The method was mainly based on the use of drills to create habit formation and emphasis was directed towards listening, repeating and speech. In the ALM method, grammar was not taught explicitly – instead, students learn correct language structures through patterned drills and it was expected that they would internalise the grammatical forms through this procedure.

The Cognitive Code Approach was developed in the 1960s and counteracted the rote-learning approach advocated in ALM. Here, emphasis was placed on meaningful language learning activities in which learners were encouraged to be creative and to use their analytical skills. In this approach learning is viewed as an analytical process and explicit grammar instruction played an important role.

In the 1970s the Natural Approach was devised by Krashen and Terrell. In this approach, it was assumed that learners would learn grammar through inductive means in direct opposition to the grammar-translation approach. Terrell (1991) points out that the study of grammar is viewed as lowering the

[24] ALM is a method in the true sense of the word according to Richards and Rodgers (1986) because it has a specific instructional design.

affective filter[25] and thus has a negative effect on adults learning an L2. Meaning-focussed activities take precedence over form-focussed (or grammar-focussed) learning. Terrell, for example, incorporated Krashen's distinction between 'learning' and 'acquisition' into this method – acquisition was classroom based while learning exercises were to be carried out outside the classroom. This method was the precursor to communicative teaching in the 1980s in which communication was at the centre of the language classroom.

Communication became the central objective of the language classroom and grammar was also taught through inductive means. In communicative styles of language teaching less emphasis is placed on learner mistakes and more emphasis on communication based on the idea that one learns by doing, i.e., implicitly. Communicative language teaching relies on the creation of situations in which the learner becomes a protagonist, and thus this approach became a precursor for task-based learning[26] (TBL). TBL, as its name suggests, is based entirely on the learner completing tasks or language activities in the L2. Focussing on the end goal of a task is critical to TBL and the task[27] must involve "meaning-focussed language use" (Ellis, 2003:3). Tasks have a non-language goal – they are built around outcomes and real-world needs.

Ellis (2003) points out that although TBL research provides positive evidence of learning, long-term language acquisition remains hypothetical.

[25] The Affective Filter is one of the five elements of Krashen's Monitor Model and refers to emotional variables which impact on SLL, such as anxiety, low self-esteem and lack of assimilation values with the L2 group.
[26] TBL is also referred to as problem-based learning.
[27] Tasks have the following features:

1. A task is a work plan.
2. A task involves a primary focus on meaning.
3. A task involves real-world processes of language use.
4. A task can involve any of the four language skills.
5. A task engages cognitive processes.

A task has a clearly defined communicative outcome. (Ellis, 2003)

> At this stage, it is only possible to hypothesize that the kind of production learners engage in will have long-term acquisitional effects – for example, that a solid diet of tasks that encourage fluency will result in the development of this aspect of proficiency at the expense of, say, accuracy. (Ellis, 2003: 137)

As mentioned above, TBL is essentially goal-based learning where learners are encouraged to focus on the goal and learn the L2 incidentally. Because there is a degree of externalising involved in this approach (i.e., focus on the task), it may appear to be equated with the external-focus instructions from the Wulf model investigated in this study. However, whereas a TBL approach essentially involves non-linguistic outcomes, the approach adopted in this study is primarily language based. This is because, as pointed out in Section 1.2, although there is a degree of remoteness or focus on an external goal in the external focus of attention instruction, nevertheless, the instruction also importantly focuses the individual's attention on an effect which is task-related. For example, in the language experiments, the learner's focus of attention is external, but the focus of learning remains language. In TBL, on the other hand, the focus of learning is external, e.g. on task completion and language is demoted to the medium.

More recently, a variation of TBL has been introduced to include an explicit grammar focus or focus on form (FonF). Long (1991) describes FonF as the incidental focus on grammar during meaningful language activities. This is similar to code-oriented instruction where specific features are made more salient or, a more recently introduced technique, input enhancement. Input enhancement techniques include for example using typeface such as italics or bold to draw the learner's attention to specific grammatical categories in particular morphological changes such as the addition of *–aba* or *–ía* in Spanish to denote the imperative. This approach is advocated by Robinson (2003), but criticised by Cook (2008: 258): "To some extent this modifies the basic TBL tenet that language itself is not the focus of the task, by letting language form in through the back door". Question marks hang over when and at what stage of learning a focus on form is appropriate. For example, Hulstijn (1994) claims it is not possible to generalise - without limitations - that explicit grammar instruction is beneficial in teaching. He states that "it is far more likely that explicit grammar instruction is beneficial in some cases and non-beneficial or even detrimental in other cases […]". VanPatten, (1998) takes a stronger view disputing whether focus on form has any relevance to early stage language learners.

According to Norris and Ortega (2003), the most recent consensus among SLL theorists is that explicit learning is more successful as a means of language teaching. But this generalised view fails to take account of different learner groups, different proficiency levels, different aspects of the L2 (grammar, phonology, lexicon, etc.) The issue remains unresolved and new teaching techniques continue to be developed, for example, the use of gesture is currently being researched at the Max Planck Institute for Psycholinguistics in The Netherlands (Gullberg, 2008). It is hoped that this study will highlight the importance of instruction in SLL and add to current pedagogical theories by adapting the successful techniques emerging from empirical studies in motor learning.

Since the internal and external focus instructions in the Wulf model are related to explicit and implicit learning processes, these variables will be discussed next vis-à-vis SLL.

1.3.3 Implicit versus explicit instruction in SLL

In the introduction to *Implicit and explicit learning of languages* (1994) N. Ellis describes implicit learning as unconscious, or at least not completely accessible to awareness:

> Some things we just come to be able to do, like walking, recognising happiness in others, knowing that *th* is a more common that *tg* in written English, or making simple utterances in our native language. We have little insight into the nature of the processing involved – we learn to do them implicitly like swallows learn to fly. (N. Ellis,1994:1)

Reber (1989) claims that implicit learning is superior to explicit learning, is more resistant to injury (for instance, individuals with amnesia continue to learn implicitly) and is older in evolutionary terms (Reber *et al.* 1991). In the 1960s, Reber and his colleagues commenced a series of experiments testing the implicit learning of artificial languages comprising letter strings in diverse syntactical order (See Reber, 1989 for a review). Typically in these experiments, subjects are divided into two groups and given exemplars of an artificial grammar. Both are instructed to memorise the examples - one group is instructed to look for a pattern or structure (i.e. the rule-search group) while another group are given neutral instructions. The learning phase is then followed by a type of GJ involving judgement of well-formedness. The findings of these studies – summarised below - show that the performance of the rule-search or explicit group was comparatively poorer:

> They took longer to memorize the exemplars, they were poorer at determining well-formedness of test strings, and they showed evidence of having induced rules that were not representative of the grammar in use. The suggestion is that at least under these circumstances, implicit processing of complex materials has an advantage over explicit processing. (Reber, 1989: 223)

Reber (1989) suggests that the explicit instructions may have an "interference effect". More recent evidence of this interference effect has been found in a study carried out by Fletcher *et al.* (2005) using fMRI[28] to measure explicit and implicit learning processes. In an experiment (n = 11), the researchers compared subjects given instructions with a subjective intention to learn, to subjects with no instruction related to a pattern sequence – both complex and alternating visual sequences were used. Their findings provide evidence that implicit automatic learning can be reduced by explicit memory processes. Fletcher *et al.* (2005:1002) identified that the suppression resulting from explicit processing is "associated with sustained right frontal activation and attenuation of learning-related changes in the medial temporal lobe and the thalamus"

> The findings demonstrate a neural basis for a well-known behavioural effect: the deleterious impact of an explicit search upon implicit learning. (Fletcher *et al.*, 2005: 1002)

Based on these findings they contend that learning without consciously trying, in other words "implicit" learning (i.e., without the aid of explicit instruction) is superior to explicit learning.

Implicit language learning is frequently associated with Krashen's definition of *acquisition* in SLL literature (Krashen, 1982; 1994; Zobl, 1990) in which it is argued that *learning* and *acquisition* involve entirely different and separate learning processes. Learning, according to this school of thought, involves explicit learning of rules, i.e. declarative or metalinguistic knowledge of the language, and cannot be converted to implicit learning, i.e. acquisition. Acquisition involves implicit learning and results from exposure to vast amounts of input over time. A more complex picture of the explicit/implicit dichotomy has since emerged in SLL research, for example, R. Ellis (1994: 85) identifies two types of implicit knowledge in SLL: formulaic and rule-

[28] Functional Magnetic Resonance Imaging.

based. Formulaic knowledge, as the name suggests, refers to memorising language in terms of chunks or formulas – which may be analysed or unanalysed - e.g. *See you later* in English or *hasta luego* in Spanish. R. Ellis refers to this type of knowledge as intuitive. Implicit knowledge can also be rule-based – similar to Reber (1989), Ellis (1994) proposes that rules can be acquired implicitly from the start.

Importantly, learnability also depends upon the type of rule, the stage of learning at which the learner is at and the *teachability* of the rule (Piennemann, 1989). Terrell (1991), for example, cites a study in which she participated where, in spite of concentrated instruction on forms and uses of Spanish subjunctive, first year university students were unable to use it correctly. Some rules are thus developmentally constrained, i.e. are related to learner proficiency levels or stage of learning:

> […] even if learners have their consciousness raised about specific linguistic properties (i.e. are equipped with explicit knowledge) and then are subsequently given opportunities to practice using these properties they do not acquire them to the point where they become evident in their communicative language use unless they have reached the stage of development that makes their acquisition possible. (R. Ellis, 1994: 88)

Explicit learning, according to Ellis also includes the creating and testing of hypotheses by the learner[29]. This view of explicit learning amplifies the interpretation extending the definition to include language learners with little or no educational background – possibly the largest group of L2 and L3 speakers worldwide. In sum, recent views on explicit and implicit learning demonstrate that (a) implicit learning does not necessarily exclude rule-

[29] This definition of explicit learning poses further challenges for researchers as the creation and testing of hypothesis is introspective and not always accessible to awareness.

learning, and (b) explicit learning involves not only rule-learning in the conventional sense of the term, i.e. grammatical rules, but also rules which are generated and tested by the learner through a hypothesis-testing process.

An alternative view on the explicit/implicit debate is proposed by Bialystok (1994) which encapsulates the conceptual framework of explicit and implicit in terms of degrees of analysis. Explicit and implicit learning belong to the same continuum and it is the degree of analysis which determines the point on the line of the continuum:

> […] analysis is the process underlying the phenomenological experience that implicit knowledge becomes explicit. In this way, explicitness is really a statement about the level of organization in the mental representation". (Bialystok, 1994: 159)

Bialystok's definition serves, in my view, to provide a more complete view of the explicit/implicit debate as, importantly it incorporates different aspects of language use. Analysis, however is not necessarily equated with analytic knowledge of grammar. For example, Widdowson (1989: 132) claims that: "[…] there is a great deal that the native speaker knows of his language which takes the form less of analysed grammatical rules than adaptable lexical chunks".

Robinson (1995) claims that differential performance in experiments comparing explicit and implicit processes can be accounted for by the demands of the task as opposed to the processes applied to the task. In Robinson's (1997a) study, sixty adults with different L1s (e.g. Japanese, Korean and Chinese), were randomly assigned to one of four training conditions[30]: incidental, implicit, rule search and instructed[31]. A transfer test (grammaticality judgements) followed the training session. The instructed group excelled with regard to judgement on ungrammatical sentences not previously seen in the training session. However all groups performed accurately on previously-viewed grammatical sentences, i.e. decisions were memory-based. Judgements on new sentences, Robinson argues, are rule-based which accounts for the superior performance of the instructed group compared with implicit learners who wrongly accepted 80% of the ungrammatical sentences. The speed and accuracy of the instructed group was related to the fact that their decision-making was guided by a rule and not slowed down by hypothesis testing. Robinson concludes that explicit and implicit learning was fundamentally the same as all four groups demonstrated learning in the transfer test[32]. The results show similarities in automaticity amongst groups but differences in learning with focus on form (Fonf) groups excelling.

Whereas Wulf (2007) contends that implicit learning is suited to the learning of motor skills, it may be that this type of learning cannot be fully generalised to SLL and that implicit learning is more suitable to some aspects of SLL than others. For example, drawing on a comparison with motor skills, N. Ellis (1998) suggests that implicit learning is suitable for the acquisition of vocabulary:

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[30] The choice of the four training conditions reflects the history of SLA - the implicit group represents the Audio Lingual Approach, the incidental group Krashen's Natural Approach and the enhanced group represents TBL.

[31] Logan's theory (mentioned earlier) is based on the premise that automatic performance is unconscious and directly retrieved from memory whereas resource-based theorists (Anderson's proceduralization) link it to a gradual withdrawal of attention. Implicit learning is memory-based whilst enhanced and instructed training is rule-based and therefore expected to be generalizable.

[32] One negative criticism of this study would be Robinson's use of a questionnaire to gauge learner rule awareness. Although learners acknowledged that they were aware of searching for a rule they did not have to provide any evidence of rule awareness. It is questionable whether learner response in this instance provides a reliable picture of learner knowledge.

> Like other sensory or motor skill systems, these modules do so automatically and they are tuned by practice – by frequency, recency, and regularity. To the extent that vocabulary acquisition amounts to learning these surface forms of language, vocabulary acquisition is an implicitly acquired skill. (N. Ellis, 1998: 12)

More recently, Leonard-Cook (2008) refuted claims that implicit learning is based on surface information only and contends that implicit learning involves degrees of both awareness and abstractness. In a study (n = 24) using an artificial version of Persian, her findings indicate that learners use explicit knowledge in untimed versions of the grammaticality judgements and implicit knowledge in timed versions. Her findings are in line with the theory expounded by R. Ellis (2004) that immediate judgement indicates the use of implicit knowledge whereas, delayed response is an indication of explicit knowledge.

1.3.4 Summary

Explicit and implicit instructions, memory processes and learning environments provide evidence of the complex interaction of different variables which affect learner performance:

- Instructions have different effects on learners depending on task demands;
- Instructions engage different learning processes or strategies depending on time permitted;
- Both explicit and implicit processes result in learning.

It is clear from the discussion so far that instructions are one way of steering attention and affect the performance of language learners. It is also clear that instructions interact with other variables such as type of task and time allocated for task completion. The objective of this research study is to examine the impact of different types of instructions related to focus of attention on learner development. The variables discussed in this section will be discussed again in relation to the specific findings of this study in Chapter 5.

1.4 *Conclusions*

Motor skill learning and second language learning are similar in the following ways:

1. They are both cognitive skills involving mental and physical components;
2. They involve the use of similar learning processes to attain automaticity;
3. Both are based on natural processes but involve "*learning*" (and by extension, are influenced by teaching/coaching and instruction);
4. They are both strongly influenced by attention;
5. Both skills follow the Power Law of Practice;
6. Recent research in cognitive and neurolinguistics (e.g. NTL) provide evidence of the common cognitive processes of all human cognition;
7. Both have a proven inter-section (speech therapy which includes a motor learning and language component);

Hence, it is reasonable to propose that a model devised for motor learning research can be transferred to SLL on the basis that certain aspects of the learning process are common to both fields. The empirically-based claims made by Wulf (2007) and other researchers investigating the Wulf model, are backed up by the applicability of the model to a wide range of skills tested in a laboratory and real-world environments. The research studies on focus of attention have been extensive in terms of investigating different possibilities to refine what external-focus is, in terms of investigating the impact of instructions on different groups and in terms of transferring the model from the laboratory to real-world skills and comparing these studies with other fields. These findings validate:

a) The transferability of experiments from the laboratory to the real world;
b) The transferability of experiments to different groups;
c) The transferability of the Wulf model to other domains;

The model extends to different learner groups and can be applied to therapeutic settings. The principles of the Wulf model are:

> The first principle is that the effect that the performer focuses on should be as remote as possible. The second principle, which appears to contradict the first principle, is that the effect should be related as closely as possible to the action that produced it. (Wulf and Prinz, 2001: 656)

These are the principles to be transferred in order to test Wulf's hypothesis vis-à-vis the beneficial advantages to learning resulting from external-focus instructions in other learning environments. The Wulf model and claims are robust and constitute an inspiration to test these claims in other fields such as SLL.

Chapter 2: Methodological issues relating to the transfer and replication of the Wulf model

In this chapter, the methodological and operational issues relating to the experimental design will be discussed. The first part of the chapter is devoted to the research question. This section is followed by a review of the rationale for the experimental design and the provision of a background to the procedure and research instruments selected for testing the hypotheses. The final part of the chapter is dedicated to describing and analysing the pilot trials which constitute the preliminary stage of this empirical study.

The stimulus for this research study is the empirical findings relating to the significant role of external-focus instructions in the learning and performance of motor skills. As illustrated in Chapter 1, the benefits of external-focus instructions extend to a wide range of skills and continue to generate research in other fields such as music (Wulf, 2007a) thus raising questions as to its applicability to the field of language learning. In this chapter, the methodological issues relating to the experiments devised to test the claims made by Wulf in relation to motor learning will be discussed within the context of SLL. The main research question relates to the transferability of the Wulf model to SLL. In Chapter 1, the validity of this transfer was established on theoretical grounds in terms of common cognitive processes, skill acquisition theory and the transferability of the Wulf model to a language domain, i.e. speech therapy. Here, the hypotheses generated by this research question will be discussed in detail with an introduction as to how these hypotheses can be tested through experimental research.

The pilot trials served to evaluate the experimental procedure and hypotheses and provided a testing ground for fine-tuning the wording of the instructions. For most linguists, grammar has a central part in the structure of any language (Crystal, 1987), other levels include semantics, phonology and phonetics, syntax, morphology, spoken versus written language, sign language, body language, pragmatics and discourse, etc. For the purposes of this study, three aspects of language learning were investigated, namely, grammaticality judgements, L2 word recognition and L2 pronunciation.

The design of the experiments will be discussed both at a theoretical level, i.e. discussion of the principles of the Wulf model; and at an operational level, i.e. experimental design. The sample populations tested were all adult L2 learners of English as a Second Language (ESL). Hence, it is not within the scope of this study to investigate other areas of SLL or learner groups; nevertheless, some suggestions for further research are made in the final chapter of the dissertation. The conclusion to the chapter draws together the elements of the methodology, theory and testing to provide a synopsis of the development of the research and a background for the experiments discussed in Chapter 3.

2.1 Theoretical Issues

The stimulus for this research derives from *a priori* knowledge gained from Wulf's empirical studies on instructional focus in motor learning. Under investigation here is whether the theory generated from motor learning (ML) research findings, - i.e., that external-focus instructions enhance learning – has any explanatory value for understanding learner development in SLL. To test this theory, several language experiments have been designed and conducted to investigate the possible effects of the wording of instructions on the subject's learning mechanism and developing knowledge system. In order to avoid any misunderstanding, it needs to be emphasised that it is not the intention here to investigate specifically the effect of instructions on motor skill components of SLL - *albeit* one of the trials is dedicated to L2 pronunciation - but to widen the scope of the study to investigate the non-motor skill components of language learning.

This study endeavours to replicate the methodology used in the Wulf model and explores learner performance in response to different types of instruction. A psycholinguistic approach is adopted in the research design which consists of a snapshot of learner performance as opposed to a longitudinal study of learner performance in response to class-room based teaching. It is consistent with other psycholinguistic models in which the researcher controls for as many variables as possible in a laboratory setting. In the next section, the hypotheses generated by this research will be introduced and discussed.

2.1.1 Formulating hypotheses

The main hypothesis postulates that the way in which the learner's focus of attention is directed (e.g. through the wording used in the instructions) impacts on learning outcomes. For example, instructions relating to focus may enhance or slow down the processes involved in adult L2 learning and the development of learner interlanguage (Section 1.1.3). The main hypothesis tested in these experiments is formulated below:

> **H1**: Different attentional foci induced through instruction impact on learning outcomes during the process of second language learning.

The second hypothesis addresses the beneficial effects of external FOA instructions:

> **H2**: External-focus instructions enhance learner performance in SLL compared with internal-focus or no focus instructions.

The null hypothesis predicts that the performance of a sample population of L2 adult learners in a language experiment (i.e. accuracy score) will be the same, regardless of the treatment applied:

$H_{0:}$ baseline = internal-focus = external-focus

In other words, according to this hypothesis, the instructions relating to focus of attention will not impact on learner performance and there will be no statistically significant difference between the three groups**.** The alternative hypothesis (baseline ≠ internal-focus ≠ external-focus) would be supported if there is a significant difference in performance between the three groups and that difference can be attributed to the independent variable, i.e. focus of attention instructions.

Several possible outcomes may result from testing these hypotheses, for example, if the data generated by the language experiments provide support for rejecting the null hypothesis, then, the alternative hypothesis can be accepted if other criteria are met. For example, the question of whether the difference between the three groups can be attributed to the instructions has to be addressed. Along similar lines, the existence of other extraneous variables which may influence outcomes, such as learner L2 proficiency, must be accounted for. It may be that attentional focus impacts on learner outcomes and in that case H2 must be addressed, i.e. do external-focus instructions enhance performance compared with internal-focus or baseline instructions? The discussion generates further questions such as whether the difference attributed to focus instructions generalises to other L2 learner groups (e.g. beginners or advanced); other age groups (e.g. children) or, other linguistic areas (e.g. syntax, morphology, speech, writing, etc.). Judging L2 sentences and learning new vocabulary involve different aspects of learning and therefore FOA instructions may result in different learning outcomes. It is also possible that practice and test conditions result in variability in learner performance. This is particularly important with regard to teaching implications, i.e. it will be important to identify the extraneous variables which may influence outcomes, such as age, L1, and type of language testing tool (i.e. the level at which the test is pitched). These and other variables will be discussed in detail in relation to the experimental findings in Chapters 3 and 4.

No conclusions can be reached without first verifying the internal validity of the experiments. For example, it must be demonstrated that the language experiments designed for this study test the hypotheses appropriately. The internal validity is thus directly related to the experimental design and established via the piloting of the experiments. In Section 2.1.2, the process involved in replicating the principles of the ML model in SLL, which provides the foundation for the experimental design and validates the language testing procedure, is presented.

2.1.2 Transferring principles of ML to SLL

In order to replicate the ML experiments, the first step is to define focus of attention in accordance with the principles established in the Wulf model. The two most important principles of the external-focus instruction are that the reference or external point must be remote and secondly, it must also be task-relevant (Wulf, 2007, see Section 1.2.1). In other words, the external property is not just to distract the learner from, for example, self conscious attention or too much attention (i.e. as in Singer's *external cue* model, 1988); but to direct attention to a point relevant to the task at hand.

This second principle provides the challenge and novelty of the approach with respect to other SLL studies on attention. To create the external-focus instruction, it is necessary to translate the wording of the Wulf model to the context of SLL such that the principles of remoteness on the one hand and task-relevance, on the other, are maintained. Recreating external-focus instructions within the context of the three types of L2 experiments conducted for this study, i.e. in grammar, vocabulary learning and pronunciation, proved to be the most difficult part of this research project. Whereas external-focus instructions are more readily constructed in the physically-based tasks involved in body movement; the transfer to a purely cognitive domain, i.e. SLL, proved to be more elusive[33]. A synthesis of the characteristics of these two types of instructions based on a range of experiments using the Wulf model (Wulf and Prinz, 2001, Wulf, 2007a, 2007b) is considered here:

Characteristics of internal-focus instructions in ML:

- Focus on part of body carrying out the action
- Visualise part of the body (e.g. feet)
- Focus on correct position – according to rules
- Consciously control body movement

Characteristics of external-focus instructions in ML:

- Focus on the effect of movement (on the implement or environment)
- Visualise markers (e.g. on stabilometer)
- Focus on end result – landing point of ball
- Release conscious control

Thus, identifying the characteristics of the two types of instruction defined by Wulf was a primary step towards replicating these instructions in SLL. The characteristics of the baseline or control group are not discussed in more

[33] Subsequent to the commencement of this research study, Wulf (2007: pp. 62-65) published a series of comparative tables for possible internal and external-focus instructions for environments in which “effects” are less obvious, e.g. in music and the performing arts.

detail as the wording of the instruction for this group has no reference to focus of attention. For example, the baseline group are simply instructed to make ample slalom-like movements in the ski-simulator experiment whereas under focus conditions, subjects receive additional instructions in relation to how to focus their attention.

An examination of SLL studies revealed that instructions of the type proposed in the Wulf model concerning internal-focus were already evidenced in SLL literature. For example, in Robinson's (1997) study comparing different training conditions, the form-focussed group were given an explanation of a rule and instructed to remember the rule. This type of instruction provides a close match to internal-focus instructions primarily because it promotes conscious learning and focus on detail. The wording of internal-focus instructions - when transferred to language learning - induce the learner to focus attention on grammar rules or the particular grammar item being tested. With regard to the vocabulary recognition experiment, internal-focus instructions involve the learner focussing on letters of words or spelling of words as this type of focus is akin to the first conscious controlled stage of learning. The speech therapy experiment, described in section 1.2.3 (Chapter 1), provided the basis for the phonology experiment with internal-focus instructions directing the learner to focus on the articulators, i.e. tongue placement and lip formation.

Based on a study of different experiments operated under the Wulf model and the characteristics of internal and external-focus instructions, the next step was to compare and match the wording of instructions across different learning domains. Comparing, recreating and matching the wording of the instructions involved an exploration of various options which were weighted against the Wulf model in order to identify an appropriate equivalent in SLL. As mentioned previously, determining external-focus instructions was made more difficult by the fact that (a) no equivalents for external-focus were available in the SLL literature; and, (b) the essential differences between ML and SLL in relation to the non-existence of physical equivalents in the language learning domain (with the exception of the area of phonology). With regard to the first point, previous studies regarding *focus on meaning* (Ye Fan, 2005; Gass et al. 2003) were examined and found to provide a close but not exact equivalent to external-focus. In short, *focus on meaning* studies in SLL provide some evidence of incidental learning of grammar when focus is centred on the meaning of text as opposed to grammatical rules. This approach is reminiscent of Krashen's approach and the Natural Method discussed in Section 1.3.4. However, the main difference between focus on meaning and external-focus instruction is that the former does not meet the criteria of task-relevance. It is, rather, a way of distracting the reader from a focus on grammar by providing a different focal point. Focus on meaning, is akin to TBL (Section 1.1.3) in L2 teaching methods and is not dissimilar from Singer's (1988) external cue in the ML studies (Section 1.2).

Table 2-1 illustrates possible language equivalents which were created for focus instructions with regard to grammaticality judgements. Instructions from the speech therapy experiment – the closest contact point for SLL - are set in the middle of the table as a stepping stone to SLL.

Table 2-1: Establishing equivalencies for GJ experiment

Motor Learning (Wulf Model)	**Speech Therapy (Freedman *et al.*, 2005)**	**SLL (GJ experiment)**
Internal-Focus		
Focus on part of body carrying out the action.	Focus on tongue placement.	Focus on recalling rules of grammar
Visualise part of the body (e.g. inner foot)	Visualize tongue/lip rounding.	Verbalise the grammar rule.
Focus on correct position – according to rules	Correct tongue placement – e.g. behind alveolar ridge.	Focus on retrieving correct rule
External-Focus		
Focus on effect of movement on the implement or the environment	Focus on pressure on the ball	Focus on the effect of making changes to the sentence
Visualise markers (on stabilometer)	Visualise pressure	Visualise the sentence with an extra word or a word omitted.
Focus on end result: landing point of ball	Sound or projection of the voice	Focus on the effect of adding or subtracting words.
Release	Do it naturally	Go with what looks or sounds right.

Similarly, the instructions[34] devised for the vocabulary learning experiment are illustrated in Table 2-2:

Table 2-2: Establishing equivalent instructions across different domains 1

Motor Learning (Wulf Model)	**Speech Therapy (e.g. dyslexia)**	**SLL (VOC experiment)**
Internal-Focus		
Focus on part of body carrying out the action.	Focus on the letters which make up each word.	Focus on the spelling of each word.
Visualise part of the body responsible for the action (e.g. feet)	Think about correct letters of the word.	Visualise the correct spelling pattern.
External-Focus		
Focus on effect of movement	Focus on image of the word	Focus on the image of the word
Focus on end result – landing point of ball	Use of word in context	Use of word in context

[34] The instructions devised for the phonology experiment are dealt with separately under Pilot Trial 5 (Section 2.3.5)

In the model adapted for this study, other factors relating to instructions were taken account of, such as the simplicity and clarity of the wording of the instructions. This is an important variable in terms of maintaining the same learning conditions for the three treatment groups – for example, ambiguous or difficult wording might elicit more questions from subjects in one group or result in more subject/researcher contact thus upsetting the balance between treatment groups. In addition to the aspects of clarity and simplicity, another crucial issue relating to the wording is the difference between the three types of instruction. In the motor learning experiments, for example, the difference between the instructions was minimal and subtle: “Despite the subtle difference in instructions, the attentional focus induced by them affected the learning of this task.” (Wulf *et al.*, 2002:2). An endeavour was made therefore to reproduce this condition in the SLL instructions.

It is important to point out too that other aspects of the Wulf model were not replicated in the SLL experiments. For example, in most of the experiments reported in Wulf (2007), the experiments take place over three days and on the third day, subjects were tested without instructions. Because of the nature of experimental research and the need to control for as many variables as possible, the language experiments were confined to evaluating learner performance on practice and testing of items in one session. It is, to all intents and purposes a snapshot of the learning process. This narrow definition has the advantage of affording a measurable result of learner performance in one instance with regard to one particular learning activity and can be replicated and re-tested at a future stage.

In addition, the data analysis techniques are quite different when ML and SLL are compared, the latter involving measures of minimal degrees of improvement and repeated measures of the same task. With regard to the language experiments, measurement of performance is limited to accuracy and timing in this study. That said, within these two types of measurements, analyses are conducted at more fine-grained levels (Chapter 4). Progress in the practice sessions cannot be measured in the same way in the language experiments as in the motor learning experiments. Whilst in the motor learning experiments, practice involves doing the same action over and over again at short intervals; progress in language entails dealing with different language exemplars at each turn. This aspect of the design when transferred to the context of SLL involves practice on one element (i.e. a particular grammatical feature such as pronouns or prepositions) with different exemplars.

Another important distinction between the language experiments and the motor learning experiments concerns pre-testing of the sample populations. In the Wulf experiments, subjects were not pre-tested and in most cases, the researchers refer to whether the subjects are novices or experts with respect to the task. This factor was noted in a critique of the Wulf model: Hodges and Ford (2007: 23) point out that the absence of pre-tests in the motor learning experiments makes it more difficult to ascertain whether the groups compared were equally matched and consequently to evaluate the effect of the instructions. In the language experiments, all subjects were pre-tested before the experiments and the pre-test data were used to evaluate subject proficiency levels.

2.2 Operational Issues

Several language experiments were devised to test the hypotheses discussed in Section 2.1.1. The basic tenets of the methodological design used in the motor learning experiments were replicated in the language experiments. With the exception of within-subject design experiments and those experiments comparing just two focus groups, the model is as follows:

(a) Subjects are assigned to one of three instructional groups: baseline (or control), internal-focus or external-focus;
(b) Subjects carry out the same task;
(c) The only difference between the three groups is the type of instruction they receive – i.e. the verbal message given before the task and during or after (feedback condition).
(d) A practice session followed by a test.

Except where stated differently, in the pilot trials (discussed in the next section), subjects were randomly assigned to one of three instructional groups and each group carried out the same task following different instructions. Each group was assigned to a different classroom and supervised – i.e., they were not aware of the instructions received by the other groups. In the first trials, subjects were administered the language tests in hard-copy format and used their own mobile phones to note down the start and completion times. In trials 6 and 7 as well as the experiments proper, (described in Chapter 3), the experiments were displayed and timed in a computer lab using E-Prime software. The design of the experiments (e.g. the set-up and tools of language elicitation), as well as the nature of experimental research which requires controlling variables, motivated the decision to opt for laboratory testing. Reasons for choosing this environment are presented in the next section.

2.2.1 Laboratory research

There are advantages and disadvantages to using a laboratory environment for SLL testing. According to Ellis and Schmidt (1997), language laboratory research is the only way to investigate language in real time as the sheer “mass of practice” (1997:146) involved in SLL would be impossible to access any other way. Although this approach does not provide a full picture of language learning, it is, on the other hand, questionable whether any approach can. The view proposed in this study is that the ability to isolate and measure variables is precisely the main advantage of laboratory research and it is therefore most appropriate for this experimental design. Indeed, the disadvantages of controlled laboratory studies are outweighed by its possibilities: Ellis and Schmidt, 1997; Hulstijn, 1997; Yang and Givón, 1997, Seliger and Shahomy 2003. For example, laboratory experiments permit SLL researchers to:

(a) Isolate one variable and test its impact on learner performance – this is not possible in the real world of the language learner because of the number of variables affecting performance, such as social, emotional, contextual, environmental, and individual factors;

(b) Analyse the findings in a discrete way, i.e. only with relevance to the environment in which they have been obtained. Findings derived from classroom-based research, for example, may be obscured by variability in for example teaching styles, instability in the environment (e.g. noise levels, interruptions) and the particularities of each given situation;

(c) Replicate the laboratory conditions elsewhere so that other researchers can test these results with other sample populations.

(d) Avert any negative effects on subjects' learning compared with for example, the application of different teaching treatments in classroom-based research over a period of time which could have possible negative effect on learner development.

(e) Reduce researcher subjectivity in terms of conducting and analysing research findings (Seliger and Shahoma, 2003). This is particularly important as it is directly related to the reliability of the findings and in turn facilitates the dissemination of research as illustrated in point (c) above.

2.2.2 Design issues

The primary design issue is to model the experimental design on the motor learning experiments. The basic set-up of the language experiments has already been discussed. Here other factors will be presented in order to discuss the overall construction of the design and to portray the difficulties encountered in meeting the criteria for internal validity. This is a quantitative study in which data is elicited via different research tools: grammaticality judgements, vocabulary learning and L2 pronunciation. The interpretation of the data is based primarily on measurements of accuracy, i.e. correct responses or closest target-like usage, but references to timing of responses is also provided where available.

Due to the complex interaction of different variables in SLL, it is not always possible to control for all variables. For example, even where every effort is made to ensure that instructions are clear, factors such as learner misunderstanding or lack of adherence to instructions as intended by the researcher, are not always evident in the data results or indeed, quantifiable. In addition, experienced learners, such as the subjects who took part in this study, frequently revert to their own problem-solving strategies and consequently ignore or are reluctant to follow the wording of instructions. This is a general problem related to instruction research which is also evident in the Wulf model, as pointed out by Hodges and Ford (2007). These and other interacting variables – referred to as the ‘phenomenology’ of second language research (Seliger and Shahomy, 2003) are important aspects and were taken account off both at the design stage and in the interpretation of the results as discussed in Chapter 5.

2.2.3 Research tools

As mentioned above, three research tools were initially selected for these language experiments. Each tool is introduced separately here and is discussed in more detail in subsequent sections in relation to the modifications and refinements added during the developmental stages.

Grammaticality judgements[35] (GJs) involve presenting subjects with L2 sentences and requesting them to judge their acceptability. In earlier studies (Tarone, 1985), two acceptability options, e.g. yes or no, were provided and subjects were required to correct L2 sentences where necessary. In more recent research designs, learners are more likely to be given a third "don't know" option (as in this study) or a scale of acceptability options (Toth, 2006). In these cases, subjects are generally not required to provide sentence production as well. GJs continue to be extensively used in SLL research (see proceedings of EUROSLA conferences 2005 and 2008[36]). This means a corpus of L2 English sentences is readily available to researchers providing a reliable and externally validated research tool.

As highlighted in Section 1.1.3, making a judgement on whether a sentence is correct or not involves accessing and retrieving information from the learner's interlanguage. When time is limited, the learner is put under pressure to make what is more commonly referred to as a "gut" decision. For this reason, GJs are regarded as a format which typically engages implicit processing, but Fan (2005) claims that GJs are more likely to tap into explicit processing as they involve metalingual knowledge. In my opinion, a GJ can alternatively engage implicit or explicit processes depending upon whether the exemplar triggers knowledge which has been previously stored

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[35] In SLL literature grammaticality judgements are also referred to as acceptability judgements or intuitional data elicitation tools.
[36] www.eurosla.org [Accessed 01 June 2009]

as an unanalysed chunk, a pattern or a grammatical rule. It will also depend on the stage of learning and the degree to which the learner has proceduralized explicit knowledge of the L2 as well as the learner's individual cognitive style. In addition, the selection of learning process will also be a function of time. R. Ellis (2004) claims, for example, that immediate judgement is an indication of implicit knowledge whereas delayed response indicates the use of explicit knowledge.

GJs provide a way for researchers to evaluate learner interlanguage knowledge which is not always accessible to the learner in terms of awareness – a learner may know the 'how to' (proceduralization), but not the 'what' (declarative knowledge) or vice versa (Section 1.1.1). Furthermore, in preference to production tasks, GJs are frequently used as a language elicitation tool as a way to tap into internal processes of the language learner as they can reveal more about a language learner than production data alone (Gass and Selinker, 2001). In this respect, requesting learners to make a judgement of acceptability involves language objectification (Gass and Selinker, 2001: 41). The extent to which focus of attention – induced through instruction - acts as a mediating factor in the processes involved in accessing and retrieving knowledge from the learner's interlanguage is investigated and tested in this study (Experiment 1 and 3).

Similarly, in the case of selecting tools for the vocabulary and phonology experiments, the choices were motivated by several design aspects. First of all, given the profile of the subject population and the desire to control for as many variables as possible in the learning environment, artificial words were used. The use of artificial words is a means of controlling for learner history of exposure or prior knowledge. From this standpoint, the impact of the independent variable on learning performance can be more clearly interpreted from the data.

For the vocabulary experiment, the initial stage involved in vocabulary learning, i.e. vocabulary recognition, was selected as the research tool. As such, the vocabulary experiment represents dynamic learning processes in contrast with the grammaticality experiment which involves accessing previous knowledge of the L2. Both research instruments therefore differ on several counts, (a) two different linguistic areas were tested – grammar vs. vocabulary, and, (b) two different learning paradigms were tested – accessing previous knowledge (i.e. interlanguage development) vs. adding new knowledge. The tool facilitated the testing and measurement of short-term vocabulary retention which is in line with Wulf's model of extrapolating just one element of, for example, learning how to play tennis, i.e. serve or backhand, as opposed to performance on different aspects of the skill.

For the phonology experiment, an L2 pronunciation experiment was devised based on Freedman *et al.*'s (2005) study on speech therapy. Subjects were tested on their performance on pronunciation of individual words which were specifically created for the test. Artificial words were utilized in this experiment which served to ensure control over prior knowledge and learner experience. The laboratory context as discussed earlier, facilitated the possibility of isolating and measuring variables and furthermore provided the possibility of creating artificial words. The third element of the research design concerns the sample population and is dealt with in the next section.

2.2.4 Sample Population

The sample populations were recruited from the same population group, namely, Erasmus students on their year-abroad programme. Pilot 2, involving high-school students, described in section 2.3.2, is an exception. Qualitative data relevant to individual subjects was collected by distributing a questionnaire administered to the subjects ahead of the experiments. This self-report instrument was used to collate subject profile information such as age, gender, L1, number of years spent studying English, and knowledge of other languages. Each subject was also pre-tested using a multiple-choice standardized test (Appendix A, p. 222).

2.2.5 Summary

In this section, the formulation of hypotheses generated by the research question was discussed. The hypotheses present the claims made by Wulf in relation to FOA instruction and are transferred to the domain of SLL. The various outcomes predicted by these hypotheses were also discussed. The key methodological issues identified in this section relating to the experimental design are:

- The transfer of ML principles to SLL based on:
    - the characteristics and principles of focus of attention instructions;
    - the establishment of equivalents for wording of instructions based on ML principles and experimental constraints (e.g. clarity of instruction and close resemblance of three instructional environments).
- The limits of transferring the experimental design:
    - Differences between ML and SLL in terms of practice session;
    - Differences between measurement techniques.
- The choice of research tools:
    - Grammaticality Judgements
    - Vocabulary learning
    - L2 pronunciation
- Sample population
    - Pre-testing
    - Use of self-report instrument

The key elements of the design are modelled on the ML studies with the objective of isolating the independent variable and measuring its effect on learner performance. Both qualitative and quantitative data are gathered in the language experiments which are conducted in laboratory conditions in order to control for as many variables as possible. In the next section, the piloting of the language experiments will be discussed and the result of each pilot trial will be presented.

2.3 Introducing the Pilot Trials in Language

The next sections comprise a summary of the design, results and findings of seven pilot trials conducted between May 2005 and February 2008. Although the pilot trials have shortcomings, they served to test the experimental design, facilitating subsequent fine-tuning and development of the experiments proper. In addition, these pilot trials provide some indications that instructions inducing different foci of attention interact with L2 performance and learning providing the impetus for further investigation.

2.3.1 Pilot Trial 1: Grammaticality Judgement

Tarone's (1985) study of language learner performance variability as a function of task inspired the choice for the first pilot trial (see Section 1.3.1). In short, Tarone predicted that a grammaticality judgement task would invoke a focus on grammar and result in greater accuracy compared with the production of the same forms in a task involving spontaneous oral communication (e.g. narrating a story to a listener). Contrary to her predictions, she found that a higher degree of attention focussed on grammar did not result in more accurate performance. This last point was particularly significant in terms of the Wulf model, for example, Tarone's focus on grammar (a close equivalent to internal-focus instructions as discussed in Section 2.3), did not result in better L2 performance. In a follow-up study, Tarone reformulated the L2 sentences grouping them under grammatical headings. This reformulated version of the GJ provided the basis for the internal-focus treatment and was adapted for use in the first pilot. Additionally, the L2 sentences used in Tarone's (1985) study provided a previously tested corpus of L2 sentences hence contributing to the reliability of the research tool.

In the pilot trial the L2 sentences for the internal-focus group were presented under grammatical category headings, for example, the group were instructed to decide whether the pronouns were correct.[37] The sentences were presented in random order in both the external-focus and baseline conditions. The external-focus instruction had no reference to grammar rules or use of terms relating to grammar, instead, the instruction directed subjects to search for word omission or an extra word in each sentence. The baseline or no-focus condition contained an instruction to identify sentences as correct or incorrect and provide corrections where necessary. Before commencing the experiment, participants were instructed to read the instructions carefully and to take note of the time they commenced the experiment. On finishing the experiment, each participant noted down the time of completion.

Eight French-speaking subjects aged between 21 and 23 took part in the first pilot trial. On the first day of their course, a multiple-choice pre-test was administered. This is a standardised language test used at I.T. Sligo to gauge student proficiency level in English (L2) and is administered to all international students as a general assessment tool (see Appendix A). On day two, the participants filled in a five-item questionnaire as part of a data

[37] In hindsight, it was found that the internal focus group were in fact at an advantage over the other two groups because the L2 sentences were grouped according to the errors in them.

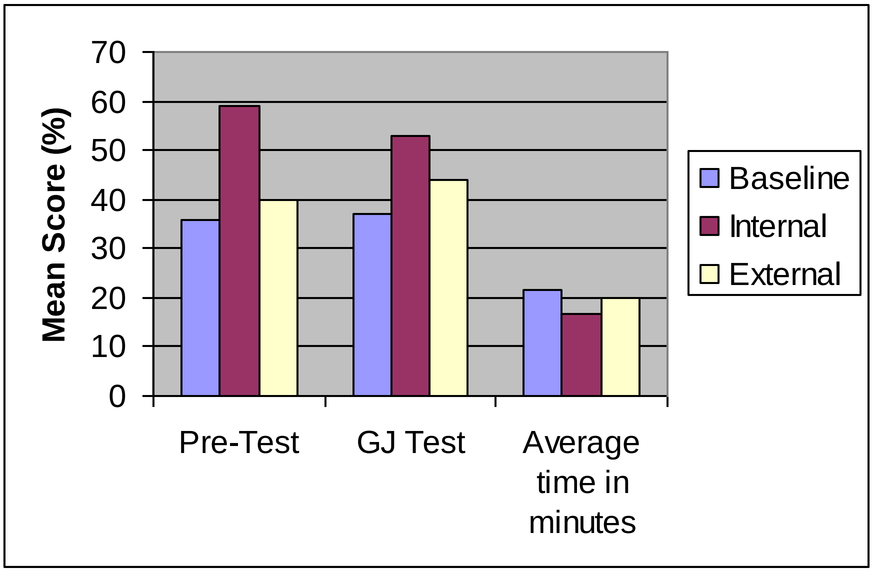
collection procedure. With the exception of minor modifications,[38] the same questionnaire was administered from the beginning of this study. The final version of the questionnaire is available in Appendix A (p. 234).

Subjects were randomly assigned to one of three groups (i.e., baseline, internal or external-focus instructions) and instructed to make a judgement of acceptability (correct/incorrect) about the L2 sentences. They were also required to correct the erroneous portion of any L2 sentences deemed incorrect[39]. Following the experiment, the researcher carried out a post-hoc interview. Twenty-four L2 sentences were presented - some sentences from Tarone (1985) were modified to suit the Irish context, e.g. 'Joe/*Sean* walked in and sat down on the couch/*sofa*'. Sentences with subject pronoun, object pronoun and articles were selected and noun plurals and gender were omitted on the basis that they were considered less challenging for the sample population tested. A section on prepositions, a particularly difficult component of English grammar (i.e. lack of consistent rules, lack of transparency, multiplicity of options, etc.) was added instead.

The results are illustrated in Figure 2-1. The scores reflect the mean accuracy percentage score for each FOA group as well as the average time.

[38] For example, in the version in the Appendix A, subjects were not required to fill in start time or finish time as they did in the pilot trials.
[39] In the first two piloted versions of the GJ, subjects had to both judge and correct sentences which they deemed wrong. The accuracy scores provided in Chart form represent the first part only, i.e. accuracy in judgement.

Figure 2-1: Score and time as a function of focus in Pilot 1



As illustrated in Figure 2-1 above, there is a marked disparity in the accuracy scores of the three groups (H1). Contrary to the predictions made in H2, subjects in the internal-focus group outperformed the other two experimental conditions both in terms of accuracy and timing. The internal-focus group also attained the highest pre-test score (M[40] = 59%) indicating a higher L2 competence level compared with the other two groups. The group mean score on the GJ trial was 45% and both the baseline (M = 37%) and external-focus group scored below this point (M = 44%). With regard to timing, the average time in minutes was 19.1 minutes; that said, participants were not instructed to complete the experiment within a specific timeframe.

For the internal-focus group the high pre-test score corresponded to a relatively high score in the experiment. The score attained in the GJ, although higher than the other two groups, is lower than on the pre-test. The pattern of scores relevant to the internal-focus group is different from the other two groups and indeed the entire group since most subjects scored higher in the GJ compared with the pre-test. So, the group with the highest

[40] M = mean score

L2 proficiency (internal-focus group), demonstrated greatest accuracy in the GJ, however, the other two groups scored higher in the experiment than on the pre-test (baseline = 36%, external-focus = 40%) which would seem to indicate that instruction may have facilitated to some degree the performance of both comparably lower proficiency groups. Hence, it could be inferred from these results that no instruction (i.e. baseline) or external-focus instructions enhances performance to some degree on the GJ. This variability in performance is a first indication that type of instruction, L2 proficiency and type of language activity (i.e. pre-test versus GJ) are crucial factors and interact in terms of learner performance.

A post-hoc interview followed the tests with open-ended questions asked by the researcher in order to get general feedback from the subjects. The purpose was to ascertain whether the subjects had understood the instructions as intended. Subjects were given the option of answering in English (L2) or in French (L1). The main findings are summarised below:

a) Although all of the participants firstly indicated that they found the instructions easy to understand, further questioning revealed that there was some degree of confusion. For example, one participant was not sure whether s/he could add an extra word when amending the L2 sentence (external-focus condition).
b) All of the participants found the tests very difficult. They used what they referred to as "*le feeling*" to guide them as opposed to trying to remember grammar rules (internal-focus condition).

Amendments were made as a result of Pilot 1 in order to improve the experimental design and reduce differences between the three learning conditions:

a) A practice session with five L2 sentences was added to ensure better comprehension of the instructions;

b) The content of the second pilot was modified so that in the internal-focus group instruction the L2 sentences were not grouped under grammatical headings but were presented in exactly the same manner as for the other instructional groups;

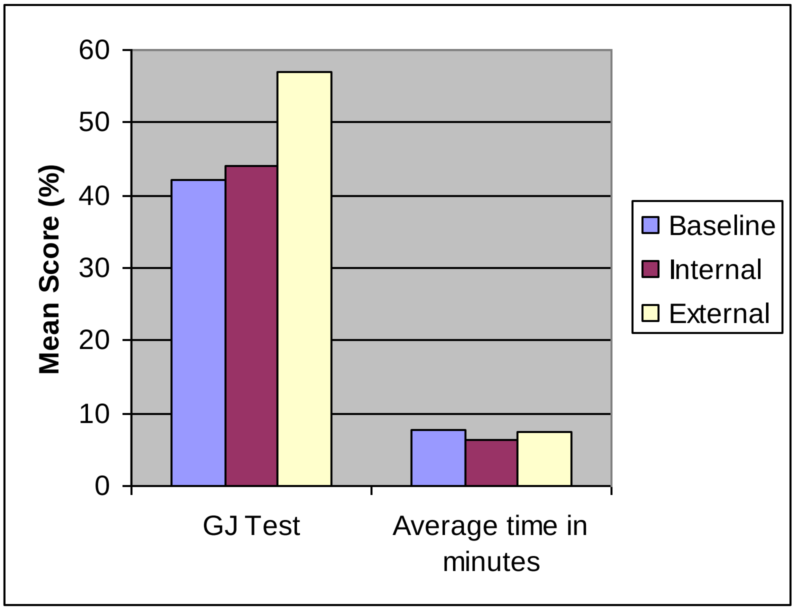
c) An instruction for timing was added - subjects were instructed to complete the experiment as quickly as possible.

2.3.2 Pilot Trial 2: Grammaticality Judgement

A second pilot trial was conducted with twenty-eight Swedish high-school students who were visiting I.T. Sligo as part of their school trip around Ireland (May, 2005). There were 23 female and 5 male students and their ages ranged from 17 to 19 years. As mentioned above, in this second pilot a practice session was included and speed of completion was timed. Time did not permit administration of a pre-test ahead of the trial. A post-hoc interview, however, and consultation with the high-school in Sweden would seem to indicate a higher L2 proficiency level in this case compared with the sample group tested in the first trial. Furthermore, the overall pattern of scores on the GJ was much higher than in the first pilot trial indicating a much higher base proficiency level.

As in the first trial, subjects were randomly assigned to one of three learning conditions. Before commencing the GJ, the subjects were given 5 practice sentences and each subject responded individually. The correct answers to the practice sentences were then given to each group and a question/answer session followed. Once it was clear that all of the subjects understood the instructions for their particular group, the GJ with 25 L2 sentences was administered. Subjects were instructed to complete the GJ as quickly as possible. Figure 2-2 illustrates group performance in terms of accuracy scores and time.

Figure 2-2: Score and time as a function of focus in Pilot 2



As illustrated in Figure 2-2, the scores between the three groups on the grammaticality test are very close and higher compared with Pilot 1. The completion time is also much shorter. The higher scores attained across the three groups may have resulted from (a) higher proficiency levels in L2 English, (b) the practice session prior to the experiment, or (c) time and interaction during practice. It is not clear, from the results of this pilot, which if any or all three factors interacted here and a causal relationship cannot be established. Nevertheless, the factors – both learner and design-based - which surfaced as a result of each pilot trial provided valuable insights for the development of the experiments.

It would appear also from these results that FOA instructions had little or no impact. Mean scores on the GJ test were close with the baseline group outperforming the other two groups both in terms of accuracy and time.

Contrary to predictions (H2), the external-focus group attained the lowest performance score in grammaticality. The baseline and internal-focus groups scored above average whereas the lowest scores obtained for the external-focus condition. The greatest difference in performance on the GJ can be seen between the baseline and external-focus groups both in terms of accuracy and time. Given that the Swedish L1s had a comparatively higher L2 proficiency level and also taking into consideration the results of Pilot 1 (the lower proficiency groups performed better when pre-test score was taken into account) the data resulting from this Pilot Trial indicates that focus instructions may have a varied influence on different L2 proficiency groups. These results, although by no means conclusive, provided more confirmation of the need to investigate the relationship between factors such as the set-up of the practice session, the FOA instructions and L2 proficiency levels.

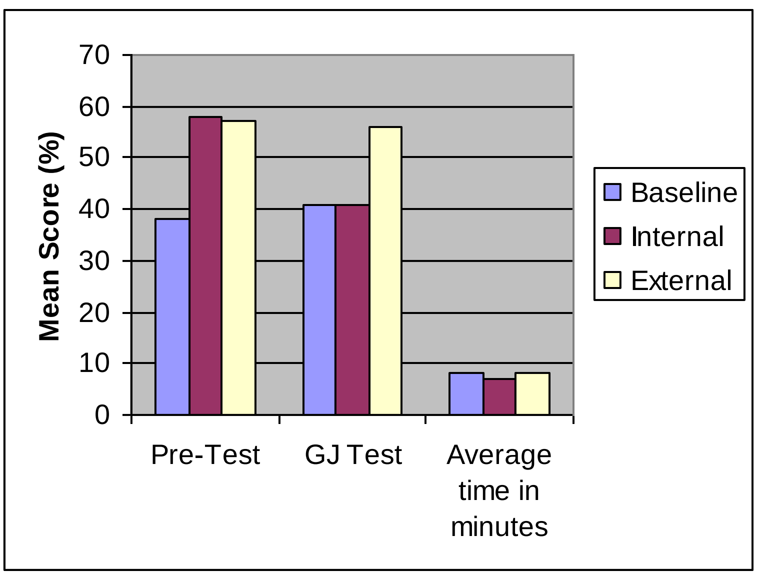
Fine-tuning of the wording was again necessary in order to ensure that the hypotheses were being appropriately tested. For example, for the next trial, the word “grammar” was removed from the wording of the baseline instruction as it was too similar to the internal-focus group. In addition, the wording in the external-focus instruction was emboldened in order to replicate an equivalent to the markers on the stabilometer (i.e. as in the ski-simulation experiment described in Section 1.2.1). The L2 sentences used in Pilot 3 were the same as Pilot 2 and the results are discussed in the next section.

2.3.3 Pilot Trial 3: Grammaticality Judgement

The next pilot constituted the first cross-linguistic study based on a larger group of subjects (September, 2005). Sixty-five Erasmus students from different L1 backgrounds with intermediate proficiency level in L2 English took part in this pilot experiment. Data results for thirty-five subjects were retained for analysis here since thirty subjects were not pre-tested. The subjects did the same pre-test used in Pilot 1 and were then administered the self-report questionnaire. Again each subject was randomly assigned to one of three experimental groupings: baseline, internal or external-focus.

The random assignation of a greater number of subjects resulted in a lack of homogeneity between the groups in terms of L2 proficiency and L1 background. For this reason, at the experimental stage (discussed in Chapter 3) each subject was assigned by the researcher to one of the three learning conditions in order to control for these variables. For example, in this pilot trial the baseline group had more L1 French subjects and a lower L2 proficiency level according to the pre-test (M = 38%). This effectively meant that the basis for comparing the groups in terms of accuracy on the GJ was somewhat tipped in favour of the internal and external-focus groups.

Figure 2-3: Score and time as a function of focus in Pilot 3



Interestingly, the results reveal that the baseline group performed comparatively well relative to subjects in the internal-focus group. The mean scores on the GJ test reveal that subjects in the external-focus condition significantly outperformed the other two instructional conditions in terms of accuracy - lending some support for H1 and H2. On the other hand, the internal-focus group (Group 2) completed the trial at a marginally faster speed than the other two groups. This is a surprising result, as one would expect that adopting an internal-focus would necessarily involve processing explicit knowledge and thus be more time-consuming. Contrary to Ellis' predictions discussed earlier (Section 2.2.3), accessing explicit knowledge was faster compared with the other two groups.

When accuracy in baseline and external-focus group scores on the GJ and the pre-test (M = 38%, M = 57%) are compared they are much closer than with regard to the internal-focus group. The internal-focus score is lower on the GJ (M = 41%) compared with the pre-test (M = 58%) – this is similar to the results obtained for Pilot 1 in which the GJ scores were lower than the pre-test. In Pilot 3, the performance of the baseline group is the most surprising, in particular relative to their pre-test score. Their GJ score was identical to the mean score of the internal-focus group although it would have been expected that the latter group – with a significantly higher pre-test score - would have attained a higher accuracy score.

Two other experiments were piloted to test FOA principles in two other linguistic areas, namely vocabulary learning and L2 pronunciation. These trials are described next.

2.3.4 Pilot Trial 4: Vocabulary Learning

Thirty-three subjects with L1 French took part in this trial experiment in September, 2006. They were assigned to one of two instructional groups: internal or external-focus. The internal-focus group were instructed to learn a list of 20 artificial words paired with English equivalents (See Appendix A, p.235). Subjects were instructed to focus on the words and their translation into English, e.g., House = Linta. Following the guidelines for transferring principles (Section 2.1.2), the external focus instruction was directed away from specifically focussing on the word-pairs. Instead the focus was directed towards a secondary task involving a mapping activity. The word-pairs were arranged in accordance with their associative relationships or taxonomical grouping, i.e., sub-ordinate, cognate, etc. Examples were given during the practice session as shown in the example in Figure 2-4.

Figure 2-4: Placement of words for learning phase (Pilot 4)

Framework:

Superordinate

↑

Synonym ← <u>WORD</u> → Part of

↓

Subordinate

Application:

Building= Thanort

↑

Home= Heiloringe ← <u>House= Linta</u> → Roof = Lintle

↓

Cottage = Herint

Both groups were allocated 10 minutes for the learning phase. Subjects were then tested on the words in a fill-in-the-gaps exercise (see Appendix A) immediately after. The data analysis included accuracy in the test and speed of completion.

The results from this pilot trial (Pilot 4) were somewhat obscured by shortcomings resulting from the experimental design. For example, the learning session of the experiment was not equally balanced for both groups. The external-focus group had to carry out two tasks, namely slotting the artificial words in relation to other related words as described above, and vocabulary learning. Secondly, the activity designed for the external-focus turned out to be more demanding and time-consuming than anticipated. It is possible that this experimental set-up may have allowed the external-focus group more opportunity for greater depth of processing during the practice part of the experiment and perhaps the benefits of this instructional design would have emerged in long-term retention of the vocabulary. In this experiment, however, the time allocation proved too short for the task demands.

The design of the test – fill-in-the-gaps - also proved to be problematic. For example, several subjects used English words in the test instead of artificial words and others adopted a word-flooding technique placing the same artificial word several times. In addition, one of the L2 sentences contained unfamiliar vocabulary, e.g., DIY. Notwithstanding these shortcomings, the results provide some indication that two groups with similar language competence (i.e. mean pre-test scores are the same), perform differently under different learning conditions (H1).

Table 2-3: Mean Scores for Vocabulary Trial (Pilot 4)

Groups	Vocabulary Experiment	Average Time (minutes)
External FOA N = 18	45%	6.4
Internal FOA N = 15	56%	6.4

Interestingly, both groups performed quite differently when the pre-test and the vocabulary experiment scores are compared – while both scored 49% on the pre-test, the external-focus group obtained a much lower score on the experiment than the internal-focus group. These scores seem to indicate that instructions to focus on the spelling (internal-focus) are more beneficial than external-focus instructions – i.e. matching up the words into family groups. Again, these findings suggest that type of instruction has an effect on the learning outcomes (H1) but contrary to predictions, external-focus instructions, as operationalised in this experiment, do not facilitate short-term word learning (H2). Long-term word retention may be facilitated by external-focus instruction, but this question was not addressed in this experimental design.

Much was learned from this first pilot in vocabulary learning. The design of both the practice and test of the vocabulary trial were reassessed and amendments were made. The new design is detailed in full in Chapter 3 and was piloted in Pilot Trial 7 (see Section 2.3.7).

2.3.5 Pilot Trial 5: Phonology

The pronunciation trial was designed to test focus instructions in relation to the pronunciation of L2 vocabulary. The trial was conducted using French-speaking subjects only. For this experiment, artificial words were created in order to test the learners on words not encountered before the experiment. The set of ten artificial words[41] resembled English cognates and each one presented particular difficulties for French-speaking learners of English, for example, tendency to stress final phonemes adding an aspiration of the consonant [k] in the word “sook”; absence of aspirated [h] in initial word position, for example, “hostellian” and addition of aspiration where initial vowels are concerned, e.g. “aureliac”. The list included words with just one syllable, e.g. “crench” and “lool”, and a five-syllable word: “stabiliopraph”. Also included were words similar to French orthographical patterns, e.g. “menide” (e.g. ‘menace’ or ‘ménage’ in French), but following English pronunciation (see Table 2-4). Most of the words included challenging vowel pronunciation for French-speakers.

Seventeen French-speaking subjects were randomly assigned to one of three instructional groups: baseline, internal-focus or external-focus. Subjects practised the words with the researcher individually and received different instructions relating to how to pronounce the words. The instructions were administered orally to each subject in face-to-face contact. Using a Phillips Dictaphone, a recording of each word and a written version on individual cards was presented.

Subjects were recorded both in the practice session (three final repetitions) and in the test. In the baseline or control group, subjects were requested to simply repeat each word after the recording. The internal-focus group were given a picture[42] illustrating the articulators and were instructed to focus on correct lip and tongue placement before they began repeating each word. The external-focus group viewed a sound spectrogram generated by a

[41] The word “lintel” was included unintentionally and recognized as a mistake afterwards. It was retained in spite of this in the data analysis since none of the subjects were familiar with the word prior the experiment.
[42] http://www.phon.ox.ac.uk/~jcoleman/phonation.htm [Accessed 7 May 2009]

speech analysis tool[43] representing the wavelengths produced by each word. This group were instructed to focus on the pattern they created when pronouncing each word. Their objective was to recreate the same pattern viewed on the screen when repeating the words. Each subject practised and repeated the words until they considered that they knew the words – they had a hand-held microphone for the study. The list of words is presented in Table 2- 4.

Table 2-4: List of artificial words used in phonology experiment (Pilot 5)

Artificial Words	Phonetic transcription
Sook	[su:k]
Aureliac*	[ɔ:‘ ri:lɪək]
Hostellian	[‘hɒstɛlɪən]
Crench	[krɛntʃ]
Stabiliopraph*	[stæbɪˌlɪ:əʊpræf]
Menide*	[‘mɛn:aɪd]
Lintel*	[‘lɪntəl]
Sookles*	[su:kʌls]
Virporeter	[vɜrpɜrɛ:tər]
Lool	[‘lu:l]

The asterisk (*) indicates words tested following the practice session.

A spectrogram image is exemplified in Figures 2-5 and 2-6. Figure 2-5 depicts a recording of the researcher's pronunciation of the artificial word [hostellian]; whereas Figure 2-6 depicts a subject's rendition of the same word.

[43] The speech analysis tool is produced by SIL International (Summer Institute of Linguistics). http://www.sil.org/computIng/catalog/index.asp [Accessed 10 February 2009]

Figure 2-5: Screenshot of spectrogram (researcher's recording)

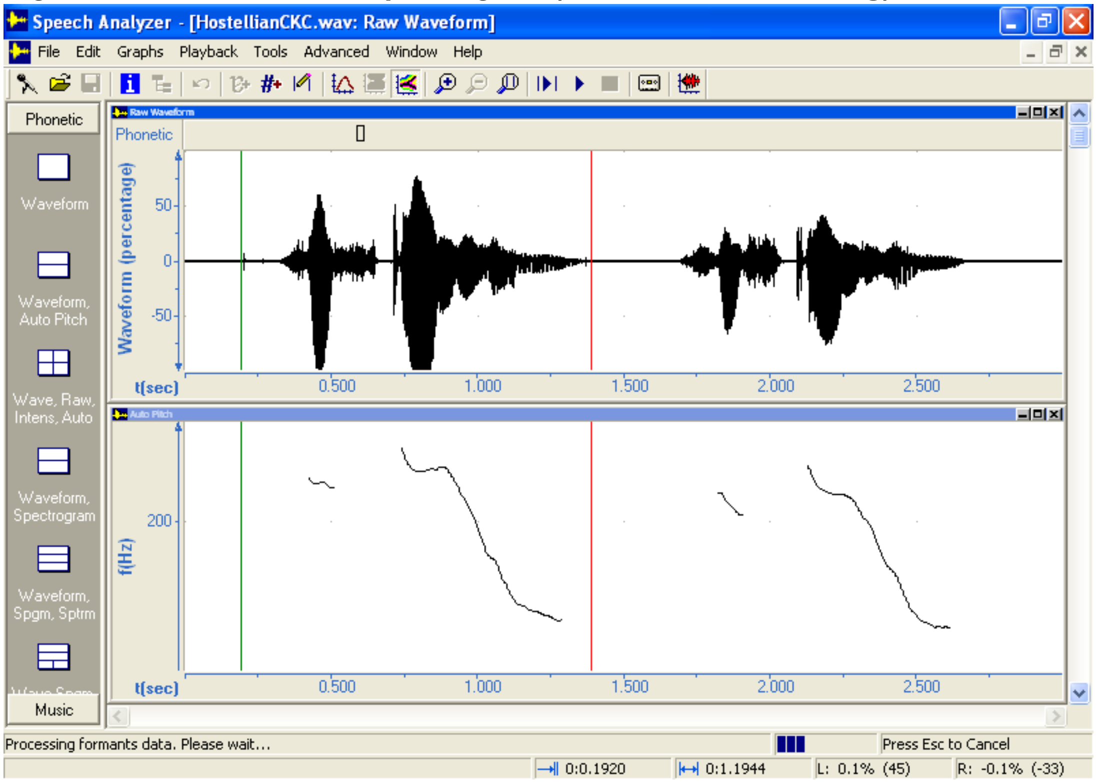
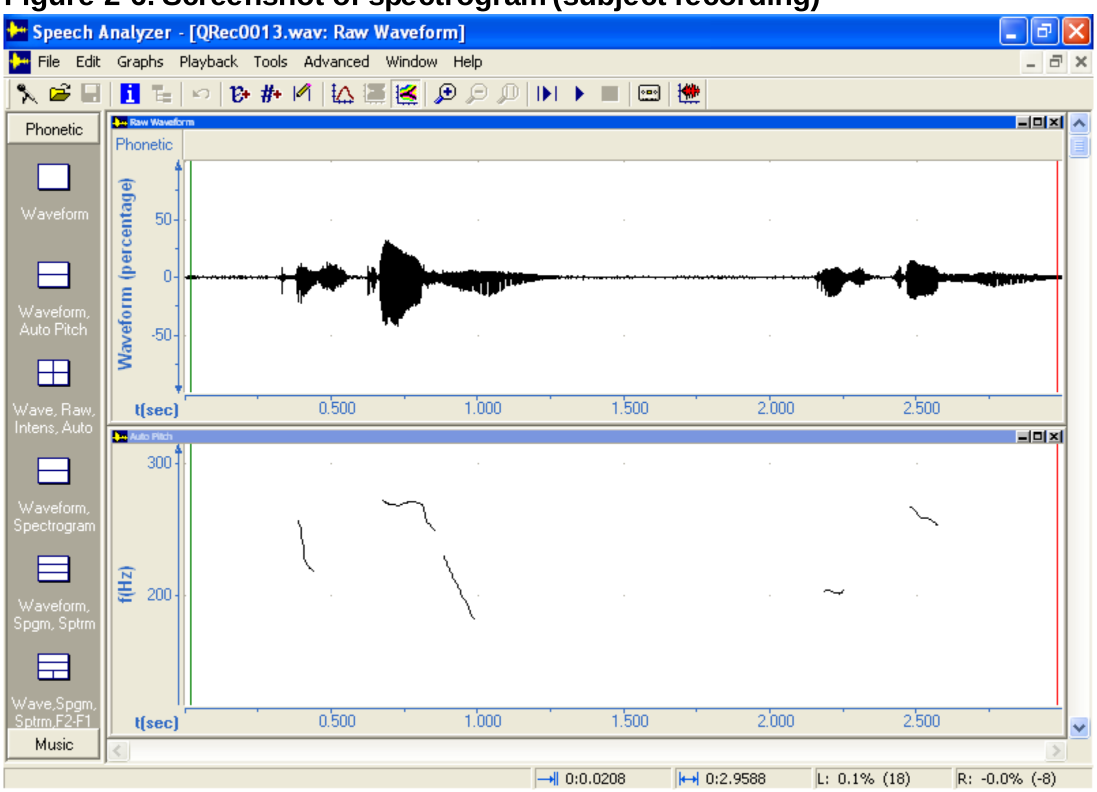
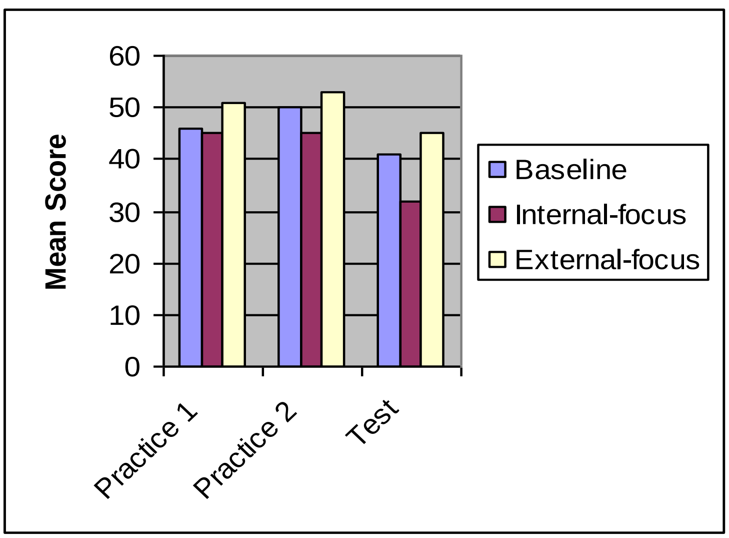


Figure 2-6: Screenshot of spectrogram (subject recording)



Following the practice session, the same focus instruction was repeated to the subject and they were tested on the same words without listening to the recording of the word beforehand. They were tested on five of the words (marked * on the list in Table 2-4), and subjects had to rely on their own memory of how the word was pronounced. Performance in the practice and test sessions was measured on a scale of 1-10 in terms of target-like usage (TLU). The TLU scores revealed firstly that type of instruction influenced learning outcomes in both practice and test (H1) and, secondly, that external-focus instructions enhanced learner pronunciation (H2).

Figure 2-7: Results of Phonology Trial (Pilot 5)



The mean scores for each group on the test were: baseline (M = 41%); internal-focus (M = 32%), and external-focus (M = 45%). These scores provide an indication that focus instructions impact on learner L2 pronunciation providing some preliminary evidence in favour of the main hypotheses of this study. The chart (Figure 2-7) illustrates that external-focus instructions lead to improved pronunciation compared with both baseline and internal-focus instructions. In Practice 1 and Practice 2, both the external-focus group and the baseline group improve in their performance whereas the internal-focus group remains more or less stable. The three groups perform less well on the test in comparison with the practice session. Recall that in the test the learners had to rely on their own memory of how each word was pronounced, thus the test was more challenging than the practice session.

This language trial provided the first clear evidence of the impact of FOA instructions on language learners to a degree which is parallel to learners of motor skills. Firstly, there is a difference in the performance of the three groups in terms of their accuracy in L2 pronunciation, secondly, their performance on practice and test are also differentiated and thirdly, in both practice and test conditions, the external-focus group excels in comparison with both the baseline and internal-focus group. It may be that instructions inducing different attentional foci have more of an impact in the area of pronunciation given that this aspect of language learning directly involves motor skills unlike the other areas tested in this study. Equally, it is worth noting that, in the case of the phonology pilot trial, the tractable task of determining the instructions for external and internal focus of attention was more easily resolved compared with the other areas tested.

It is important to note also that the instructions here were administered on an individual basis and orally as opposed to written instructions. This variable may also have impacted on the likelihood that the learners adopted the focus of attention intended by the researcher. This aspect of the experimental set-up will be discussed further in Chapter 5. Another point of consideration in this case is that the sample group were not pre-tested on their pronunciation skills. There is no exact reference point in terms of pronunciation skills but as they were recruited from the same L1 grouping, within the same age range and were all undergraduates, it is probable that they had a comparable level in the L2.

The findings derived from the pilot trial in phonology provide evidence that further investigation of FOA in SLL pronunciation is warranted. Nevertheless, a decision was reached not to bring this investigation to the experimental stage principally due to lack of resources. The vast amount of data generated for each individual subject requires more work than could feasibly be done within the time and limited resources available. In addition, to ensure objectivity in TLU assessment, a larger study would require the input of other investigators. To bring this pilot to experimental stage a much larger group of subjects would need to be tested and since the experimental design involves individual sessions, verbal instructions and recording, this would also require further resources.

In sum, the phonology trial revealed promising results in relation to the two main hypotheses. Firstly, the data provide evidence that giving subjects different instructions in relation to how to focus their attention when learning how to pronounce L2 words has an effect on the quality of their performance. Secondly, the subjects given external-focus instructions performed significantly better than the group given no instructions and those given internal-focus instructions.

2.3.6 Pilot Trial 6: Grammaticality Judgement (E-Prime)

The two remaining pilot trials were conducted at I.T Sligo and Dublin City University (DCU) during the month of February, 2008. Fifty-four participants aged between 16 and 36 (average age = 23) took part in this study. The group comprised thirty female and twenty-four male subjects and with the exception of one student, all were undergraduate students. Most of the volunteers were partaking in the Erasmus year abroad programme at either DCU or IT Sligo. Others had come to DCU to attend an English course. Most of the group had studied English as an L2 for an average of 10 years, but there were large discrepancies in terms of time spent in Ireland, i.e. from 1 month to 3 years. The group comprised speakers of different L1s including, French, Spanish, German, Italian, Slovenian, Swedish, Japanese, Korean and Vietnamese. The two largest L1 groupings were French (n = 19) and Spanish (n = 17). The sample population were less homogenous compared with other groups previously tested in terms of courses, time spent abroad (i.e. proficiency in English), L1s and age. The group were evaluated as having an intermediate to upper-intermediate level in English as a second language (68%).

Subjects first did an on-line pre-test [44] comprising 50 multiple-choice questions and the questionnaire was administered. Subjects were then assigned to internal or external-focus group and given the following instructions illustrated in Table 2-5[45]:

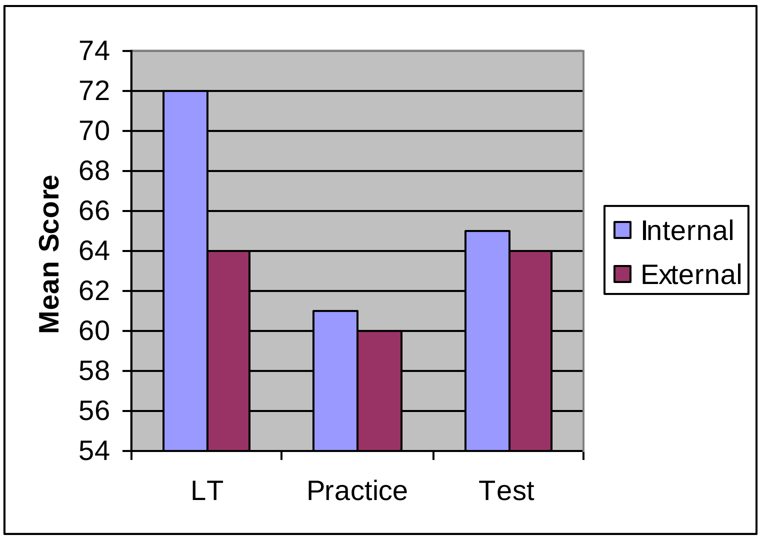
Table 2-5: Instructions for Pilot Trial 6

Internal FOA Instruction	External FOA Instruction
Screen 2: Think CAREFULLY about the sentence on your screen and FOCUS on the GRAMMAR. **Screen 3:** Press "1" if the grammar is correct. Press "2" if the grammar is incorrect. Press "3" if you don't know. FOCUS on GRAMMAR RULES!	**Screen 2:** Read the sentence on your screen and decide whether it needs to be changed or not. **Screen 3:** Press "1" for no change. Press "2" if something needs to be changed. Press "3" if you're not sure. Focus on whether the sentences need to be changed or not.

[44] See www.nll.co.uk/test.english.shtml. [Accessed September, 2008]
[45] The design of this experiment and Pilot Trial 7 are described in more detail in Chapter 3.

Ten L2 sentences were used for the practice session and fifty sentences were used in the test (see Appendix A). The mean scores in both practice and test are illustrated Figure 2-8 below:

Figure 2-8: Score and time as a function of focus in Pilot 6



LT = Language Test (i.e. the online pre-test)

As a result of having a lower turn-out of volunteers than expected, no baseline group was formed for this pilot trial. This is a shortcoming of the trial as the performance of the focus groups cannot be compared with the control group. The results indicate that both groups improved between practice and test. There is a significant difference between the LT score of the two groups indicating that subjects in the internal-focus group had a much higher proficiency level in L2 English. Nevertheless, the test score for the internal-focus group is lower than the LT score whereas the external-focus group attained the same mean score on both the LT and the GJ test. This result provides some evidence in support of hypothesis H2, i.e., that external-focus instructions enhance SLL performance compared with internal-focus instructions when the pre-test result is taken into account, but indicates a benefit for the internal-focus when excluded.

Further analysis of subjects with a score above 50% (n= 42) on the pre-test reveals that the external-focus group score is significantly higher (74%) compared with the internal-focus mean score (67%) indicating that although the overall group score on the pre-test for the internal-focus group is higher, the external-focus group comprised a larger number of subjects with scores at both the higher and lower ends of the range.

Although this cross-linguistic study revealed interesting trends, there are notable shortcomings. First of all, the low turn-out ruled out the creation of a baseline group and secondly, the lack of homogeneity in the sample population obscured a clear interpretation of the results. The experimental set-up, design and content of the experiment were sound and consequently, the same experiment was administered to another sample population without any further changes (See Experiment 2, Section 3.4)

2.3.7 Pilot Trial 7: Vocabulary Recognition (E-Prime)

The final pilot trial involved a second vocabulary learning experiment designed to test whether instructions inducing different foci of attention (FOA) influence the learning outcomes of L2 learners in vocabulary acquisition. Like the first pilot in vocabulary learning, (Section 2.3.4), lexical items – e.g. word-pairs - were created to specifically test the mechanisms involved in the first steps of vocabulary acquisition rather than testing memory of previously stored vocabulary. This version of the experiment was designed to address the shortcomings of the first pilot trial. For example, all instructional groups had the same practice session or learning phase and there was no cloze test. In addition, the word direction was changed, i.e. artificial word → L2. This change was incorporated based on more recent research indicating that this direction is more challenging than *vice versa* (Steinel and Hulstijn, 2007).

Pilot Trial 7 involved subjects studying word-pairs for a limited amount of time (10 seconds per word pair), following which they were presented with a new set of word–pairs some of which corresponded to the first set (correct) and others comprised new or jumbled word-pairs (incorrect). Subjects had to distinguish the correct pairs from the incorrect ones and key in their responses. A more detailed description of the experimental design is presented in Chapter 3 with regard to the software, randomisation of trials and feedback.

The subjects remained in the same instructional group as for Pilot Trial 6, i.e. either internal or external-focus. The results are illustrated in Table 2-6:

Table 2-6: Comparison of Mean Scores in Pilot Trial 7

Learning Conditions	**Internal Group N = 27**	**External Group n = 28**
Vocabulary Practice	76%	78%
Vocabulary Test	77%	75%

The mean scores are very close with the external-focus group performing better than the internal-focus group in practice and the internal-focus group performing on the test *albeit* to a minimal degree in both cases. These results provide clear evidence in support of the null hypothesis with regard to both H1 and H2. It would appear from the results of this pilot study that FOA has little or no bearing on L2 learners' ability to learn new vocabulary items under practice and test conditions. However, as pointed out in the previous section, the results are somewhat unreliable because (a) the lack of homogeneity between and within the two groups violates the experimental design, and (b) the performance of the FOA groups cannot be compared with a baseline group.

Pilot trials 6 and 7 were initially intended as part of the main experiments and were subsequently designated as pilot trials for the reasons outlined above. In addition, time limitations meant that a shorter version of the pre-test was administered in a different format, i.e. on-line, rendering the comparison between the experiments less ideal.

2.3.8 Summary

In the seven pilot trials reported here, a total of 163 subjects were tested on different versions of experiments on grammaticality judgements, vocabulary learning and L2 pronunciation. These pilot trials provided a testing ground for the experiments revealing the need for greater balance between the three instructional groups, the need for control over variables such as homogeneity between the groups and the need to refine the instructions in order to more closely replicate the Wulf model. The pilot trials produced very different results and revealed interesting trends with regard to the research hypotheses. First of all, it would seem from these preliminary trials that there is a clear need for further experimentation. Some support for the prediction that instructions inducing different foci of attention impact on learner performance in different types of language learning activities has been presented. In addition, the results reveal other factors which interact with performance such as the type of activity and the level of learner proficiency. Importantly, the results of the phonology trial provide the closest replication of Wulf's findings.

Adjustments were made to both the content and experimental procedure as a result of the pilot trials:

- The language materials were modified and improved on for both the grammaticality judgement and vocabulary experiments (See Appendix A);
- The wording of the instructions was modified to ensure close proximity to the Wulf model, balance between the three treatments (baseline, internal and external) as well as clarity for the sample populations tested;
- The procedure for assigning subjects to treatment groups became fixed in order to ensure a balance between the three groups in terms of L1 background, L2 proficiency, age and gender;
- All subjects included in the data set were systematically pre-tested.

It is not possible nor is it the objective of the pilot trials to draw any conclusions vis-à-vis the research questions. These pilot trials served a key purpose for this study: providing insight into methodological issues in relation to experimental procedure; receiving feedback from subjects; providing initial data results which seem to indicate that focus instructions impact to some degree on learner performance and testing the experiment in terms of the reliability and validity of the research tools.

2.4 Conclusions

In this chapter, the theoretical background has been added to by providing a proposal of how the empirical findings resulting from motor learning research can be transferred to the domain of SLL. Here, the methodological issues, including the formulation of hypotheses and the creation of an experimental design to test these hypotheses has been presented. The difficulties of finding parallels in SLL for the motor learning instructions were outlined and proposals were put forward in a bid to provide initial ways to test the hypotheses by creating language experiments relating to different linguistic areas.

The objective of the pilots was to find a valid and reliable way to test the hypotheses raised in this study. Although the piloted experiments had some shortfalls – as detailed previously – a preliminary glance at the results justified further testing of these hypotheses under more closely controlled experimental conditions. In the next chapter, the language experiments will be presented and discussed.

Chapter 3: The language experiments

This chapter is dedicated to describing in detail the design, administration, data collection and analyses of the language experiments designed to test the research hypotheses (Section 2.1.1). Two sets of experiments were devised in L2 grammaticality judgements (GJ1 and GJ2) and vocabulary learning (VOC1 and VOC2) and tested under practice and test conditions. These experiments were administered to two different sample populations (see Appendix B for full data sets, pp. 243-249) and run using E-Prime software which is described in Section 3.1. The experimental procedure, instructions and data collection tools were similar for the two versions of each experiment - the main distinctions being in terms of the higher number of trials tested in the second version as well as additional grammatical categories (GJ2) and variations on word-matching (VOC2). According to Wulf (2007), the advantages of an external-focus of attention are not manifested when the task is not challenging enough and this assertion motivated the decision to conduct a second, more challenging experiment in each case.

3.1 E-Prime

The experiments were designed and run using the E-Studio application of E-Prime. E-Prime is a psychology software tool designed for research purposes and used widely in the field of psycholinguistics. It has been used most notably at the Max Planck Institute for Psycholinguistics (The Netherlands) and for several SLL research studies[46], e.g. Leonard-Cook (2008); Steinel and Hulstijn (2007), and Fukkink *et al*. (2005). The use of a

[46] http://www.pstnet.com/products/e-prime/e-publications.htm#Published%20Papers [Accessed: 08 February 2009]

standardised research instrument such as E-Prime adds to the reliability of the testing procedure and facilitates future replication.

Running the experiment on this software permits control for subject exposure to language trials (e.g., L2 sentences or word-pairs) as well as timing of screen display and subject response time. The programme also facilitated data collection and analysis procedures. In this study, the main features used were E-studio for designing and running the experiments, E-Merge for merging the data and E-DataAid for data collation and analysis. Each of the four experiments discussed here was displayed via an individual PC screen to each subject. Subjects were instructed to follow the instructions relative to their designated group, i.e. baseline, internal-focus or external-focus, via the PC screen. By hitting the spacebar, subjects could change to the next screen. After the instructions were presented, each language trial[47] was displayed individually and subjects were requested to respond via the number-pad on the keyboard. Whereas the subjects had control over the amount of time spent on reading the instructions, the response time was controlled as illustrated in Table 3-1.

The basic design of each experiment included trial exposure, subject response followed by a feedback condition and an interval time for both practice and test conditions. The interval refers to the time between response feedback and the display of the next trial. This time-out addition or interval time was incorporated in order to reduce possible stress caused by rapid succession of the trials. As illustrated in Table 3-1 below, the interval time was set at infinite indicating that the subject could choose to continue to the next trial at his/her own pace. The components of the experimental set-up for time control are depicted in Table 3-1.

[47] Trial here refers to each L2 sentence in the grammaticality experiment and the word-pairs in the vocabulary experiment.

Table 3-1: Timing Protocols

Components	Timing	Duration
Instruction screens	Unspecified	Infinite
Language Trial	Specified	10, 000 milliseconds (ms)
Feedback Response	Specified	10, 000 ms
Interval Time	Unspecified	Infinite
Average score (Practice session)	Specified	10, 000 ms

Next, the specific aspects of the experimental design are discussed.

3.1.1 Feedback and randomisation of trials

The design issues relevant to the set-up and content of the experiments have been discussed in relation to the Pilot Trials described in Chapter 2. Here, the technical issues relating specifically to the running of the experiment on E-Prime are presented. As mentioned above, the use of E-Prime software to run the experiments ensured control of variables such as timing and contributed to the overall development of the experimental design, for example, in the experiments, each trial was presented in random order and a feedback condition was incorporated. In addition, the programme allowed for each trial to be displayed individually which meant that subjects could not compare their responses with previous instances. Each trial was randomly selected for display. This was also an important addition to the experimental design in particular with regard to the practice session during which subjects repeated trial exposure. Randomisation of the trials meant that subjects had to engage with each L2 sentence in terms of judging its acceptability each time as opposed to referring back to previous responses. This learning factor, i.e. availability of all language trials at once, was not controlled for in the pen and paper versions in the pilot trials.

Following each response keyed in by the subject, feedback was automatically provided in real-time. The feedback was of two types: response feedback, i.e. feedback in relation to whether the subject had provided a correct response or not; and score feedback, i.e. once the subject had successfully completed the practice session their overall average score was displayed. Both types of feedback also served to provide a motivational factor especially for subjects who did not answer within the time limit or failed to answer correctly since the feedback instruction encouraged the subject to continue onwards[48].

3.1.2 Practice and test sessions

Each language experiment comprised a practice and test component. During the practice session – which immediately preceded the test – subjects had to obtain a target score of 60% in order to graduate to the test phase. As mentioned in the previous section, the sequencing of exposure to trials was randomised and subjects were instructed to key in a response to each trial by using the number pad on the keyboard. In order to ensure comprehension of the instructions and the language activity, the target score was incorporated into the programming. The score was set at 60% in order to ensure a level higher than above chance (e.g. 50%). Scores on the practice session represent a calculation of the average performance of the subject on the trials in relation to the number of cycles completed. Consideration was given to setting the level at 70% or higher but was disregarded on the basis that setting the target at such a high level might lead to attrition. Where subjects attained less, the programme displayed a

[48] The instructions are: 'Never mind. Keep Going!'

screen informing them to repeat the session and the display reverted back to the start of the session where the trials were repeated[49]. In addition to ensuring full comprehension of the language activity and the instructions, the inclusion of the target level programme allowed for evaluation of the number of cycles repeated in each instructional group and in tandem, this information revealed whether focus instructions had any impact on the number of cycles required to attain 60%.

When subjects attained 60%, their overall score (i.e. score feedback) was displayed on the screen and they continued on to the test stage. Before the test session commenced, the instructions relating to focus were repeated and subjects moved from one screen to the next at their own pace. In accordance with the practice session, forward movement from screen to screen was controlled by using the spacebar and subjects could not return to previous screens. Feedback also continued throughout the test following subject response.

The final experimental design resulted from testing out several versions of the E-Prime experiments with colleagues[50] (University of Utrecht, The Netherlands) in addition to incorporating the methodological issues and amendments to the piloted trials discussed in the last chapter. Trials were conducted to test the E-Studio design as well as the data collection and analysis programmes. The trials were primarily used for the purposes of improving presentation and user-friendliness as well as testing the reliability of the experiment from the perspective of the researcher.

[49] Subjects were not aware of this obstacle until they were actually doing the experiment.
[50] Summer Course in Psycholinguistics, August, 2007.

3.2 Experimental procedure

The four experiments were globally called “The Language Game” and volunteers were recruited from the cohort of international students at I.T Sligo in September 2007 and September, 2008. The designated name for the experiments was used as a way to encourage students to volunteer and to highlight the fun aspect of the exercise.

Figure 3-1: Screenshot of first E-Prime screen

In accordance with ethical procedures, participants were made aware that the language game was part of a research project and that individual performance would not be used for their academic record[51].

On the first day, a language test evaluating knowledge of L2 grammar, lexicon and syntax was administered to both sample populations. As mentioned in the previous chapter, this is a general language proficiency test used as a placement test for students attending the two-week intensive English course held prior to term commencement. (See Appendix A for a

[51] All of the subjects included in this database consented to their data being used for this research.

copy of the test in full, p. 222). The pre-test comprises 100 multiple-choice questions and was completed on average in an hour to an hour and fifteen minutes. On day two, a five-item questionnaire was administered. As in the pilot trials, this self-report instrument was issued to elicit information relating to language background, age, gender and number of years spent studying the L2.

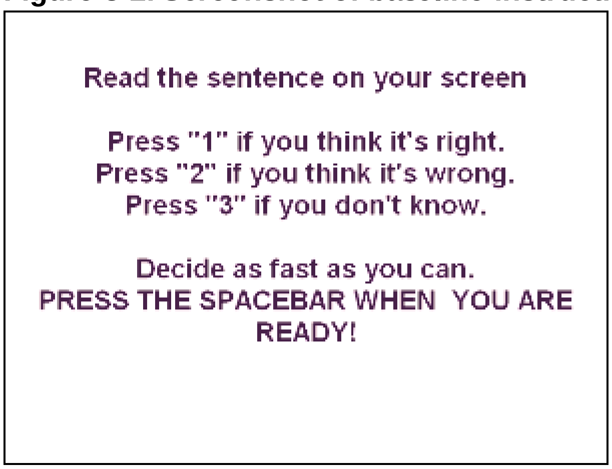
Each instructional group attended the computer laboratory at different times. Subjects were informed beforehand of the time and venue, but were not informed as to either the content of the research or the internal organisation of the experiments, i.e. the existence of different instructional groups or the selection procedure. Subjects individually logged on using the designated individual number provided by the researcher. As mentioned previously, subjects followed the instructions displayed on their screens at their own pace under the supervision of the researcher. Once the subject had finished reading the instructions, they were then presented with the trials. In both practice and test session, each L2 trial was presented individually for a period of 10 seconds in random order. Subjects responded by pressing keys 1, 2, or 3 (see Figure 3-2) at any point within the 10 seconds. After the 10 second interval elapsed, the programme automatically displayed the next screen.

3.2.1 Design and instructions

As in the basic experimental design discussed in Chapter 2, all subjects did exactly the same experiment under practice and test conditions. Subjects were assigned to one of the instructional groups, baseline, internal-focus or external-focus, and each group followed different instructions. The wording of the instructions was based on the principles of internal and external-focus instructions established in the Wulf model and a review of the different types of instructions used in the ML experiments such as in ski-simulation, golf, speech, etc. Consideration was also given to the results of the pilot trials (Chapter 2) and an endeavour was made to refine the experimental design and the wording of the instructions in order to recreate the closest possible reproduction of the Wulf model.

With regard to the grammaticality judgement experiments (Experiments 1 and 2), the baseline or no instruction group were instructed to read the sentence and decide whether it was right or wrong. An illustration of the instructions is conveyed in Figure 3-2:

Figure 3-2: Screenshot of baseline instructions[52]



In order to replicate internal-focus mode, the subjects were instructed to focus on grammar. The different grammatical items examined in the GJ were made explicit in the instructions, i.e. articles, prepositions and pronouns. By naming the grammatical categories, it was expected that the subjects following internal-focus instructions would focus more on the grammar thus inducing a conscious focus on detail. In other words, as the internal-focus group were primed – via the wording of the instruction – to

[52] The instructions were displayed in 22 Arial Font.

process the grammatical forms listed, it was expected that their focus of attention would replicate the characteristics of Wulf's internal FOA.

For the external-focus instruction, no reference was made to grammar. Instead, the subjects were instructed to focus on the end goal which, in this case, was the L2 sentence. In the GJ, when an L2 sentence is accepted as correct, then no changes are required to be made. On the other hand, if there is something unacceptable about the sentence, some change is required. Following this line of reasoning, subjects were instructed to read the sentences and decide whether any changes were required or not. It was expected that this instruction would direct the learner to focus away from grammatical correctness and to reflect upon the objective which was to accept or reject the sentence. As a counter-weight to the internal-focus instruction where explicit reference was made to grammatical categories, the subjects in the external-focus group were informed that changes would involve either adding or deleting a word. Unlike the internal-focus group, the clue was not grammatical in nature and referred more to the elements comprising the L2 sentence and the acceptability or cohesion of these elements.

As indicated above, the subjects did exactly the same language experiment, i.e. they had to make an acceptability judgement as to whether the L2 sentence displayed on the screen was correct or not. Each L2 sentence was displayed individually and subjects were prompted to respond as quickly as possible. As indicated in the screen shots below, response options reflected the instructional focus in order to reinforce the type of focus of attention desired by the researcher:

Figure 3-3: Screenshot of internal-focus instructions

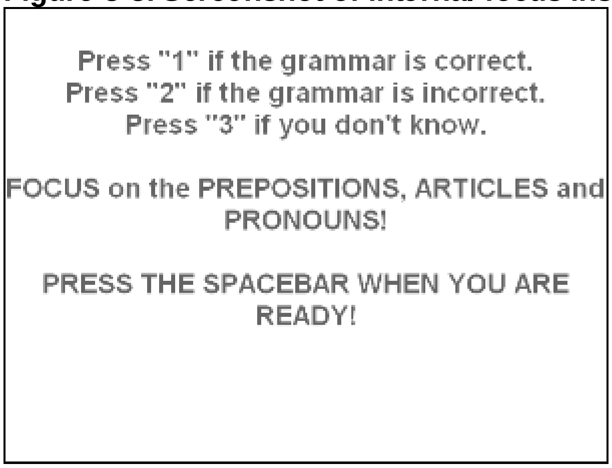
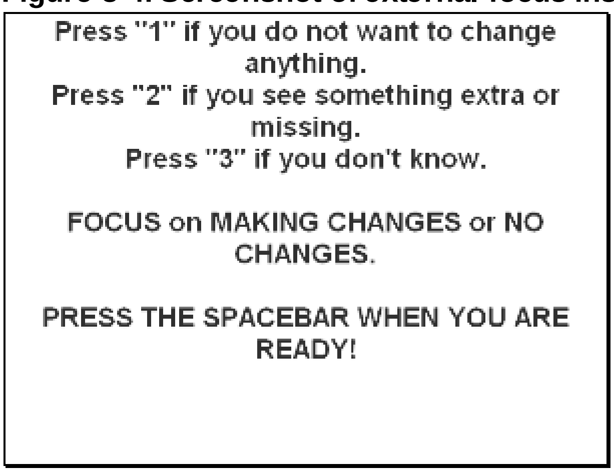


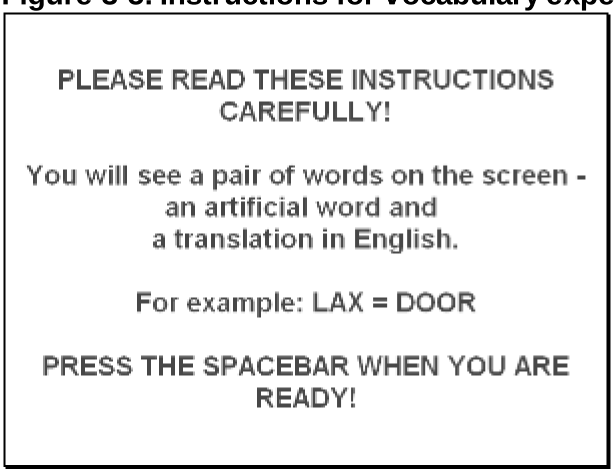
Figure 3-4: Screenshot of external-focus instructions



To sum up, the baseline or no instruction group was therefore at the most basic level of instruction in comparison with both internal and external-focus instructions. In line with the Wulf experiments, the baseline group received no instruction as to where to focus their attention in each trial. They were simply instructed to decide whether the L2 sentence was right or wrong. The wording of the instructions for the two focus groups was intended to direct their focus of attention internally via explicit reference to grammatical detail or externally by directing focus towards the objective of decision-making. The instructions also reflected the principles of the Wulf model as discussed in Chapter 1. For example, the internal-focus instruction induced a focus which entailed conscious reflection on the grammatical detail in the sentence. The external-focus instruction directed learner attention towards the end goal of whether any changes need to be made to the sentence and to reflect upon the cohesion of the sentence.

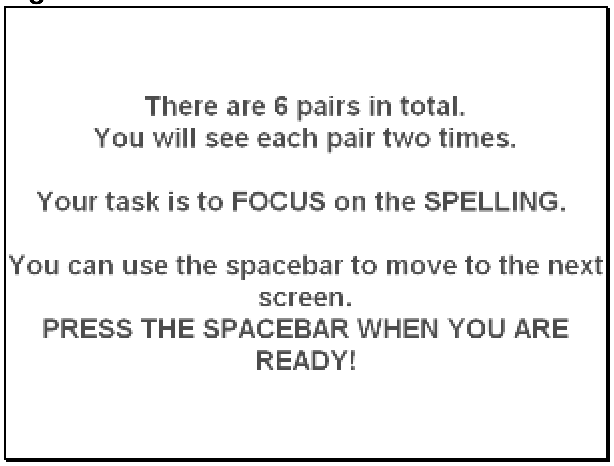
For the vocabulary learning experiments (Experiments 3 and 4), subjects were given instructions related to focus of attention (FOA) and were then presented with the word-pairs. The words were presented to the three instructional groups with the artificial word first followed by its equivalent in English as illustrated in Figure 3-5:

Figure 3-5: Instructions for vocabulary experiment



The baseline or no instruction group were instructed to memorise the word-pairs during the first part of the experiment. They were then required to decide whether another set of word-pairs corresponded to the previously viewed pairs. In order to replicate internal-focus mode, the subjects were instructed to focus on the spelling as illustrated in Figure 3-6:

Figure 3-6: Instructions



This instruction directed learners to focus on the details of each word pair which provided a parallel to the conscious focus on the detail of an action induced by internal-focus instructions in ML studies. Arguably an instruction to focus on the letters in the words may have induced more of an internal-focus of attention. (The aspect of different degrees of focus will be returned to in Chapter 5 of the thesis).

For the external-focus instruction, the focus was directed towards the imageability of the word-pairs. Subjects were instructed to focus on an image of the word. This focal point was used in order to induce an external focus of attention, i.e. a focus which directed the learner to an external point of reference related to the end goal of memorising the word-pairs. By incorporating an instruction related to visualisation, another way of coding information in memory was also introduced: the subjects could study the word-pairs – as in the other two groups – and in addition, think up an image of the words. Dual coding is considered as an aid to second language learning (Fukkink *et al.* 2005, Barcroft, 2007).

In short, the baseline group received no instruction as to where to focus their attention in each trial. Nonetheless, it could be argued at another level that their instruction directed attention to the goal of the learning phase, i.e. to memorise the words, and thus to a degree constituted external-focus. However, this line of reasoning also applies to the other groups as most students at this level would expect some kind of subsequent testing of new words after exposure during the learning phase. Thus, learner expectations may stimulate self-generated L2 learning strategies which may or may not concur with the FOA intended by the researcher. In line with the Wulf model, the wording of the instructions for the two focus groups was clearly differentiated – the internal-focus group being directed to concentrate on the spelling of the words whereas the external-focus group concentrating on visualising images of the words. The instructions also reflected the principles of the Wulf model as discussed in Chapter 1. For example, the internal-focus instruction induced a focus which entailed conscious reflection on the orthographical detail of each artificial word. The external-focus instruction directed learner attention towards the end goal which was to enhance retention.

3.2.2 Data collection and analysis

Subject data was collected in the E-DataAid application of E-Prime. For the analyses in this study, the main collection data involved accuracy and number of cycles in the practice session and response times. Subject data was merged for group analysis (e.g. E-Merge) and then exported into Excel. From this point, the data were also transferred to SPSS[53] for statistical analysis.

Prior to the administration of the experiments, data were collated from both the pre-test scores and the questionnaire in order to assign subjects to one of three instructional groups. The procedure of assigning subjects as

[53] SPSS = Statistical Product and Service Solutions Software.

opposed to random selection, was used in an endeavour to create three homogenous groups of subjects, i.e., balanced in terms of L1, language proficiency, gender and age. Controlling variables in this manner resulted in a data set which was much clearer in terms of data interpretation. The procedure for assigning subjects to instructional groups was based on three criteria. The first criterion was L1 background data which were elicited via the questionnaires. An endeavour was made to place an equal number of speakers from each L1 grouping in each of the three instructional groups. For example, a minimum of ten French-speaking L1s were assigned to each group. The second criterion was L2 competence which was gauged on the basis of the subject pre-test score. The third criterion was gender[54]. Once the other two criteria were met, the third criterion was used as a placement tool.

The selection procedure described above also ensured that qualitative data would be available to the researcher in order to provide contextual information for the discussion on the findings (Chapter 4). In the case of these experiments, the sample populations were found to be homogenous in terms of L2 proficiency, i.e. there was no significant difference between the pre-test scores of the three groups (see Appendix C and D). On the other hand, had it been the case that the sample population turned out to be a less homogenous grouping of L2 learners, the qualitative data could be used to clarify reasons, e.g. higher proficiency levels. For example, a bilingual subject or a subject who commenced studying the L2 at a much earlier age than the majority of the group might attain a much higher pre-test score. In addition, statistical procedures were used to identify standard deviations and provide statistical support for homogeneity. As illustrated in Table 3-2, in the case of the experiments reported in this study, the low standard deviations indicate that strong homogeneity was found amongst all groups tested.

[54] This data was also gleaned from the questionnaires.

Table 3-2: Standard deviations for the pre-tests

	Baseline	Internal	External
Sample Population 1	0.14	0.13	0.12
Sample Population 2	0.16	0.14	0.13

Subjects were assigned a number corresponding to their group assignation (i.e. baseline, internal or external-focus) and their native language (L1). To facilitate identification and extrapolation of data based on group and L1 background, subjects assigned to the baseline condition were assigned numbers beginning with 1 (e.g. 101); and the first 10 to 12 numbers of each group were issued to French-speaking L1s (e.g. 101 -112). This procedure facilitated data collection as it was then possible to extrapolate data for L1 French subjects for an analysis of the results in terms of L1 background (see Chapter 4). For the second sample population, a parallel system was applied - an extra zero was added to the subject numbers, e.g. 1001, to signify a different data set for the same instructional group (i.e. baseline). The extra number also indicated that it was the longer version of the experiment[55].

3.2.3 Summary

In this section, an explanation of the procedure, design and instructions devised for the four language experiments has been conveyed. The language experiments involve grammaticality judgements and vocabulary learning trials and there are two versions of each experiment. The versions differ in that the second running of the experiments, i.e. GJ2 and VOC2, involved an increased number of trials and additional grammatical categories as well as variations on word-matching. The experiments were tested on

[55] Subjects logged on using the same identity number for each of the experiments.

two different sample populations which were comparable in terms of L1s, age, gender and language proficiency in English. Each subject did two experiments: either Experiments 1 and 3 (Sample Population 1) or Experiments 2 and 4 (Sample Population 2).

The use of E-Prime software to run the experiments ensured greater control over certain SLL variables, such as timing and subject exposure to trials. The experimental design was enhanced by the addition of a feedback condition, interval time and providing more measures of learner performance, e.g. measurement of the number of practice. The advantages procured as a result of using E-Prime are:

- Time control over responses;
- Time control regarding subject exposure to language trials;
- Control over subject attainment in the practice session;
- More precise measurement of subject performance in practice;
- Feedback[56] available in response to individual trials and overall attainment in the practice session;
- The possibilities of data analyses were amplified.

The remainder of this chapter is devoted to a discussion of the language experiments. A section is dedicated to each experiment providing details regarding the materials, instructions, subject group tested and results. At the end of the four sections, there is a general discussion of the results of the four experiments (Section 3.4).

[56] It is possible that the addition of feedback evoked an external-focus of attention for all groups, i.e., receiving constant feedback meant that subjects may have focussed more on the effect of their actions or the end goal. This factor will be discussed further in Chapter 5.

3.3 Experiment 1 (Sample Population 1)

Experiment 1 involved four components, a pre-test to gauge learner proficiency in English, a questionnaire to elicit qualitative data and the experiment proper which comprised a practice and test component in grammaticality judgements. The components of the experiments were conducted during the first two-weeks of the first term of the academic year. The pre-test was conducted on the first day and the questionnaire was administered the following day. The subjects were assigned to one of three groups based on an analysis of the data generated by both research instruments. Following collation of the data, the experiment was conducted with both practice and test performed at the same sitting. In order to maintain consistency throughout the experiment, all components were conducted by the researcher.

3.3.1 Procedure and materials

Subjects were assigned to their instructional groups and each group attended the computer lab at separate sittings. The researcher was present during the experiments but the instructions were sufficiently clear as not to warrant any interaction either between the subjects and the researcher or between the subjects themselves. In other words, each subject individually followed the instructions displayed on the PC screen and completed the experiment at their own pace.

A total of 16 L2 items were tested in GJ1. The first 6 were conducted under practice conditions and therefore, could be repeated until the target level (60%) was reached. Whilst in the pilot trials, sentences were, for the most part, adapted from Tarone's (1985) study, a new set of sentences were devised for this experiment. At the first GJ1 sitting, a number of subjects were mistakenly assigned to the baseline group. This meant that only 2 subjects did the experiment under internal-focus instructions. To rectify this discrepancy a new set of sentences were devised for GJ1 and a second experiment was conducted the following day. Subjects who had already completed the first experiment typed in ‘session 2’ to account for this factor. The new set of sentences was devised by following the same criteria derived from the pilot studies.

This set of criteria was established in order to maintain the reliability of the testing instrument, to refine the research and control for variables such as sentence length. Some of the criteria, such as appropriateness for sample population, had already previously been validated in the Pilot Trial. The selection criteria for the L2 sentences are as follows:

- The L2 sentences were targeted at intermediate to upper-intermediate learners of L2 English, i.e. they were suitable for the sample population tested here;
- Sentences were selected on the basis of grammatical categories, i.e. in the practice, 2 sentences had a correct/incorrect article; 3 sentences with correct/incorrect preposition; and 3 sentences with correct/incorrect pronoun. The same procedure with a higher number of exemplars was adopted for the test.
- There was a balance between L2 sentences with a word missing or an extra word. All of the incorrect sentences either had a missing or extra word in order to provide the objective for the external-focus instructions as described in section 3.2.1;
- There was a balance between the number of words in each sentence (e.g. an average of 10 -12 words per sentence);
- There was a balance between correct and incorrect sentences in both the practice and the test.

The L2 sentences are presented in Tables 3-3 and 3-4:

Table 3-3: L2 Sentences for GJ1 Practice session

Grammatical Category	L2 Sentences
Preposition	He is thinking completing all the work by New Year.*
Article	He has a reputation for being a bit of a flirt.
Preposition	Last year I applied for a job at our local post office.
Pronoun	I'm going to give it him a present tomorrow for his birthday.*
Article	She would love to see the U2 in concert during her stay.*
Pronoun	She gave him the ring and he put it on.

Table 3-4: L2 Sentences for GJ1 Test

Grammatical Category	L2 Sentences
Pronoun	The map was on the table so she handed to him.*
Pronoun	The birthday cake, when she emerged with it, was lopsided.
Pronoun	They promised to bring it to her in the afternoon.
Article	The Erasmus students were exhausted after their first week in Ireland.
Article	Afterwards, I went on to do the further studies in Art History.*
Article	I love the Mediterranean food, especially with a glass of wine!*
Article	Funding for a major investment has now been made available.
Preposition	They walked down some side streets to find an inviting restaurant.
Preposition	I'm going in Ireland next year to improve my English.*
Preposition	Lissadell house in Sligo is set 23 acres of land.*

Note: The asterisk (*) indicates incorrect sentences.

3.3.2 Subjects

The sample population comprised 34 female and 31 male undergraduates recruited from a total population of 130 Erasmus students (IT Sligo: 2007-

2008 Academic year). The group - sixty-five subjects in total - were aged between 18 and 32 with an average age of 22 years. The two largest L1 groupings were French (n = 34) and German (n = 19). The other subjects were speakers of Italian (n = 6), Dutch (n = 3), Flemish (n = 1) and Romanian (n = 2)[57]. Most of the group had studied English for an average of eight to ten years and this was their first experience of living abroad. The group were evaluated as having an intermediate to upper-intermediate level in English as a second language - 63% was the mean score attained on the pre-test.

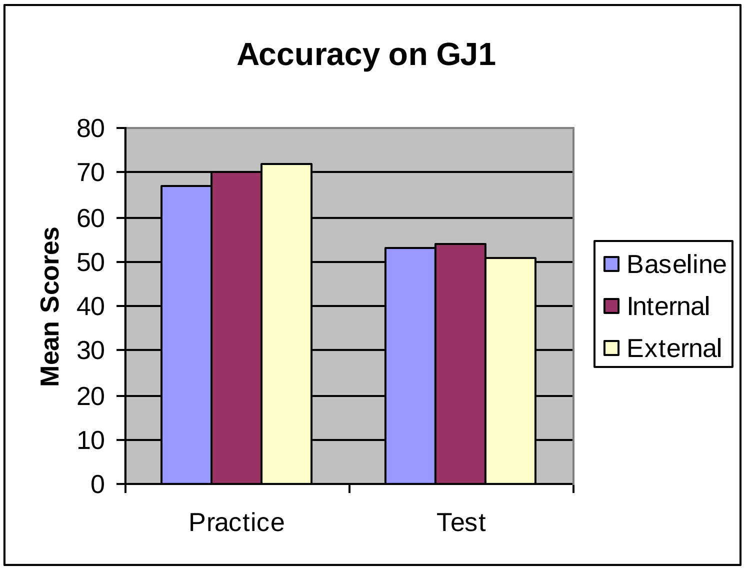
The sixty-five subjects were assigned to one of three learning conditions: baseline (n = 20), internal-focus (n = 21) and external-focus (n = 24). The sample group were found to be homogenous - homogeneity is important because where groups are equal on all identified levels; this may indicate that any variances emerging from the data derived from the experiments are attributable to the FOA instructions. In addition, as mentioned in section 3.2.2, the SDs were low signifying that group mean score is representative of individual subject performance within the group. Homogeneity is important because where groups are homogenous in identified areas (e.g. number in sample, age, L1 grouping, L2 proficiency), more can be inferred from the data vis-à-vis the effect of FOA instructions

3.3.3 Results

Figure 3-7 depicts the mean scores for each instructional group on accuracy in grammaticality judgements in practice and test conditions.

[57] With the exception of the pilot trials, the sample populations were, for the most part, speakers of Indo-European languages.

Figure 3-7: Experiment 1 practice and test accuracy scores



There is a statistically significant difference between how subjects perform in practice and test conditions with all groups excelling in practice. The external-focus group attains the highest mean score in the practice session but there is no statistically significant difference in subject accuracy when the three treatment groups are compared. The higher scores attained by the three groups during practice may be related to the fact that the practice session involved repeated exposure to the L2 trials. Therefore, practice on repeated instances of the same L2 resulted in all subjects attaining higher scores with the external-focus group attaining the highest score compared with both internal-focus and external-focus groups. This finding is consistent with other SLL studies on the positive effects of practice (Michas and Berry, 1994, see DeKeyser, 2001 for a review of this issue).

Both the baseline and internal-focus groups attained higher scores on the GJ1 test compared with the external-focus group thus providing some support for the main hypothesis (H1, Section 2.1.1), i.e. that instructions inducing different foci of attention impact on L2 learning outcomes. Contrary to the predictions related to the beneficial effects of external-focus (H2, Section 2.1.1), the results seem to indicate that not focussing on grammar (baseline) or focussing on grammatical features of L2 sentences (internal-focus) is more beneficial to L2 learners compared with external-focus instructions under test conditions. However, once again, like the practice part of the experiment, the differences between the groups are small and the effect on learning is not of any great significance.

Statistical analysis was performed on the data for Sample Population 1 which included the vocabulary experiment[58] using a 3 group (baseline, internal, external FOA) X 5 trials repeated measures analysis of variance (ANOVA). The within-subject factor was trial (i.e. the pre-test, GJ practice GJ Test, VOC Practice and VOC Test) and the between-subjects factor is group. The ANOVA reveals that there is no significant difference between the scores attained by the three groups: $F\ (2, 62) < 1$[59]). This effectively means that, apart from the disparity in mean scores illustrated in Figure 3-7, there is no significant statistical difference in how the three groups performed in relation to the instructions they received. As mentioned earlier, statistical analysis also reveals that there is no difference between the groups in terms of their L2 proficiency score indicated on the pre-test. Thus, three groups of comparable L2 proficiency show no significant difference in terms of judging L2 sentence acceptability in spite of the different instructions administered to each group. Because the difference between the three groups did not reach significance, this result provides some support for the null hypothesis.

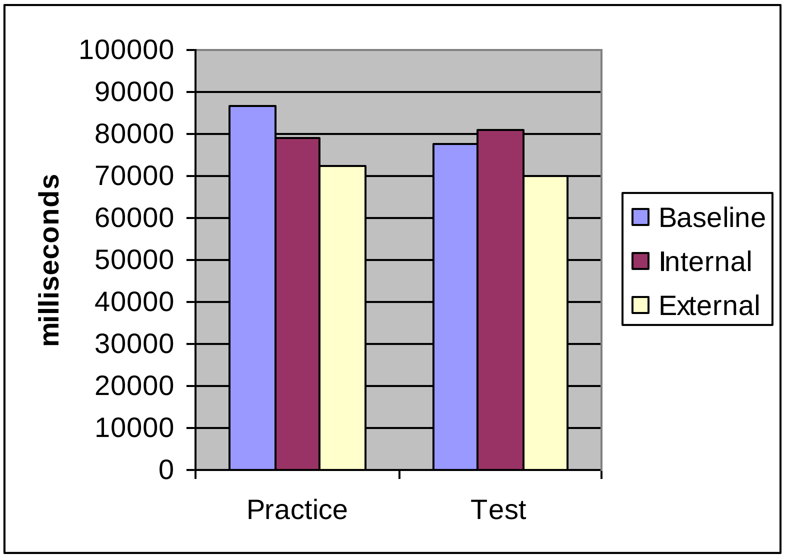
[58] The results for the vocabulary experiment are discussed separately in Section 3.5.2.

[59] The F Ratio provides a measure of the difference between the variability within the group and the variability between the groups. For example, a high F value indicates that the difference between the groups is higher than the difference within the groups. The reverse is true when the F value is low. ‘p’ indicates the significance of the variance. For all the tests in this study, the significance level was set at 0.05 as is common in most SLL research. This level of significance indicates that there is only 5% probability that the scores attained occurred by chance.

Whereas the Group X Test interaction is not significant (F 8, 248 < 1), the main effect of Test is: $F(4,248) = 28.38$, $p < .001$ indicating that the performance of subjects across the pre-test, practice session and GJ test varies to a significant degree. The Pairwise Comparisons test indicates that scores on the pre-test significantly differ from all the other trials. In addition, the distinction between accuracy in GJ practice and GJ Test is significant at $p > .001$ level as is that between pre-test and the GJ test. It would seem from this evidence that other variables have a significant bearing on learning outcomes – practice vs. test, the number of trials (GJ Test = 10 vs. Pre-test = 100), with (GJ Practice and Test) vs. without instruction (Pre-test), multiple-choice vs. GJ. The type of morpho-syntactical features being tested also influenced learning outcomes - the multiple-choice pre-test was a general grammar test consisting of lexical, semantic and grammatical forms whereas the GJ examined articles, pronouns and prepositions exclusively.

Next, an evaluation of the timed responses of subjects and the number of cycles generated in each group during the practice session are discussed. The results are presented as group means for baseline, internal and external-focus on each of the experiments. The time is calculated by filtering the data in EDataAid in order to access the target reaction time (RTT) for each subject. The RTT time property indicates the reaction time relative to the start time of the experiment which is then subtracted from the end time in order to calculate length of time spent on each block of trials in the practice session and the test. Figure 3-8 depicts the subject response times for the practice and test sessions in Experiment 1 (GJ1). Recall that the maximum time allowed for each response was 10, 000 milliseconds (Section 3.1.1) and that for the practice session, subjects could repeat for as many cycles as necessary to reach the pass level set at 60%.

Figure 3-8: Mean Time in milliseconds on GJ1



The response times are relatively close when the results of the practice and test are compared (See Appendix C for a full set of results, pp. 257-261). The external-focus group completed both practice and test session in a shorter time than either the internal-focus group or the baseline group. The baseline group were the slowest on the practice session whereas the internal-focus group were slowest – but only marginally slower than baseline – on the test. Even though the external-focus group completed the GJ practice and test in the fastest time, the ANOVA demonstrated no significant difference between the three groups: $F(2, 60) < 1$. With regard to the number of cycles, no significant difference was found between the three groups: $F(2, 61) < 1$; the external-focus group needed a marginally higher number of cycles (1.78) to graduate to the test compared with baseline (1.70) and the internal-focus group (1.71).

In the practice session the external-focus group perform best in terms of both accuracy on the language trials and response times. In the test, the mean scores obtained by each group are very close and the internal-focus group perform marginally better than the other two groups in terms of accuracy but they also take longer to complete the test in comparison with baseline and external-focus. This result corresponds to Ellis' (2004) prediction that accessing explicit knowledge requires more time than implicit knowledge; furthermore, it would seem that accessing explicit knowledge for L2 grammaticality judgements induced via internal-focus instructions resulted in marginally better performance in this instance during the test.

3.3.4 Summary

To sum up, sixty-five subjects from different L1 backgrounds were tested on grammaticality judgements involving an equal number of correct and incorrect L2 sentences in English. In accordance with the Wulf model, the subjects were assigned to one of three instructional groups and each group did the same GJ under different instructional conditions. The baseline group were instructed simply to decide whether the sentences were correct or not, the internal-focus group were informed that errors were related to incorrect use of articles, prepositions and pronouns; whereas the external-focus group were instructed that deviant sentences had an extra or missing word. The difference between the three groups did not reach statistical significance which provides some evidence that instructions inducing different attentional foci have little or no impact on learner performance in grammaticality judgements.

However, the findings of this study as discussed so far provide some support for the beneficial effect of external-focus instructions during practice. Therefore, it may be that external-focus instructions are more beneficial during practice at least as far as SLL learning of grammar is concerned. These findings deviate from the findings based on the Wulf model as no clear indication of the beneficial effect of external-focus instructions emerged. On the other hand, the findings are consistent with other ML studies on other fronts:

- Practice improves performance;
- There is a distinction in results between practice and test;
- External-focus instructions may be beneficial during practice.

3.4 Experiment 2 (Sample Population 2)

Experiment 2 was administered to a separate sample population in September, 2008 and was designed to answer the same research questions as Experiment 1. Because GJ1 was relatively short, a second experiment involving the same task was designed to test a different sample population on a larger number of trials. In order to be consistent and provide clear grounds for comparison, the experimental procedures, including ethical procedures and selection criteria were replicated in accordance with GJ1. GJ2 was identical on most accounts to GJ1. In the next sections, the specifics of any procedural and material modifications are discussed.

3.4.1 Procedure and materials

A total of sixty L2 sentences were tested in the second version of the experiment (for a full list, see Appendix A, p. 238). Ten L2 sentences were included in the practice session and fifty sentences were utilized for the test. The criteria established for selecting L2 sentences for inclusion in the GJ1 were followed in GJ2. All of the sentences included in the GJ1 were re-tested and a new set of sentences were added most of which were adopted from other similar SLL studies (DeKeyser, 2001) and previously tested in pilot trial 7 (Section 2.3.7). Instead of adding more exemplars to the grammatical categories already tested, i.e. articles, prepositions and pronouns, one new category was added to include verbs in both affirmative sentences and interrogatives. The inclusion of this category meant that in addition to re-testing previously tested exemplars and adding further exemplars within these categories, an additional category in a two-dimensional mode was tested under the same attentional focus conditions. In sum, GJ2 was both a replication and an amplification of GJ1 and was designed to test the research hypotheses in relation to more exemplars and an additional category of L2 grammar.

Table 3-5: Content of GJ1 and GJ2

Experiments	Practice Session	Test
GJ 1	6	10
GJ 2	10	50

With regard to the instructions, minor changes were added to the wording to reflect the changes above and in an endeavour to make the external-focus instruction clearer for L2 learners. For the internal-focus instructions, the word [verbs] was added to denote the additional L2 sentences. In the external-focus response, reference to missing and extra words was supplanted by add and delete. Changes to the wording are depicted in bold print in the Table 3-5:

Table 3-6: Instructions for GJ2

Baseline	**Internal**	**External**
Identical to GJ1	Press "1" if the grammar is correct. Press "2" if the grammar is incorrect. Press "3" if you don't know. Focus on the PREPOSITIONS, ARTICLES, PRONOUNS and **VERBS**	Press "1" if you do not want to change anything. Press "2" if something needs to **be ADDED or DELETED.** Press "3" if you don't know. Focus on MAKING CHANGES or NO CHANGES.

Because of the length of the test session, after the first 20 trials, the instructions were repeated. This repetition was added to ensure that the subjects were following the FOA instructions as intended by the researcher. The first 20 trials were analysed as Test 1 and the remaining trials comprised Test 2 of the GJ2 experiment (see Figure 3-9, p. 130).

3.4.2 Subjects

Seventy participants aged between 18 and 28 (average age = 20) took part in this experiment. The group comprised 41 female and 29 male undergraduate students. As in GJ1, the volunteers were partaking in the Erasmus year abroad programme and had studied English for an average of 9 years. The two largest L1 groupings were French (n = 36) and German speakers (n = 21). The rest of the group were speakers of Spanish (n = 4), Italian (n= 3), Serbo-Croatian (n = 1) and Dutch (n = 1).

Following the protocol used in GJ1, the questionnaires were administered to the subjects before the experiment and used as a research tool to provide qualitative data for the study. According to the qualitative data collected from the questionnaires, the group make-up for the second study (GJ2) was very similar in terms of courses, time spent abroad and L2 background to

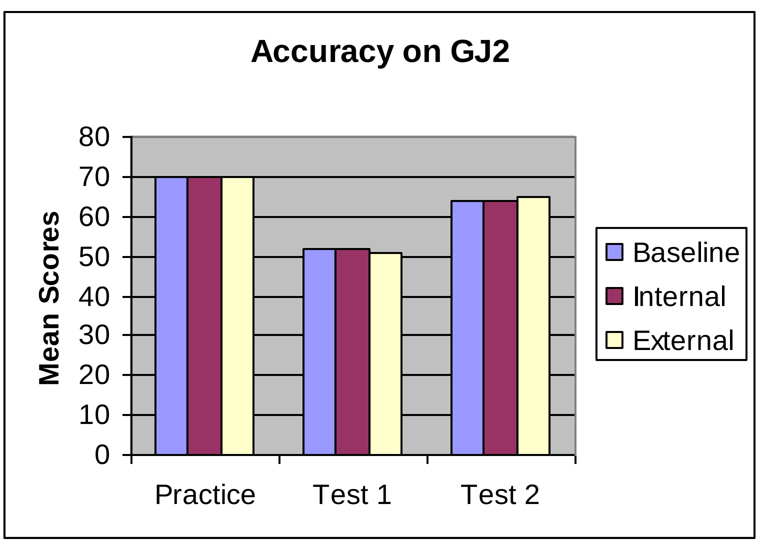
GJ1. Both groups correlated well in age range, gender dispersion and extent of L2 studies. The sample population were evaluated as having an intermediate to upper-intermediate level in English as a second language. The participants in both studies (e.g., GJ1 and GJ2) attained similar mean score on the pre-test (Sample Population 2: M = 62%).

Statistical analysis revealed low standard deviations across the groups signifying that the mean score is reflective of individual scores within each group. As is the case with the GJ1 data set, no significant difference was revealed in the pre-test score. Thus, the three treatment groups were homogenous and their language proficiency in English was at a comparable level to the first group tested.

3.4.3 Results

The mean scores for the three instructional groups are illustrated in Figure 3-8:

Figure 3-9: Experiment 2 practice and test accuracy scores



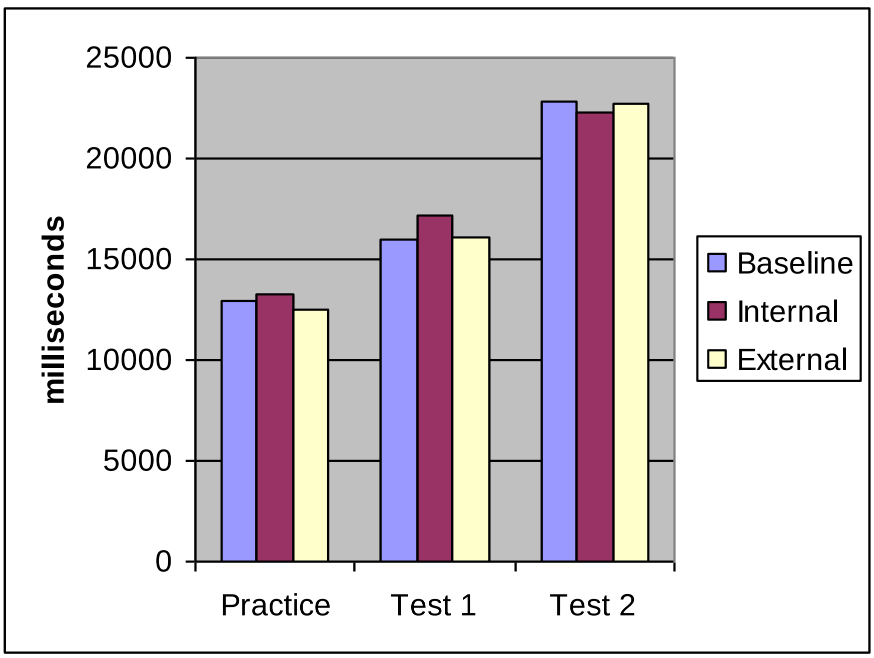
In GJ2 the three groups attained almost identical mean scores in the practice session indicating a strong effect for practice over instructional difference. Recall that in GJ1, the external-focus group performed best in practice with the two other groups attaining lower mean scores. In this experiment, the practice involved adding four more exemplars of L2 sentences and it would seem, at least based on this preliminary analysis, that practice on these L2 sentences resulted in higher scores for all three treatment groups, i.e. practice on more exemplars seems to have been the variable which pushed all three groups to excel over the variable of FOA instruction.

When practice and test scores are compared, the results are in line with GJ1 in that all groups attained higher scores during the practice session compared with the test. An analysis of variance using repeated measures with trial (on 7 levels) as the within-subject factor and group as the between-subject factor, reveals that the differences between the groups does not reach significance: $F (2, 67) <1$. As demonstrated in the chart the differences between the groups are marginal and indicate that, as far as grammaticality judgements are concerned, focus of attention induced through instructions has little or no effect on adult L2 learners.

In line with the findings in GJ1, the Group X Test interaction is not significant ($F (12, 402) <1$ and there is a significant difference found in terms of the test type: $F (6, 402) = 77.13$, $p < .001$. Thus, intermediate L2 adult learners vary significantly in their performance according to the type of language activity being tested. Multiple comparisons of the results demonstrate that accuracy on the pre-test is significantly different from performance GJ Practice and GJ Test 1 but not from GJ Test 2.

As for the other assessment tools, namely, number of cycles and response times, no significant difference was found between the treatment groups. The number of cycles in the GJ2 practice was marginally higher than in GJ1 but no significant difference was found between the groups on this count. Figure 3-10 charts the results of GJ2 with respect to response times. Firstly there is a significant difference in length of time required by the groups to complete each part of the experiment. The increase is reflective of the increasing number of trials in each part: practice = 10 L2 trials; Test 1 = 20 L2 trials, and Test 2 = 30 L2 trials. The trend here is somewhat different from GJ1 with the external-focus group fastest in the practice - as in GJ1 - but, equalled by the baseline group in Test 1. In Test 2, the internal-focus group is the fastest group but only marginally so in comparison with both the baseline and internal-focus groups.

Figure 3-10: Mean Time in milliseconds on GJ2



3.4.4 Summary

To sum up, seventy subjects from different L1 backgrounds were tested on 60 grammaticality judgements involving an equal number of correct and incorrect L2 sentences in English in practice and test conditions. In accordance with the Wulf model and the design of GJ1, the subjects were assigned to one of three instructional groups and each group did the same GJ under a different FOA treatment. For all intents and purposes, the wording of the instructions was the same as in GJ1 – the main difference in this experiment was the increase in the number of L2 sentences from 16 (GJ1) to 60 (GJ2) which included a new category, namely, verbs. The difference between the mean accuracy scores of the three treatments came very close to reaching statistical significance but statistical analysis indicated that there was no major effect for group, i.e. the F value was very low. A significant difference was found between performance on practice and test and with regard to the different GJ tests.

The two experiments described thus far were designed to test the impact of focus instructions on learner performance in grammaticality judgements. The dependent variable was accuracy score in both practice and test sessions and the independent variable was the treatment, i.e. focus of attention. The findings of both studies more or less correspond with each other and are in line with the findings derived from ML studies in that the results on practice and test differ significantly. Unlike the ML studies, however, the result of these language experiments do not provide evidence for the beneficial effects of external-focus instructions as far as intermediate L2 learners are concerned (H2).

3.5 Experiment 3 (Sample Population 1)

Experiments 3 and 4 are devoted to vocabulary learning involving learner exposure to word-pairs displayed on a PC screen followed by a recognition test. The objective was to test the impact of focus instructions on memory processes, i.e. accessing and retrieving L2 words from memory (i.e. as in pilot trials 4 and 7). The vocabulary experiments were designed to test whether focus instructions influence the performance of L2 learners during the initial stages of vocabulary acquisition. Only one aspect of vocabulary learning was tested, i.e. vocabulary recognition. This aspect was chosen because it is the first step in the process of vocabulary acquisition and secondly, because it could be reliably tested under laboratory conditions. Following the procedure adapted for the pilot trials, a set of artificial words were created and paired with English words (L2). Unlike the grammaticality experiments discussed in the previous section, the vocabulary experiments represent an investigation of FOA instructions on dynamic learning processes. Whereas the objective of the grammaticality experiments was to investigate the influence of FOA instructions on accessing learner interlanguage, i.e. an already existing language system, the vocabulary experiments was designed to investigate the learning of new lexical items, i.e. learning in terms of changes to mental representations (Bialystok, 1994).

The experimental procedure, instructions and data collection tools were similar for the two versions of the experiment (VOC1 and VOC2) but tested on two different sample populations. In line with the first series of experiments in grammaticality judgements, the main difference between the two versions was in terms of an extension and amplification (i.e. alternative word-pair matches were introduced) of the research instrument.

3.5.1 Procedure and materials

Each subject grouping, i.e. baseline, internal-focus, external-focus were given different instructions in relation to how to focus their attention for the purposes of learning the word-pairs. The screen shots portrayed in Figures 3-11, 3-12 and 3-13 exemplify the wording of the instructions presented to each of the groups:

Figure 3-11: Screenshot of baseline instructions (VOC1)

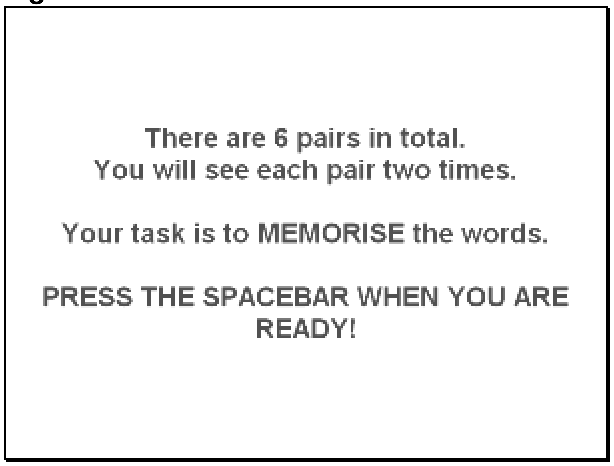


Figure 3-12: Screenshot of internal-focus instructions (VOC1)

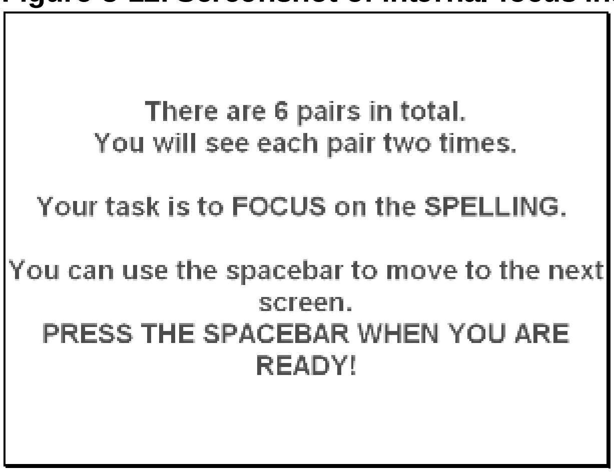
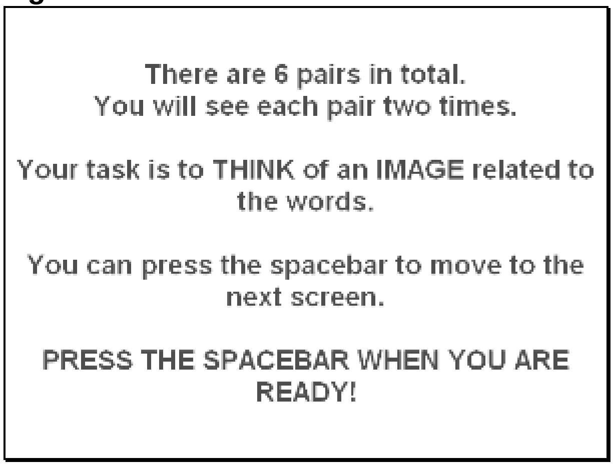
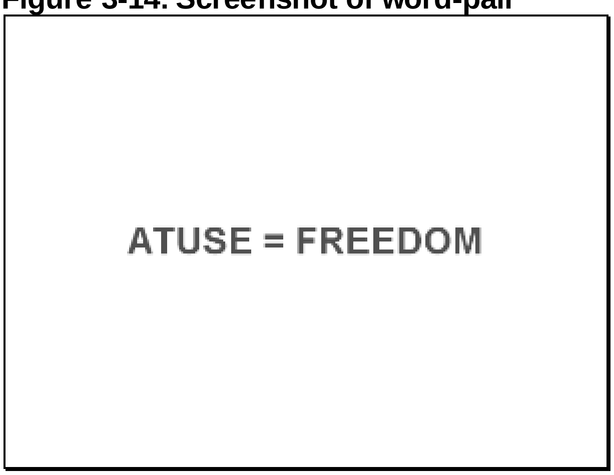


Figure 3-13: Screenshot of external-focus instructions (VOC1)



The design of the experiment included both practice and test phases and each phase comprised two components, namely a learning and test session. During the learning session, subjects were exposed to a set of word-pairs which were individually displayed on the screen as illustrated in Figure 3-14:

Figure 3-14: Screenshot of word-pair[60]



[60] Word-pairs were displayed in Arial 30 Font.

During the learning phase, each word-pair was displayed twice in random order. The learning session was followed by a practice session the purpose of which was to test the first set of word-pairs. A second learning session followed with a new set of word-pairs which were subsequently tested in a final test. The experiment was programmed so that subjects could work at their own individual pace but within a time-frame fixed by the researcher. Subjects used the spacebar, for example, to move to the next screen or they could wait until the maximum time-period allocated had elapsed (10 seconds) and allow the display to change automatically.

Two types of content word-pairs were used in this experiment and can be categorised on a scale from abstract (e.g. atuse = freedom) to non-abstract (e.g. treth = bottle). This scale is related to imageability, e.g., non-abstract words being easier to create images for than abstract words (Steinel and Hulstijn, 2007). The artificial words were created based on the following criteria:

(a) Adhering to a spelling pattern similar to English;
(b) Keeping the words as short and varied as possible in order to increase the challenge of recognising them in the test;
(c) Adhering to other vocabulary studies in SLL research (Ellis and Schmidt, 1997; DeKeyser, 2001; Fukkink *et al.* 2005; Halberda, 2006);

The six word-pairs utilized for the first learning phase (practice) are displayed in the list below:

1.	treth = bottle	4.	rense = learn
2.	atuse = freedom	5.	dilt = nurse
3.	throp = voice	6.	shile = cooker

During the practice session, the subjects were tested on the set of six word-pairs depicted on the previous page, which included three from the previously viewed set plus three word-pairs which did not correspond to the original set. The incorrect pairs included words spelled incorrectly, e.g. tuse and dilt, and a new distracter word, e.g. rilde = cooker.

In order to explain the procedure to the subjects, the following instructions were presented to all groups:

Figure 3-15: Screenshot of instructions for vocabulary experiments

Subjects were instructed to respond as quickly as possible as to whether the stimulus (the word-pairs) was correct or not by pressing “1” or “2” respectively. They also had the option of using key “3” if they were unsure. During the second part of the experiment, subjects were presented with twelve new word-pairs following the same procedure and timing protocol as established during the practice phase (See Table 3-7). The word-pairs were subsequently tested with an equal balance of correct and incorrect equivalents (See Table 3-8). .

Table 3-7: Word-pairs used in the VOC1 Learning Phase

Abstract word-pairs	Non-abstract word-pairs
wuve = happiness	smet = hotel
roon = tasty	pone = wheel
honish = ugly	lorp = car
gloont = love	tibe = house
dax = hatred	toly = doctor
filk = sadness	pern = food

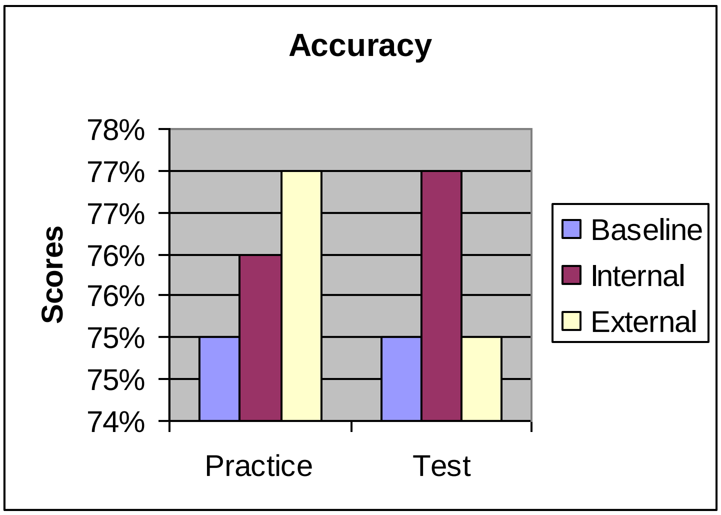
Table 3-8: Word-pairs used in the VOC1 Test

Word-Pairs Tested	Correct Answer Correct = 1 Incorrect = 2
RIVE = FOOD	2
TOLY = DOCTOR	1
DREN = HAPPINESS	2
LORP = CAR	1
POM = WHEEL	2
RALP = HOUSE	2
DAX = HATRED	1
GLON = LOVE	2
ROON = TASTY	1
FILK = SADNESS	1
PERNT = UGLY	2
SMET = HOTEL	1

3.5.2 Results

In this experiment the sixty-five subjects were assigned to one of three focus conditions: baseline (n = 20), internal-focus (n = 21) group, external-focus (n = 24). Subjects were assigned to the same group as in the GJ1 experiment and retained the same identity number for logging on. The mean scores for accuracy in both practice and test conditions are depicted in Figure 3-16 for each instructional group. Given that the scores were relatively close, the chart has been rescaled (e.g. like in the speech experiment, Section 1.2.3). There is a notable difference between the results attained by the external-focus group in practice compared with the test (e.g. a much higher result is attained in the practice session). The pattern of the internal-focus group score also shows marked improvement between practice and test but in the opposite direction (e.g. a much higher result is attained in the test session). The baseline group remain at the same accuracy score in both. From this depiction of results it would seem that external-focus instructions benefit learners during practice, whereas adopting an internal focus results in enhanced performance in the test.

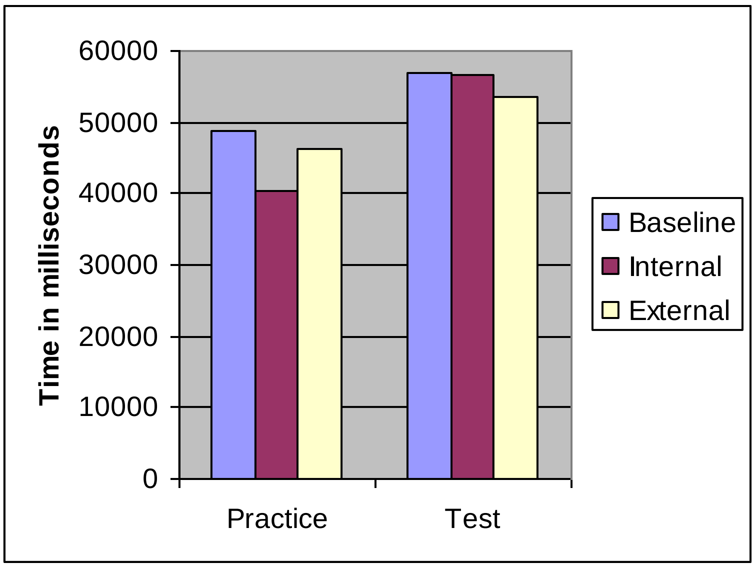
Figure 3-16: Practice and test results for VOC1



The mean scores in both practice and test in the vocabulary experiment are significantly higher than those attained by the same group of subjects on the grammaticality judgement experiment - for example, a number of participants attained 100% on both practice and test. Contrary to the results attained in the grammaticality experiment, here there is no significant difference between subject performance in the practice and test parts of the experiment. This result may indicate that practice on a higher number of L2 trials significantly affects learning outcomes, thus the three groups – regardless of FOA instruction – converge more in terms of mean accuracy scores when they are exposed to more L2 trials.

Figure 3-15 illustrates the mean response times for Experiment 3. The external-focus group are fastest in the test part of the experiment but not in the practice session. The internal-focus group complete the practice session in the shortest time whereas the baseline group appear to finish last in both cases.

Figure 3-17: Mean time in milliseconds on VOC1



In terms of the number of cycles, the average was low for each group: 1.3, 1.2, 1.4, respectively and no significant difference was found between the three groups.

When the response times and accuracy scores are compared between the GJ and VOC, we see that not only did the same subjects attain significantly higher scores on the VOC but they also completed the experiment in a much faster time period. In both cases, there is more variability between the groups during the practice session compared with the test. This begs the question of whether the language learners paid more attention to the instructions during the practice session resulting in more differences between the groups. This is a possibility since the practice session represents the first encounter with the instructions and perhaps greater adherence to the instruction compared with the test.

As mentioned previously, when the accuracy scores on the GJ and VOC experiments are compared using a repeated measures ANOVA, a statistically significant difference was found for test type ($F(4,248) = 28.38$, $p < .001$) indicating that subject accuracy varied to a significant degree according to the type of language activity tested. In other words, for Sample Population 1, learning outcomes are strongly influenced by the content of the experiment (e.g. grammaticality judgements versus vocabulary learning) and the condition (e.g. practice vs. test). The F value for group, i.e. FOA instruction, is not significant for the vocabulary trials. A repeated measures ANOVA in 3 (group) X 2 (trials – e.g. VOC Practice and VOC Test) indicates no significant main effect between the groups: $F(2, 62) < 1$; and the same result for the Group X Test interaction.

3.5.3 Summary

Sixty-five subjects took part in the first experiment testing firstly the hypothesis that instructions inducing different foci of attention influence learner ability to retain new L2 words and secondly the hypothesis that external-focus instructions would benefit learner performance. The subjects were assigned to one of three instructional groups in accordance with the procedure used in the grammaticality judgement experiment described heretofore. The subjects were tested on two sets of word-pairs totalling 36 items under practice and test conditions. The instructions for each of the groups are summarised in Table 3-9:

Table 3-9: Instructions for VOC1

Baseline	Your task is to MEMORISE the words.
Internal Focus	Focus on the spelling of the word-pairs.
External Focus	Focus on an image related to the word-pairs.

The findings of this cross-linguistic study provide evidence that L2 intermediate learners achieve similar high results on the vocabulary recognition task under practice and test conditions regardless of the FOA instruction provided. Even though the subjects had not previously been exposed to the artificial words, the accuracy scores were significantly higher than in the grammaticality experiment and the pre-test. The accuracy scores are also very close between the three groups and standard deviations are low signifying homogenous results within each group. The difference between the three groups did not reach significance level according to various statistical tests with a probability level set at $p. > 0.05$. There is, however, a significant difference in how the same group of learners performed in the vocabulary experiment compared with the GJ.

It would seem from the general results presented thus far that focus of attention induced through instruction has a minimal impact on vocabulary learning at least to the extent that it was tested here. However, it is also evident that external-focus instructions seem to have more of an impact on the practice part of the experiment compared with the test and this is parallel to the results derived from the grammaticality experiments.

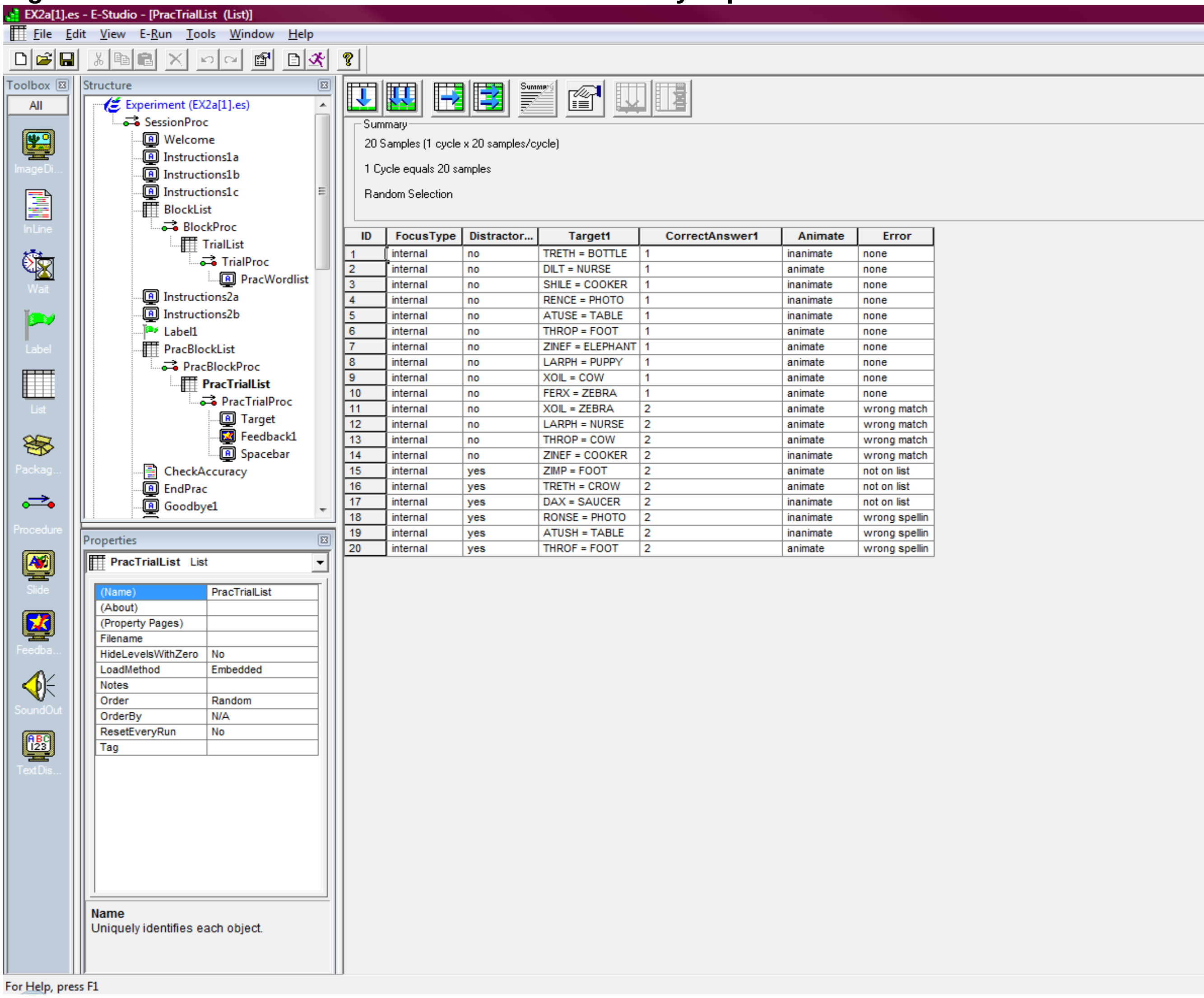
3.6 Experiment 4 (Sample Population 2)

The second study was conducted in September, 2008 under the same conditions with a different sample population. This experiment was designed principally in order to test whether the accuracy scores obtained in the first experiment would be replicated in response to a larger number of trials and whether instructions inducing different attentional foci would interact with trial number and complexity in a positive or negative way. The instructions for VOC2 were identical for each of the groups to the wording used in VOC1. A reminder of instructional focus – after 20 trials – was incorporated. This repetition of the FOA instructions was added to ensure that learners would not revert to self-driven learner strategies as a result of the higher number of trials.

3.6.1 Procedure and materials

This experiment comprised four components: during the first learning phase, subjects viewed 10 word-pairs and were subsequently tested on 20 word-pairs. A second learning phase included 20 new word-pairs which were subsequently tested on 30 trials. In addition to increasing the number of word-pairs, a second challenge was added to the testing phases in both the practice component and the test, i.e. there are more variables than in VOC1 (View column designated 'errors'). In VOC1, errors resulted from non-correspondence in relation to spelling and distracter words only. In VOC2, mis-matched word-pairs were also included.

Figure 3-18: Screen view in E-Studio of the vocabulary experiment



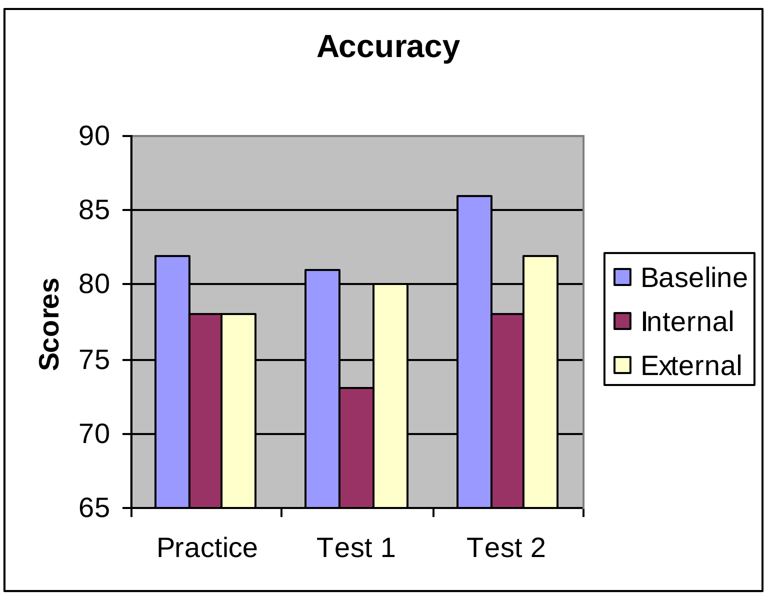
In order to counter-balance the effect of potentially rendering the experiment too difficult or inappropriate for the level of the subjects, i.e. because of the significant increase in number of trials and the extra variable involving mis-matched pairs; the abstract words were removed from the design. The abstract/non-abstract division used in VOC1 was replaced with an animate/inanimate category of content words, as illustrated in the screen shot (Fig. 3-18).

The VOC2 experiment consisted of 100 items in total, of which 30 were tested under practice conditions, i.e. which could be repeated when necessary, and 70 items were presented in the test conditions.

3.6.2 Results

The seventy subjects who took part in this experiment were assigned to one of three learning conditions, i.e. baseline (n = 26), internal-focus (n = 19) or external-focus (n = 25).

Figure 3-19: Practice and test results for VOC2[61]



The first notable observation of these general accuracy scores is that once again the level of performance on the vocabulary recognition task is comparatively high for all groups. Second, there is no significant difference between scores obtained in practice and test conditions even though there

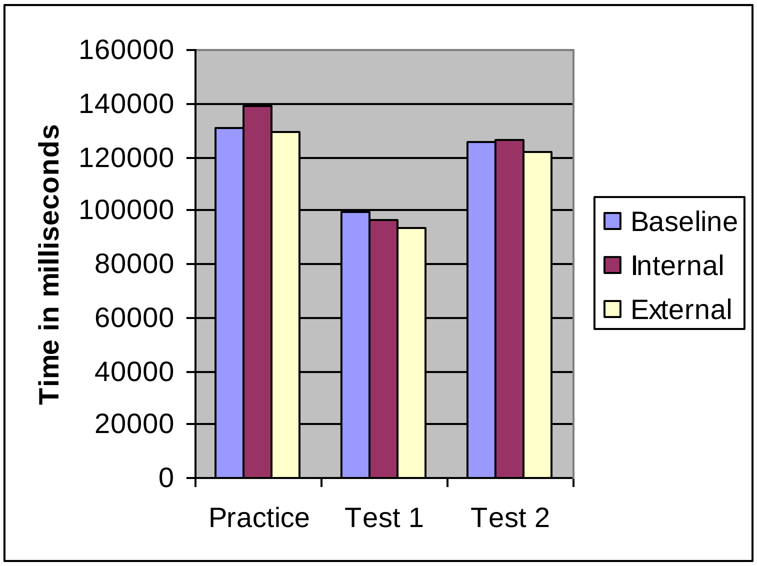
[61] Note that the chart has been re-scaled.

were a smaller number of trials in the practice compared with tests 1 and 2 and subjects could repeat the session as often as required to reach 60%. The number of cycles required to reach the pass point is similar to the findings in VOC1 indicating that the additional complexities incorporated into the design of VOC2 did not have any effect on learner performance or at least did not have a negative impact on learning outcomes.

Although the difference between the three groups does not reach significance, the baseline group performed best in terms of providing accurate answers in both practice and test in VOC2. The two focus groups reached the same mean score in the practice and the external focus group attained higher scores in the test compared with the internal-focus group. By contrast to the other experiments and the ML studies, here the external focus group performed better on the test in comparison with the practice. In this respect, the results of the external-focus mirror those of the baseline group but are very different from the internal-focus group who obtained a higher score in the practice session compared with the test. This result suggests that the increasing practice gained from a higher number of trials interacts in a positive way when subjects adopt an external-focus.

With regard to response times, the findings resemble GJ1 in that the external-focus group completes the practice and test sessions in a marginally faster time than the other two groups. This finding may be an indication that the external-focus instruction induced implicit learning processes – i.e. faster responses – in comparison with the other two groups. Interestingly, the greatest difference between the groups is found during practice where the internal-focus group are slower than the other two groups.

Figure 3-20: Mean time in milliseconds on VOC2



3.6.3 Summary

In this section, the second experiment in vocabulary learning and recognition has been described and the findings of general accuracy scores have been presented. Seventy subjects from different L1 backgrounds were tested on recognition of newly learned vocabulary pairs involving an equal number of correct and incorrect trials in practice and test conditions. The subjects were assigned to one of three instructional groups and each group did the same experiment under different instructional conditions. The wording of the instructions was the same as in VOC1 and in line with the grammaticality experiments (Experiments 1 and 2), the main difference in this experiment was the increase in the number of word-pairs from 36 (VOC1) to 100 (VOC2). VOC2 also included more challenging varieties of matched pairs. The difference between the mean accuracy scores of the three treatment groups did not reach statistical significance.

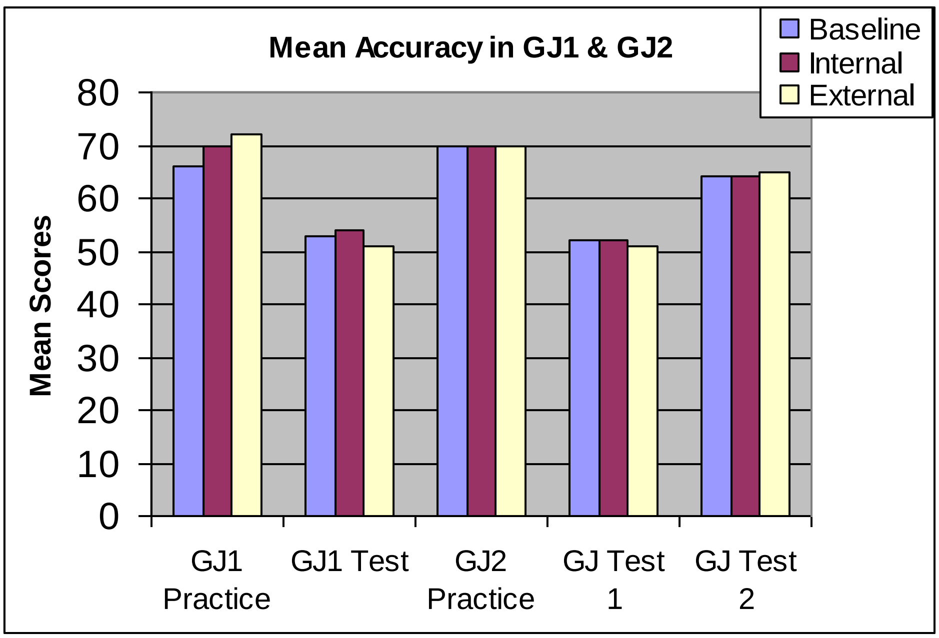
Contrary to expectations, the increased number of trials did not result in a very different data set compared with VOC1. In fact, the findings derived from both studies are quite similar with respect to subject score and similarity between practice and test scores. The difference between accuracy scores for the three instructional groups in VOC2 does not reach statistical significance indicating that FOA instructions did not have any significant impact on the performance of the L2 learners on either the practice or the test. Similarly, there is no statistically significant difference between the three instructional groups in terms of response times or number of cycles.

Another pattern which emerges from the vocabulary experiments is that the external focus group completes both the practice and the tests in a shorter time compared with the other two groups with the exception of the first VOC practice (Sample Population 1). This finding is consistent with the findings in both grammaticality experiments (i.e. again with one exception where the internal-focus group were faster) and may indicate that the external-focus group did indeed follow the instruction and operated in accordance with implicit learning processes. However, this is a tentative conclusion at this stage of the analysis and further analyses are required in order to examine the results on other levels, for instance, in accordance with learner proficiency and learner L1.

3.7 An overview of the results

Figures 3-21 and 3-22 represent the range of experiments administered to the two sample populations. Both charts convey the significant variability in learner performance in the different language experiments. Consistent with the findings in the other language experiments, in Sample Population 2, a significant difference emerged with regard to the type of test. This is an important finding and emerges in both data sets – i.e. for both sample populations. Five types of test were administered to Sample Population 1 and two extra tests were administered to Sample Population 2 – (GJ Test 2 and VOC Test 2). In both cases, the F value indicating the variances between accuracy scores on the different tests was significant. The difference was more than double with regard to Sample Population 2: (F = 77.13) Sample Population 1: (F = 28.38) and both were significant at .001 level. There is no significant difference between learner accuracy in VOC practice and VOC tests for either sample population whereas scores vary significantly between GJ practice and tests as well as the pre-test score.

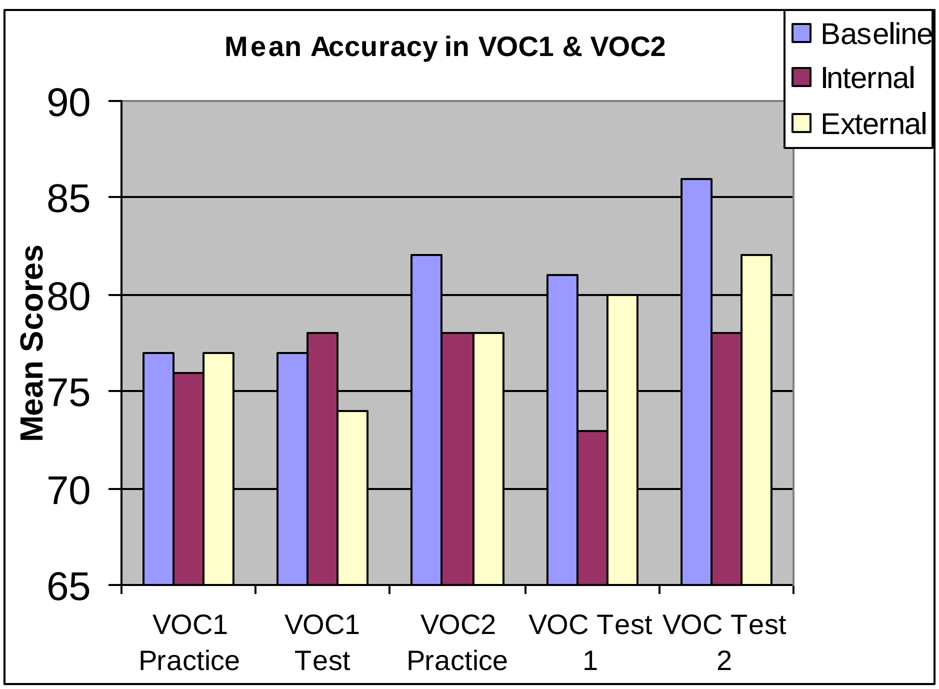
Figure 3-21: Summary of grammaticality experiment results



Several factors may account for these results vis-à-vis H1 and H2 including the choice of research instrument, i.e. grammaticality judgements; the wording of the instructions, i.e. the question of whether the wording adequately represented FOA instructions; and the assimilation of the instructions as intended, i.e. learner reluctance to follow instructions or adherence to other learner-driven approaches to the L2. Another possibility resides in the assumption that learner accuracy in GJs may be reliant on rule learning or knowledge of rules, i.e. an internal-focus instruction. It could be argued that providing the subjects with the grammatical categories at issue in each language trial may have afforded the group an extra clue or advantage over the other two instructional groups. On the other hand, given that the sample populations tested were experienced L2 learners, it may be that all of the subjects were looking out for problems in the sentences related to these much tested grammatical categories in L2 English.

Figure 3-22 represents the performance of both sample populations on the vocabulary experiments. There is greater variability between the treatment groups on the vocabulary experiments in both practice and test providing some support for H1, particularly with regard to the second more complex version (VOC2). However, as the variability between the instructional groups does not reach significance, this conclusion is tentative only.

Figure 3-22: Summary of vocabulary experiment results



With regard to the research hypotheses, the five major findings are:

(1) FOA instructions did not have a significant main effect on learning outcomes with regard to judgement of L2 sentences or recognition of new L2 lexical items (Hypothesis 1);

(2) External-focus instructions did not result in enhanced performance in the grammaticality or vocabulary tests, however, there are some indications that external-focus instructions facilitate learner accuracy during practice (Hypothesis 2);

(3) Although the differences between the instructional groups did not reach significance, it would be premature to accept the null hypothesis on the basis of the analysis conducted thus far as there are differences in mean scores and response times in the data which raise questions and warrant further analysis;

(4) There was a significant difference between individual performance across the tests with regard to both Sample Population 1 and Sample Population 2. The replication of this finding in both populations together with the statistical significance of the finding lend support to the claim that type of task is more closely related to learner accuracy compared with type of instruction;

(5) In the language experiments, the effect of practice on improved learner accuracy was supported by both data sets.

Chapter 4: Discussion of findings

In this chapter, the results are further analysed on diverse levels including learner proficiency in the L2, learner native language (L1) as well as experimental factors. The first sections of the chapter are dedicated to learner factors and the two main traits are investigated, the first of which is L1 grouping. Recall that the two main L1 groupings comprised the French and German-speaking subjects. The accuracy ratings of each group will be assessed separately to investigate L1 background in relation to the results, i.e. to explore whether L1 has had any bearing on learning outcomes and instructional treatment. Learner proficiency will also be investigated as a learner factor and is based on pre-test scores. The scores of the different instructional groups will be considered to find out the interaction and effect (if any) of L2 proficiency on learning outcomes and FOA instruction.

Following the discussion of learner factors, Sections 4.3 and 4.4 will deal with an analysis of the content of the experiments. The content will be investigated in two ways: first, the group performance on correct language samples will be assessed and compared with accuracy on incorrect language samples in the four language experiments. This analysis (4.3) will seek to provide evidence of whether or not the adoption of different attentional foci has any impact on decision-making in relation to correct and incorrect language trials. It may be, for example, that instructions inducing an external-focus enhance learner ability to recognise inconsistencies in the language exemplars whereas internal-focus instructions may facilitate recognition of acceptable L2 sentences or vocabulary pairs. In the second analysis (4.4), group performance will be investigated in relation to the linguistic categories presented in the two grammaticality experiments. The final section will bring together the different levels of analysis investigated in this chapter and the findings will be discussed in relation to the research hypotheses.

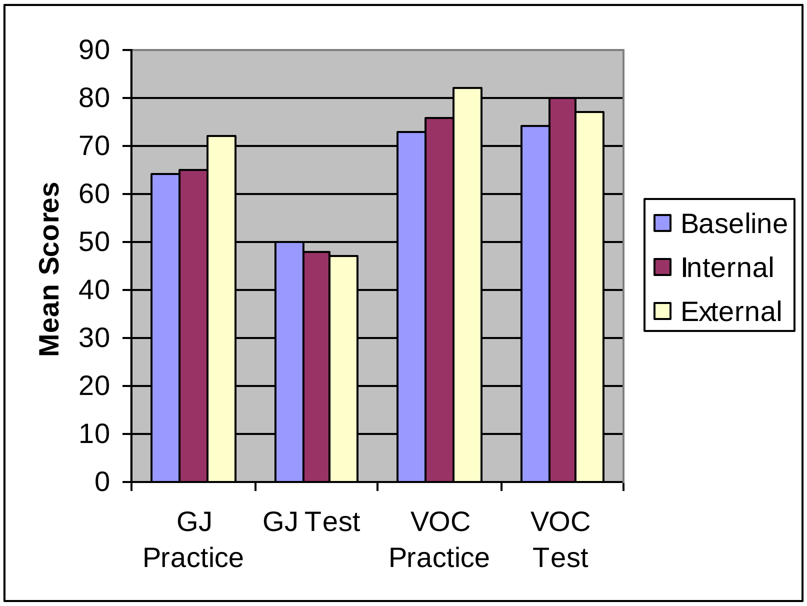
4.1 Comparing Different Language Groups

In this section, the data for French and German-speaking subjects is extrapolated from the general data set results for the four experiments. The performance of both language groups is analysed across the pre-test, grammaticality experiments and vocabulary experiments. In each section, two sets of results are presented from the two sample populations tested in these experiments. The results are graphically presented at the beginning of Sections 4.1.1 and 4.1.2 to provide an overview for the discussion which ensues. A full data set can be accessed in Appendix E (pp. 283-292).

4.1.1 French L1s

Figure 4-1 and 4-2 represent the mean accuracy scores attained by French-speaking subjects on each of the language experiments tested in this study. Figure 4-1 represents the French L1s tested in September, 2007 (Sample Population 1) and Figure 4-2 represents the French L1s tested in September, 2008 (Sample Population 2). The latter plot includes an extra test for both the GJ and the VOC experiments indicating the higher number of trials.

Figure 4-1: L1 French Group (Sample Population 1)



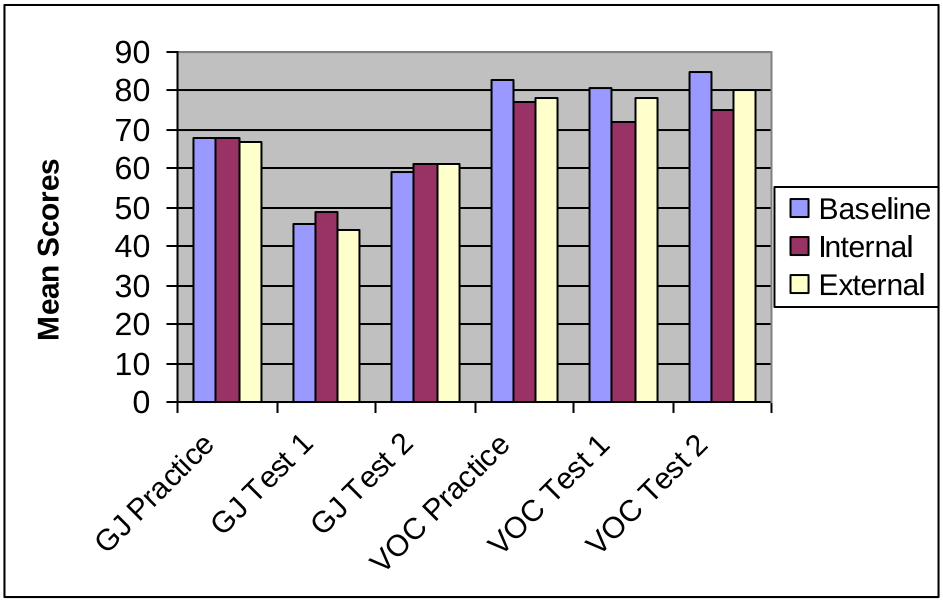
Thirty-four French-speaking subjects took part in the grammaticality experiment (GJ1) and the vocabulary experiment (VOC1). Their mean score on the pre-test was 60% and standard deviations confirm comparable dispersion of scores around this mean. The standard deviations (S.D.) for the language test or pre-test score is the same for both baseline and internal-focus groups (S.D. is around 0.12, see Appendix E for exact scores p. 283), whereas the external-focus group is lower (0.08) indicating a dispersion of scores which are closer to the mean (63%). When the results of the entire set of tests (including the pre-test) are compared, the external focus group attained the highest overall mean score, e.g. 68%. Interestingly the external-focus group attain the highest score in two out of the four language activities and they obtained the highest mean score in the practice session in both types of experiments. The variability between the groups is more marked in the practice sessions providing some evidence for H1 and also for the assertion that the learners adhered to the instructions during the practice compared with the test.

An ANOVA of repeated measures using a 3 Group X 5 Trial design with group as the between-subject factor and trial as the within-subject factor reveals that there is no significant difference between the accuracy scores of the three FOA groups: $F(2, 31) < 1$. Although the differences do not reach significance, they nonetheless reflect a pattern which directly relates to the research questions explored in this study. That is, external-focus instructions seem to facilitate accuracy during the practice stage of the experiments and in some but not all of the L2 areas examined (H2).

There is, on the other hand, a significant difference between the mean accuracy scores of the French L1 groups across the five language activities tested here indicated by a high F ratio for within-subject effects: F (4,124 = 25.95, p.< .001). In other words, the type of language experiment or test type has had a significant effect on learner performance where the lowest scores were obtained in GJ Test and the highest on Vocabulary Practice. This pattern reflects the general group pattern as discussed in Chapter 3 (Section 3.7) and further emphasises the importance of test type in relation to learner accuracy and ultimately learning outcomes. Pairwise comparisons of scores reveal that there is a significant difference between group performance on GJ Practice and Test, whereas there is no difference between Voc Practice and Test. There is also a significant difference between the scores obtained in the Pre-test compared with the GJTest, Voc Practice, and Voc Test; but no difference between the Pre-test score and GJ Practice. Recall that the pre-test was administered before the experiments and was the only language activity without focus instructions.

Figure 4-2 depicts the performance of the French-speakers from Sample Population 2 across six language experiments:

Figure 4-2: L1 French Group (Sample Population 2)



Thirty-six French-speaking subjects did the grammaticality (GJ2) and vocabulary experiments (VOC2). Their mean score on the pre-test was somewhat lower than Sample Population 1 (55%) and the low standard deviations confirm roughly the same dispersion of scores around this mean (Appendix D). The variability in learner performance is reflected in a similar pattern in this chart as in Figure 4-1 where the lowest scores are obtained in the first GJ Test and the highest scores on the final VOC test. Interestingly, the greatest differences between the three groups are recorded in the vocabulary experiments whereas in the grammaticality experiments the three groups converge around the mean – particularly in the GJ Practice and GJ Test 2. This pattern suggests that the higher number of trials containing more challenging material administered to Sample Population 2 together with the increased opportunities for practising language may have influenced learning outcomes in a differentiated way not only vis-à-vis the treatment groups (i.e. FOA instruction), but also vis-à-vis the type of experiment, i.e. grammaticality judgements versus vocabulary learning.

According to the results obtained from a repeated measures ANOVA and in line with previous findings, no significant interaction was found between FOA group and accuracy scores: $F(2, 33) < 1$. This is a similar result to that obtained for the French-speakers tested in Sample Population 1. It can be inferred from this finding that variability in learning outcomes was not related to group differences, i.e. FOA instruction. A significant difference between subject performance across the different experiments was found: $F(6, 198) = 58.60$, $p > .001$. The F value obtained is more than double that obtained for the first sample population reflecting the effect of additional number and complexity of the trials particularly with reference to the vocabulary experiment. Thus, type of language experiment had a significant effect on the learning outcomes of French L1s where the lowest scores were obtained in GJ Test and the highest on Vocabulary Practice.

Unlike the previous group of French-speakers, the external-focus group show no advantage in comparison with the other groups in the practice sessions of either experiment (H2). The three group scores are closely clustered around the mean scores in the pre-test, GJ Practice and GJTest 1 and Test 2 and begin to separate away from each other from the commencement of the vocabulary experiment. A test of pairwise comparisons of the trials reveals that the pre-test score was significantly different from the scores attained by the same subjects in the experiments. A significant difference was found between practice and test sessions in the grammaticality experiments but not between practice and test in vocabulary learning.

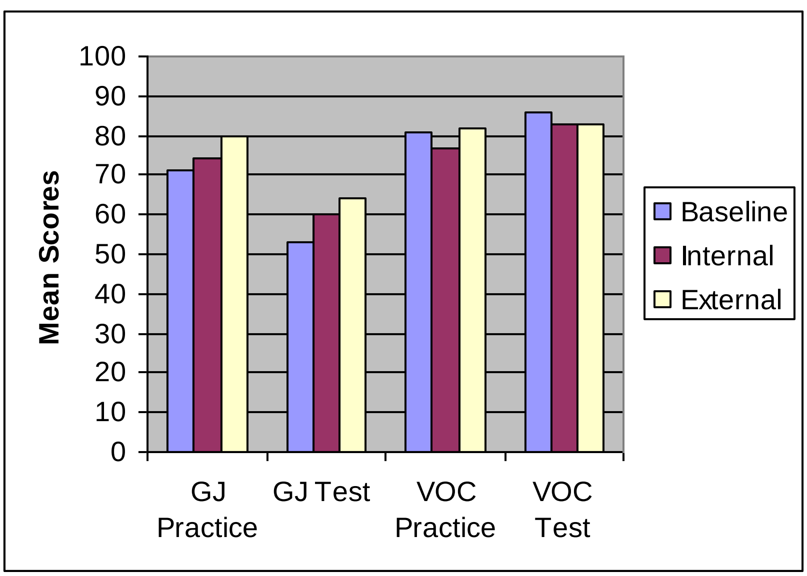
It is possible that the higher number of trials administered to the second group of French-speakers resulted in more opportunities for practice which may have interacted positively with subject performance. In addition, in parallel to the general group results, there is clear statistical evidence lending support to the contention that type of language experiment has a significant effect on learner performance – over and above type of instruction given.

In Section 4.1.2, the data derived from the German-speaking subjects will be analysed and compared.

4.1.2 German L1s

Twenty German-speaking subjects took part in the grammaticality (GJ1) and vocabulary experiments (VOC1). Their mean score on the pre-test was 65% and standard deviations confirm tight dispersion of scores around this mean (Appendix E, p.285). Figure 4-3 depicts the learning outcomes for Sample Population 2:

Figure 4-3: L1 German Group (Sample Population 1)



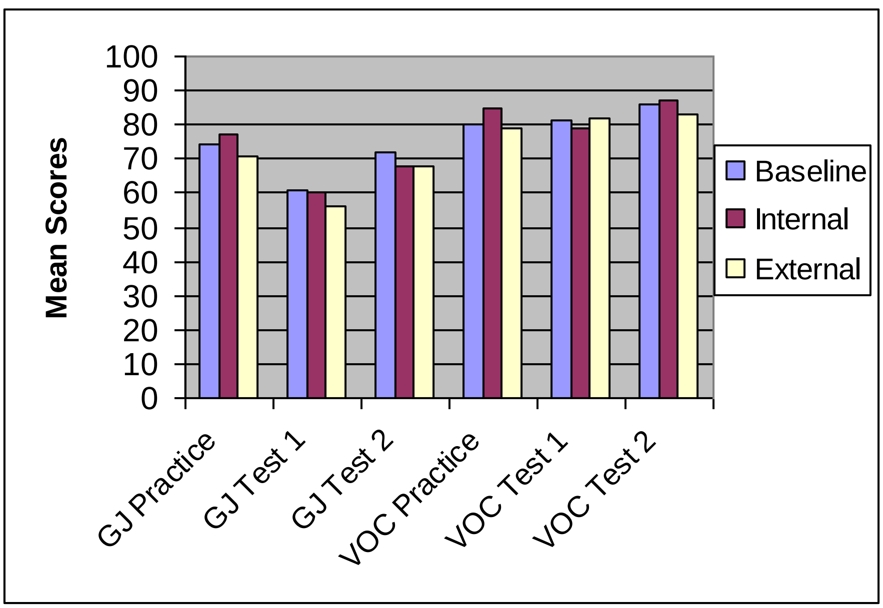
Similar to the L1 French group from Sample Population 1, the external-focus group excelled in GJ practice compared with the other two instructional groups. In addition, in this case, the external-focus group also attained higher accuracy in the GJ Test. The ANOVA test of between-subjects-effects reveals that there is no significant difference between the performance of the three groups across the four language experiments: $F(2,17) < 1$. The low F ratio indicates no significant difference in learner performance in relation to the different instructions given.

By contrast and in line with all of the findings discussed so far, a significant difference between subject accuracy across the language experiments was attested in the test of within-subject effects: $F(4, 68) = 6.17$, $p < .001$. Here again type of language activity (i.e. test type) has had a significant effect on learner performance where the lowest scores obtained in GJ Test and the highest on Vocabulary Test. Pairwise comparisons of scores on the four language activities reveals that there is a significant difference between group performance on GJ Practice and Test whereas there is no difference between Voc Practice and Test – just like the French-speakers from the same sample population. There is no significant difference between the scores obtained in the pre-test and the grammaticality judgements under either practice or test conditions nor is there a significant difference between performance on the vocabulary practice and test .

In relation to the research hypotheses, the results derived from the vocabulary practice reflect most closely the predictions made by Wulf, i.e. that external focus instructions would benefit learners at least as much as no instructions and more than internal-focus instructions. Since the scores of the German L1s, by and large, reflect those of the French, it may be that learner difference in terms of mother tongue has less to do with ultimate attainments. In addition patterns of repetition within Sample Population 1, i.e. the external-focus group excels more in practice than on the test, indicate that the content of the experiments and the number of trials constitute pre-eminently more influential factors in learning outcomes. Learner proficiency is also an important factor and may also have influenced results – this learner factor will be discussed further in Section 4.2.

In the next population tested, twenty-one German-speakers did the grammaticality and vocabulary experiments. The mean pre-test score was 69% placing them at a much higher proficiency level in English than the other groups discussed so far: French Sample Population 1 (M = 60%), French Sample Population 2 (M = 55%) and German Sample Population 1 (M = 65%). Standard deviations confirm a similar pattern of dispersion of scores as reported for the previous groups (see Appendix E, p. 286).

Figure 4-4: L1 German Group (Sample Population 2)



The greatest variability in mean scores – H1 – is found once more in practice conditions for both experiments indicating assimilation of the FOA instructions. L1 German-speakers following internal-focus instructions attained highest accuracy in three out of six experiments, including both practice stages in both types of experiment. This implies that high-proficiency learners pay more attention to instructions during practice or at least, that this group have a better comprehension of the instructions and thus adhere to them more. Higher proficiency may also correlate with increased knowledge of rules or familiarization with the grammatical categories included in the internal-focus instructions. Hence, this group may have been in a better position vis-à-vis other lower proficiency learners in assimilating the internal-focus instruction and implementing rules. It would seem reasonable to assume that this result can be attributed to the interaction between FOA instruction and higher L2 proficiency of this group compared with groups discussed previously, rather than to learner difference in terms of L1 grouping. With the exception of Voc Test 1 – and the difference is minimal - the external-focus instructions do not appear to benefit high-proficiency L1 German learners. Perhaps, high-proficiency L1 German-speakers are more familiar with rule-based learning and are less inclined to adopt new approaches to these learning tasks making them more reluctant to, for example, adopt an external focus of attention.

A repeated measures ANOVA demonstrates that group instruction has had no significant effect on performance as there is no significant difference between the groups: $F (2, 18) < 1$. Like all other levels examined thus far, a statistically significant difference was found for test type: $F (6, 108) = 20.30$, $p < .001$. A test of pairwise comparisons reveals that the pre-test score is significantly different from GJ Practice and GJTest 1, but is not different from GJ Test 2. Similar to the findings of other learner groups, there is a significant difference between practice and test in grammaticality judgements (GJ Practice and Test 1 only), but not between practice and test in vocabulary learning.

4.1.3 Summary

The previous two sections presented an analysis of the data in relation to subject L1. Several patterns have emerged from the data:

- The same pattern of results emerges from the data regardless of the L1 spoken by the subject;
- Accuracy in language trials is significantly different in relation to type of language activity tested (GJ vs. VOC);
- Mean accuracy scores are significantly different in practice and test conditions – there is a significant difference between practice and test on the grammaticality judgements but not in the vocabulary learning experiments;
- External-focus instructions seem to be more helpful during practice but this is not always the case, it is predicated upon number of trials and content of the experiment;
- More evidence for Hypothesis 1 is provided in practice sessions;
- Assimilation and adherence to FOA instructions seems to be more likely during the initial part of the experiment, i.e. the practice session;
- The number of trials and availability of more instances and thereby opportunities for practice interacts with FOA and learning outcomes.

In this section, the important influences of factors such as assimilation of FOA instruction, type of language experiment, learner proficiency, number of trials and practice vs. test conditions, have been touched upon. In the interpretation of the results provided above, it has emerged that these factors have more bearing on learning outcomes than subject L1. In the next section (4.1.3), the discussion will centre on learner proficiency and how this variable correlates with other learner variables and FOA instructions.

4.2 Analysing Results as a Function of Level of Proficiency

In this section, the results of the experiments will be reviewed in relation to learner proficiency as assessed by the pre-test score. For this analysis, the data will be divided into a Level 1 proficiency group - i.e. subjects with scores of 55% or less on the pre-test and a higher proficiency group – Level 2 (i.e. scores above 55%). Because there are two sample populations tested, each one will be examined in turn and compared at the end of each section. The results of the discussion will be summarised in Section 4.2.3.

4.2.1 Level 1 Proficiency

With regard to the first sample population (Fig. 4-5), the Level 1 proficiency group comprises nineteen subjects (M = 47%).

Figure 4-5: Results of Level 1 Proficiency (Sample Population 1)

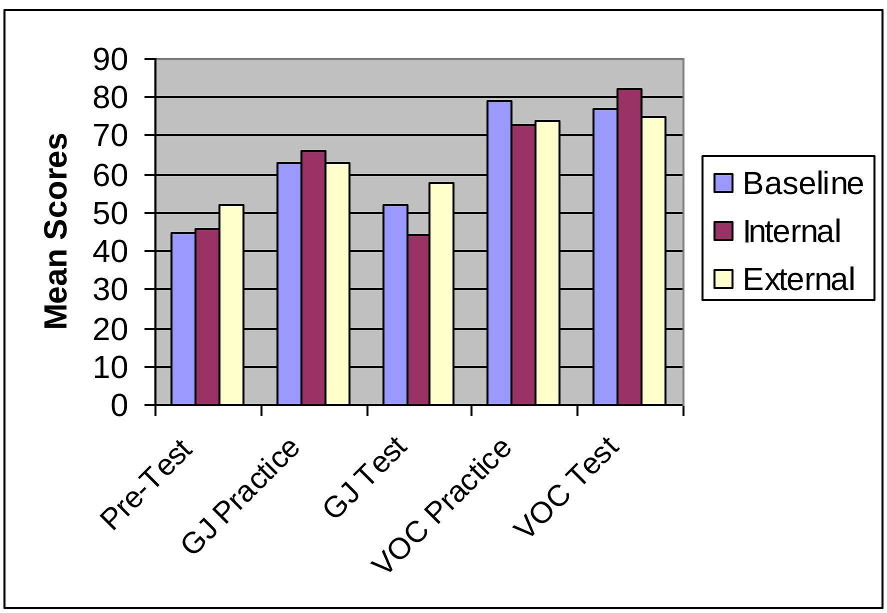
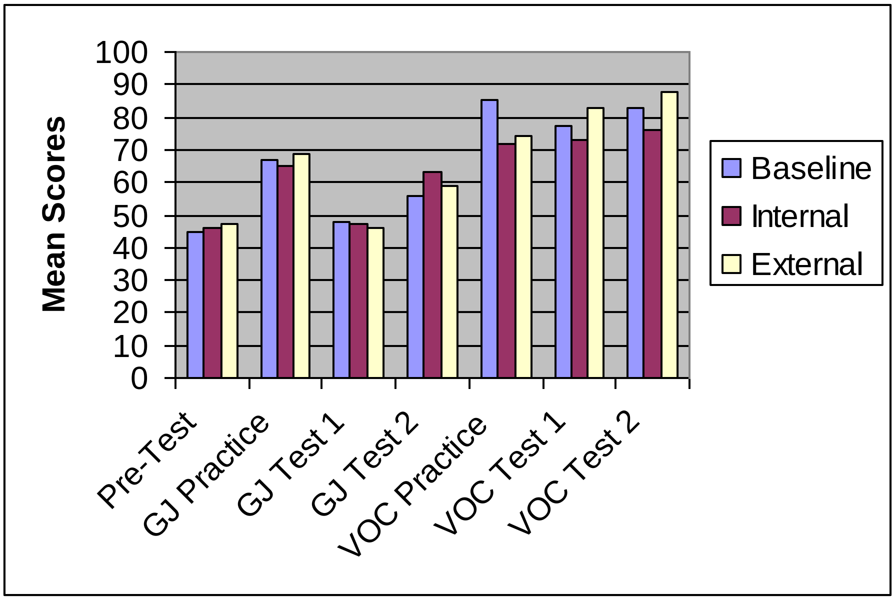


Figure 4-5 reveals more variability between the treatment groups in the two tests compared with the practice sessions with the greatest variability being evident in the GJ Test. Interestingly, the result of the GJ Test provides some evidence for H2 as the external-focus group excel compared with the baseline group and most notably in comparison with the internal-focus group. However, the variability in the mean scores is not representative of significant differences between the groups: $F (2, 16) = 1.85$, $p > 0. 05$. In line with the other analyses, the ANOVA with repeated measures reveals that there is a significant difference between learning outcomes in different experiments: $F (4, 64) = 27.66$, $p < .001$.

The second sample of low-proficiency subjects comprised twenty-four subjects with an average proficiency of 46%. Again, there was a significant difference found between the performance of subjects across the different language experiments: $F (6, 126) = 54.37$, $p <. 001$ and no significant difference between the groups on the various experiments tested either in practice or in test: $F (2, 21) < 1$. Although these results mirror those of Sample Population 1, the pattern of scores on individual experiments does not, which indicates that both the higher number of trials and increased complexity of the experiments presented to the second sample population had a bearing on learning outcomes.

Figure 4-6: Results of Level 1 Proficiency (Sample Population 2)



For instance, it would seem from the data presented in Figure 4-6, that lower-proficiency learners benefit – at least as far as vocabulary is concerned – from external-focus instructions. Interestingly, the benefits of the instruction do not emerge during the practice phase of the experiment – in fact the external-focus group attain the lowest mean score in the practice – but on both subsequent tests. Greater differences have been observed between the three instructional groups during practice and it has been proposed that L2 learners pay more attention to the instruction at first contact with the language task. For both Level 1 populations, the score for the baseline group diverges from the two focus group means. It may be that the less complex instruction, i.e. memorise the word-pairs, facilitated word learning for L2 learners of lower proficiency compared with the wording of the FOA instructions.

The other variable which is important here is practice – recall that the second set of experiments involved additional trials. So, external FOA instructions plus practice seem to have beneficial results for L2 learners with low proficiency levels in English as an L2. Perhaps too, the wording of the instruction should also be referred to in this analysis. For example, it was suggested (in Section 4.1.2) that higher-proficiency learners might follow instructions more closely because of their better comprehension of the L2. This was suggested with regard to internal-focus instructions and the familiarization of higher proficiency learners with the grammatical categories listed in the instructions. Here, it is being suggested that the external-focus instruction may benefit low-proficiency learners with regard to vocabulary learning. Yet, these learners were similarly faced with the difficulty of dealing with the L2 in that the instructions are all presented in the L2. More than likely, the instruction referring to 'image' was simple and transparent enough for this proficiency group to fully comprehend.

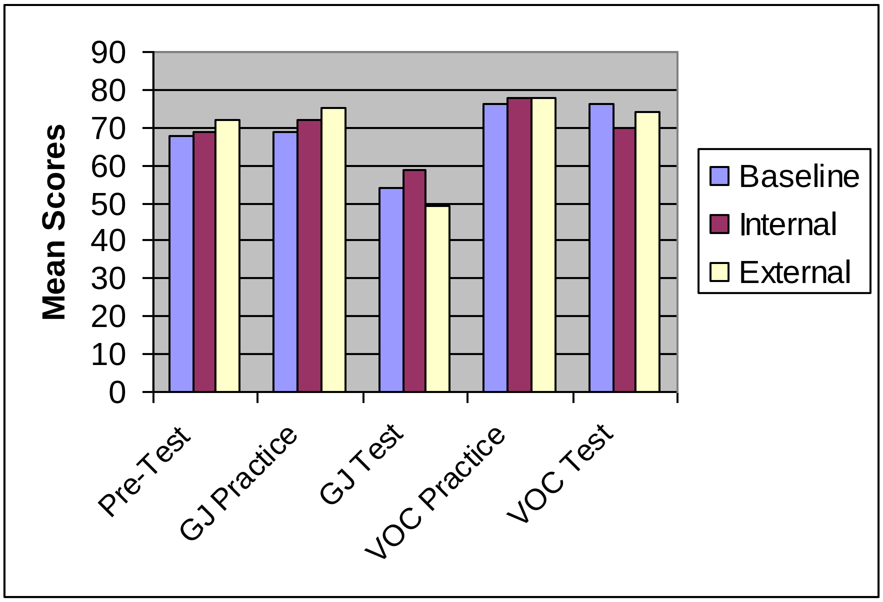
Nevertheless, this point raises a further question as to the language in which the learners were given the instructions. For instance, low-proficiency L2 learners may have experienced difficulties[62] in fully comprehending the instructions as intended in the experiments. If the learners had read the instructions in their native language, would they have been more likely to adopt the focus of attention intended by the researcher? This variable will be discussed in more detail in Chapter 5. In the next section the performance of the higher proficiency groups (Level 2) is examined.

4.2.2 *Level 2 Proficiency*

The first sample population comprised forty-six subjects with a mean score of 70%. The pattern here to a large extent reflects the trend depicted for the entire group. The external-focus group excels to a marginal extent in the GJ Practice compared with the baseline and internal-focus groups. .

[62] Robinson (2003) distinguishes difficulty, i.e. learner's perception of difficulty, from complexity, i.e. the cognitive demands of the task.

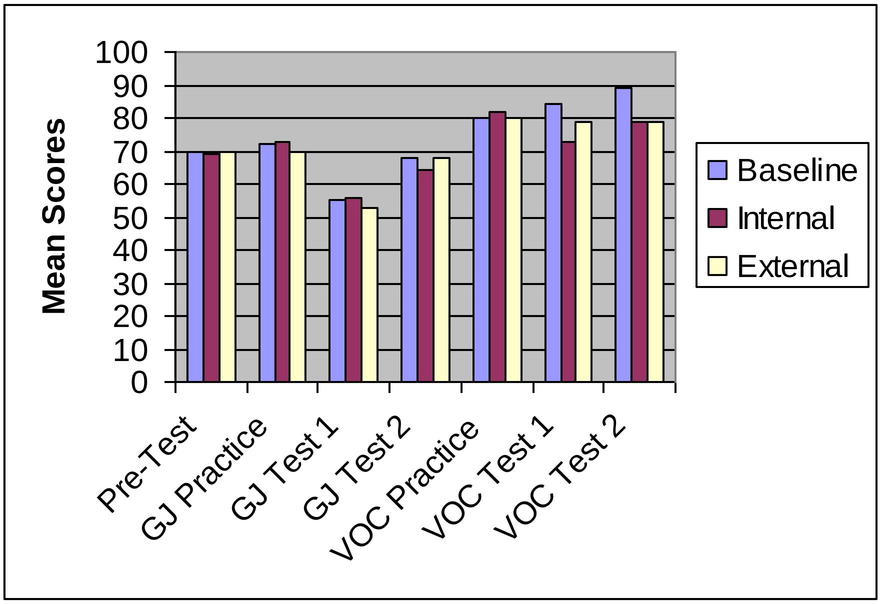
Figure 4-7: Results of Level 2 Proficiency (Sample Population 1)



As in the Level 1 cohort from the same sample group, the greatest variability emerges in the GJ Test. This pattern implies that type of experiment, content and number of language trials is more influential than proficiency levels vis-à-vis FOA instructions. However, whereas the external-focus group excelled in the Level 1 proficiency group, the internal-focus group are superior in this case. This result is in keeping with the earlier interpretation of the results emanating from the German L1 group who had attained similarly high L2 proficiency scores in the pre-test. As far as statistical differences between the instructional groups, no significant difference emerged: $F\ (2, 43) < 1$. In accordance with other results, a significant difference was found for type of experiment: $F\ (4, 172) = 16.83$, $p < .001$.

The next sample group of Level 2 Proficiency learners comprised forty-six subjects with a similar pre-test mean score (M = 70%). The mean scores for the language experiments are depicted in Figure 4-8:

Figure 4-8: Results of Level 2 Proficiency (Sample Population 2)



In line with the findings discussed for all other groups a significant effect was found for test type: F (6, 258) = 45.59, p < .001). Similarly, no significant difference was found between the groups as attested by a repeated measures ANOVA – although the F value is greater than 1 and difference remains insignificant: F (2,43) = 1.04, p. > .05.

4.2.3 *Summary*

In this section the data of the two sample populations was divided into two proficiency levels and 55% was selected as the dividing threshold. By and large the pattern of results reflects the trends seen so far with regard to both sample populations. For example, the low-proficiency sample reflects that of Sample Population 1, etc. This trend is marked by several features:

1) No significant effect for type of instruction;

2) Significant differences between performance on practice and test;
3) Significant differences between performance in grammaticality compared with vocabulary experiments;
4) Significant difference between the pre-test scores and performance on the vocabulary experiments;
5) Significant difference between types of language experiment.

In the last two sections, the sample population groups have been divided and analysed in terms of their L1s and their proficiency levels. In the following sections, the content of the language experiments will be analysed and discussed in relation to the results.

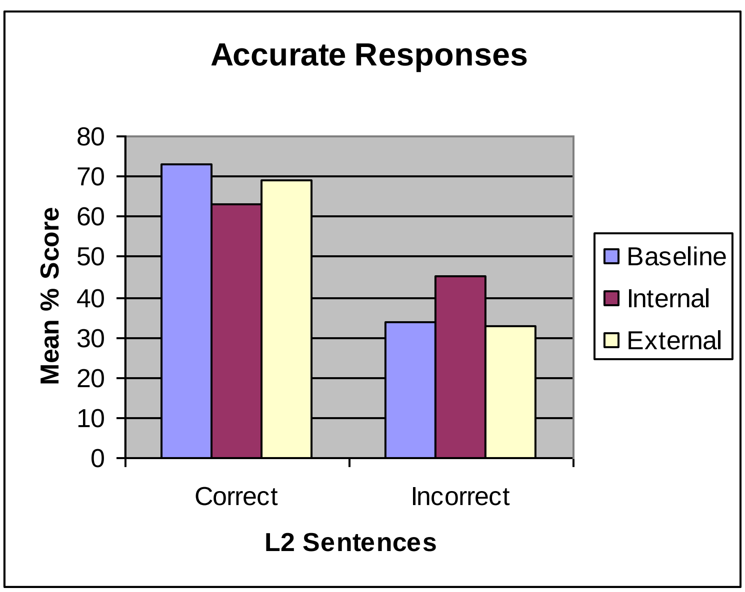
4.3 Analysing Responses to Correct and Incorrect Trials

In this section, the results of the language trials will be discussed in terms of the learning outcomes for each FOA group with regard to identifying correct and incorrect language trials in the test part of the experiments. Recall that in the language experiments, both correct and incorrect L2 sentences and vocabulary pairs were displayed on the screen to each subject. Subjects had to make decisions as to whether to accept or not the examples presented. In Chapter 3, accuracy scores were presented in global terms, i.e. mean accuracy scores as well as response times and number of cycles – in this section, the scores are re-examined in terms of accuracy on correct and incorrect instances. The objective is to tease apart these variables in order to further investigate the FOA effect.

4.3.1 Grammaticality Judgements

In Figure 4-9, the accuracy scores for the first grammaticality experiment are presented. These scores represent the mean scores obtained by sixty-five subjects on 10 L2 sentences in the test part of the experiment, 5 of which are correct and 5 incorrect. With regard to the correct sentences, baseline and external-focus groups perform best with the internal-focus group performing least well. Accurately judging incorrect sentences seems to have been somewhat more difficult for the three instructional groups, e.g. they obtain lower scores as compared with judging the correct sentences. Interestingly, the internal-focus group are best at detecting incorrect L2 sentences in GJ1 indicating an advantage of this FOA approach within this language context. This finding is in line with Fan's (2004) study where the group of subjects who had learned rules for collocations in L2 English performed better than other groups in terms of detecting incorrect sentences in the GJ.

Figure 4-9: Summary of accuracy scores on GJ1



In Figure 4-10 and 4-11, the mean accuracy scores for the two tests conducted in the second grammaticality experiment (GJ2) are presented.

Figure 4-10: Summary of accuracy scores on GJ2 (Test 1)

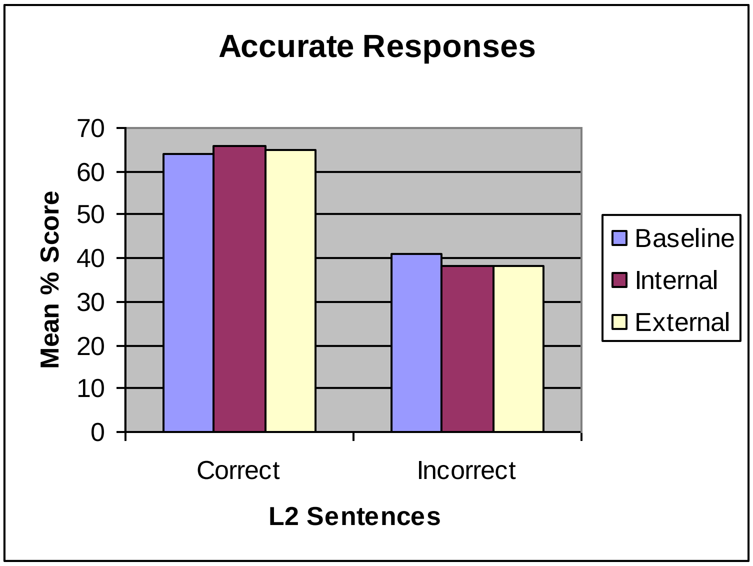
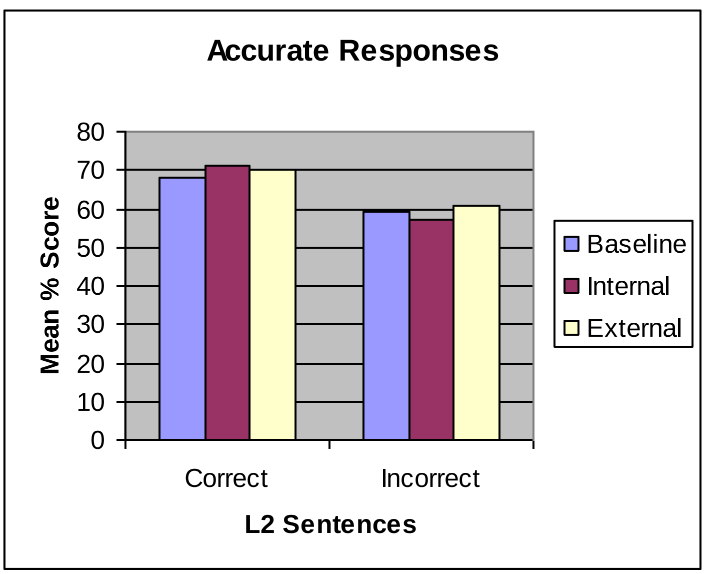


Figure 4-11: Summary of accuracy scores on GJ2 (Test 2)

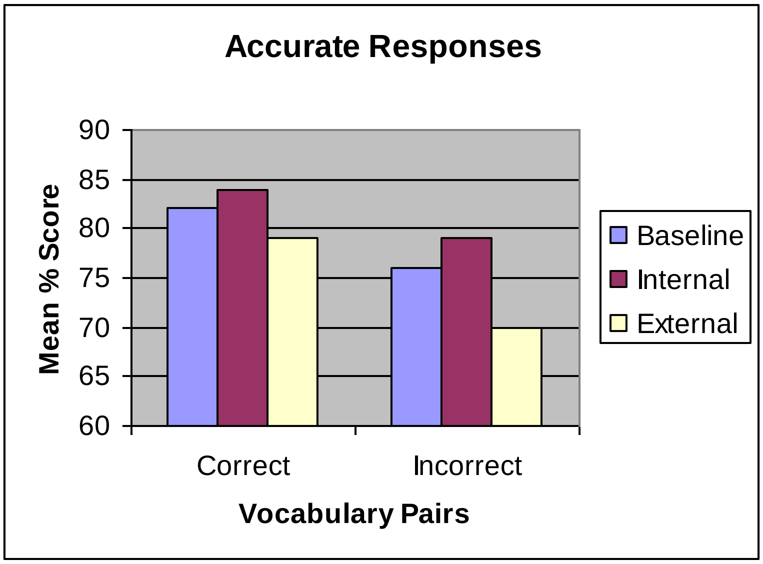


These charts represent the performance of seventy-one subjects on 20 L2 sentences in Test 1, 10 of which are correct and 10 incorrect and 30 L2 sentences in Test 2 (15 correct and 15 incorrect). The scores are much closer in both tests and there is very little difference between the three groups suggesting that number of trials and by extension, more practice opportunities, has a positive effect on the learning outcome for all three FOA groups. With regard to the correct sentences, the internal-focus group performs slightly better than the other two groups in Test 1 and in Test 2. With regard to the incorrect sentences, baseline performs best in Test 1 and the external-focus group performs best in Test 2, but again, the differences are minimal. Whereas in Test 1, the gap between success on correct versus incorrect trials is reminiscent of GJ1, in Test 2, the gap, i.e. variability in performance is less significant. This pattern is reflective of all three treatment groups and it can be inferred that the ability to correctly judge incorrect sentences is greatly improved in Test 2. This interpretation also demonstrates that the three instructional groups have improved as a result of practising on a higher number of exemplars. Thus, practice is a factor which results in more convergence between the three FOA groups and correlates positively with improved learning outcomes.

4.3.2 Vocabulary Experiments

In Figure 4-12, the learning outcomes in VOC1 for each FOA group are summarised. These scores represent the performance of sixty-five subjects on 12 word pairs, 6 of which are correct and 6 incorrect. With regard to both the correct and incorrect word-pairs, the internal-focus group performs better than the baseline and external-focus groups with the latter performing least well. Like in the GJ experiment, judging incorrect vocabulary pairs seems to have been somewhat more difficult for the three groups with the external-focus group attaining a comparatively lower score than the two other groups.

Figure 4-12: Summary of accuracy scores on VOC1



In Figure 4-13 and Figure 4-14, the accuracy scores obtained in VOC2, comprising Test 1 and Test 2, are summarised. These scores represent the performance of seventy subjects on 20 word pairs in Test 1, 10 of which are correct and 10 incorrect and 30 word pairs in Test 2, 15 correct and 15 incorrect. In line with the results in GJ1 and GJ2, the second version of the vocabulary experiment presents evidence that the higher number of trials tested has influenced learning outcomes. In Test 1 (Figure 4-13), the external-focus group make a higher number of more accurate decisions on both correct and incorrect vocabulary pairs. However, as discussed in Chapter 3, the differences are not significant[63].

Figure 4-13 representing the accuracy scores on the first VOC2 test is in line with the predictions of H2. With regard to Test 2, the external-focus group performs best on the correct vocabulary pairs in comparison with the other

[63] Please note the scale on each figure presented.

two groups and least well on identifying incorrect vocabulary pairs *albeit* group differences are not significant.

Figure 4-13: Summary of accuracy scores on VOC2 (Test 1)

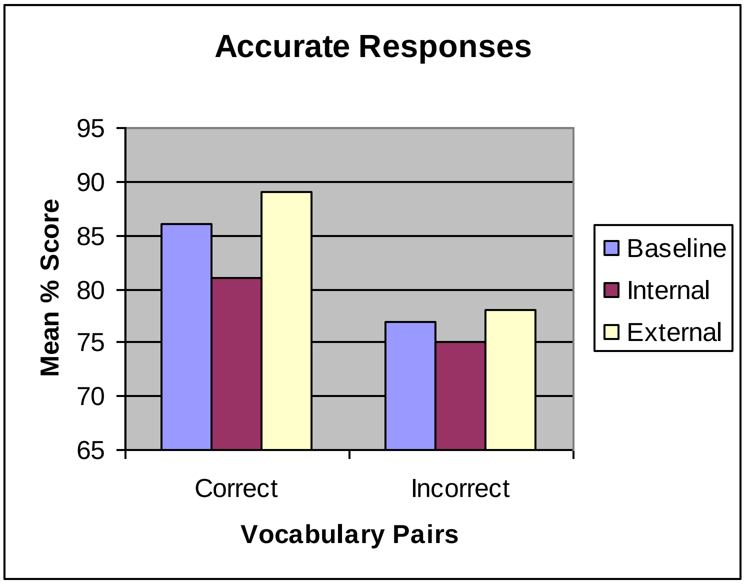
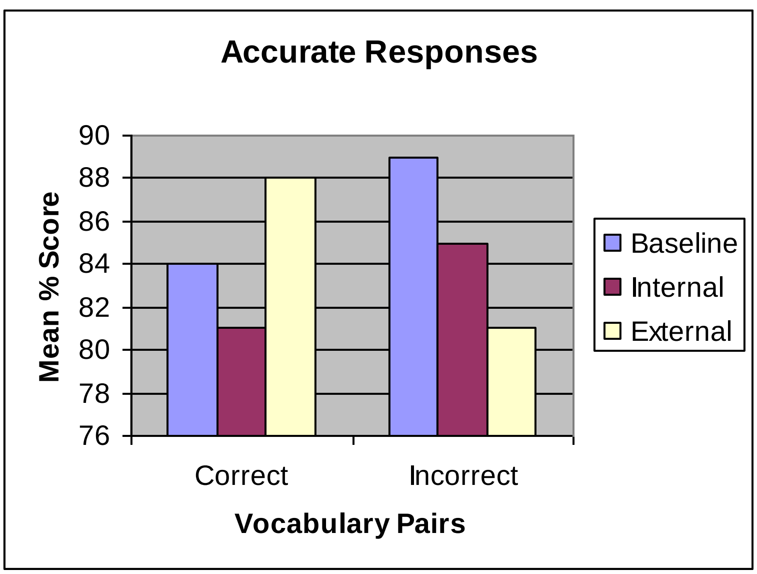


Figure 4-14: Summary of accuracy scores on VOC2 (Test 2)



4.3.3 Summary

The discussion of how baseline, internal-focus and external-focus groups perform in relation to correct and incorrect L2 trials has provided several relevant findings:

1) Learning outcomes are different depending upon correct and incorrect L2 exemplars – in most cases, accuracy is higher on correct exemplars;
2) Increasing the number of language trials influences learning outcomes regardless of FOA instruction;
3) No consistent pattern emerges with regard to the benefits of adopting one type of FOA instruction over any other vis-à-vis correct and incorrect L2 exemplars.

In the next section, a fine-grained analysis of learning outcomes in relation to the different grammatical categories tested in GJ1 and GJ2 will be presented.

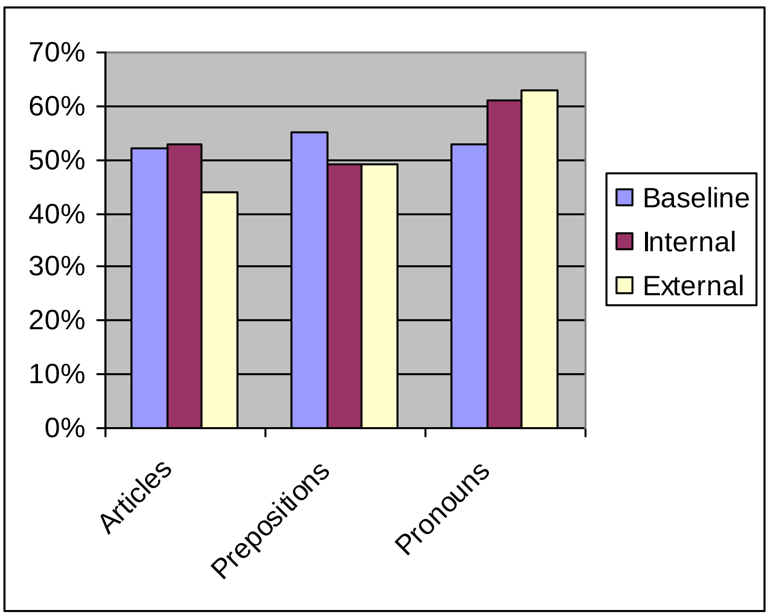
4.4 Linguistic Analysis

The linguistic analysis involves extracting each grammatical category from the data and calculating group performance in relation to that category. The objective of this analysis is to investigate whether FOA instructions have had an impact on particular categories of grammar more than others and to find out whether the external-focus instruction has interacted in a positive way in relation to any of the specific categories (H2) tested in this study.

4.4.1 Experiment 1

In the first experiment (GJ1), three grammatical categories were tested: prepositions, articles and pronouns. In Figure 4-15, the results of each instructional grouping in relation to the different grammatical categories tested, is presented. The mean scores are relatively close for each of the categories and in each case a different FOA group attained a higher score: Articles (internal-focus); Prepositions (baseline); and Pronouns (external-focus).

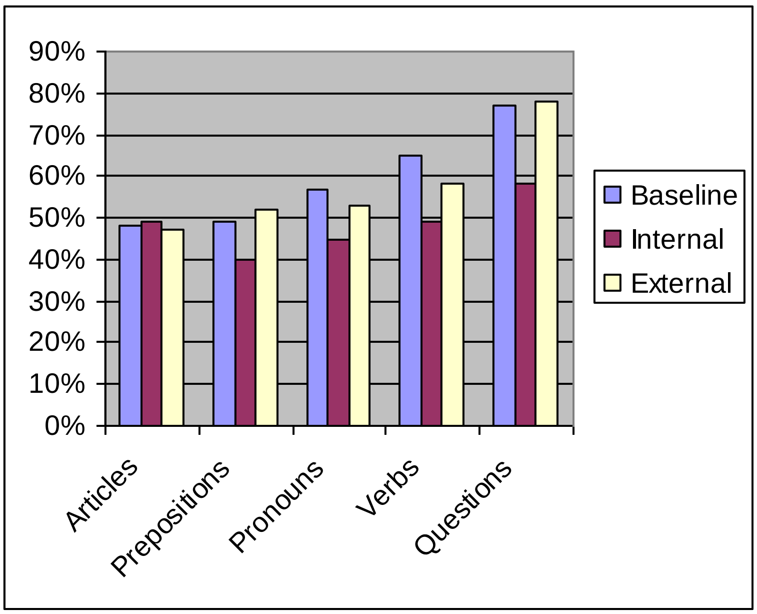
Figure 4-15: Summary of accuracy scores (GJ1)



4.4.2 Experiment 2

Figure 4-16 depicts the results for Sample Population 2. Evident from this depiction of the data is the upward slope depicting greater accuracy as a measure of increased practice. This is particularly striking with regard to the learning outcomes for both the baseline and external-focus groups. Both external and baseline groups reach a peak in Test 2, i.e. pronouns, verbs and questions. The internal-focus group also peaks highest in the questions category in Test 2. With the exception of the performance on articles, in all other grammatical categories, the external and baseline groups outperform the internal-focus group.

Figure 4-16: Summary of accuracy scores (GJ2)



It is interesting to note here that the learning outcomes for the baseline and external-focus groups are in most cases higher than the internal-focus group.

4.4.3 Summary

The results of the linguistic analyses reveal several trends which are summarised below:

- No consistent pattern emerges when comparing FOA groups on a smaller number of L2 language trials (GJ1);

- A consistent pattern emerges when the learning outcomes of FOA groups are compared on a larger number of L2 language trials (GJ2)
- The baseline and external focus groups are consistently better than the internal-focus group in most categories;
- The external-focus group perform better than the internal-focus groups on most categories (but are not better than baseline);
- The variability in group performance on the different grammatical categories tested in both experiments suggests that FOA instructions have some impact on learner performance;
- Practice on a higher number of trials (GJ2) results in better performance for all three instructional groups.

4.5 Overview

In this section, an overview of the findings is presented and the implications for SLL are discussed. Several patterns have emerged with regard to learning outcomes and the variables which influence these outcomes. Focus of attention is one variable. The results of the experiments provide evidence that other variables, such as type of language activity and number of language trials presented (i.e. opportunities for practice) are stronger predictors of L2 learning outcomes than FOA as far as grammaticality and vocabulary learning are concerned. The learning outcomes for each FOA groups are summarised in Table 4-1, in accordance with different learner categories:

Table 4-1: Summary of practice results (grammaticality experiments)

Learner Groups	**Baseline**	**Internal**	**External**
Sample Population 1			√
Sample Population 2	-	-	-
L1 French (Sample Population 1)			√
L1 French (Sample Population 2)	-	-	
L1 German (Sample Population 1)			√
L1 German (Sample Population 2)		√	
Level 1 (Sample Population 1)		√	
Level 1 (Sample Population 2)			√
Level 2 (Sample Population 1)			√
Level 2 (Sample Population 2)		√	
Total	0	3	5

Note: The tick mark (√) denotes that this is the group which excelled based on the mean accuracy score in comparison with the other two groups.
The dash mark (-) denotes that the groups attained equal scores and are not included in the total tally to avoid any confusion.

Table 4-2: Summary of test results (grammaticality experiments)

Learner Groups	**Baseline**	**Internal**	**External**
Sample Population 1			
Test		√	
Sample Population 2			
Test 1	-	-	
Test 2			√
L1 French (Sample Population 1)			
Test		√	
L1 French (Sample Population 2)			
Test 1		√	
Test 2		-	-
L1 German (Sample Population 1)			
Test			√
L1 German (Sample Population 2)			
Test 1	-		-
Test 2		√	
Level 1 (Sample Population 1)			
Test			√
Level 1 (Sample Population 2)			
Test 1	√		
Test 2		√	
Level 2 (Sample Population 1)			
Test		√	
Level 2 (Sample Population 2)			
Test 1		√	
Test 2	-		-
Total	1	7	3

The frequency tabulation in Tables 4-1 and 4-2 indicate that as far as grammaticality judgements are concerned, for L2 learners with an intermediate knowledge of the L2, adopting an FOA is more beneficial than following no instructions at all – i.e. baseline. Moreover, it would seem from this result that adopting an internal-focus of attention, i.e. focussing on the grammatical categories being tested in the GJ, is more beneficial than adopting an external-focus in the test. This result is not that surprising as it complies with other SLL studies which emphasise the importance of focus on form in L2 learning, i.e. Hulstijn, 1995; Long, 1991; and Robinson, 1997. On the other hand, it is interesting to note that the external-focus groups excel most under practice conditions. This recurring pattern discussed at earlier points in the thesis may be indicative that the effects of the external-focus instructions are more beneficial during training or at the initial stages of learning and warrants further investigation.

The totals presented in Table 4-1 show that the internal-focus instruction is beneficial to most learner groups with regard to attaining highest comparative accuracy on the GJ experiments. It also demonstrates the external-focus instructions are more beneficial than the baseline groups. Interestingly, the pattern demonstrates that adopting different FOA varies according to group, test type (test 1 vs. test 2) and according to condition (practice vs. test). It would not be prudent to claim that the variability is directly related to FOA as the statistical evidence does not support this hypothesis; nevertheless, the pattern does provide indications that the null hypothesis ($H_{0:}$ baseline = internal-focus = external-focus) cannot be rejected with full confidence.

In Tables 4-3 and 4-4, the mean accuracy results for each of the instructional groups are compared in accordance with practice and test in the vocabulary experiments.

Table 4-3: Summary of practice results (vocabulary experiments)

Learner Groups	Baseline	Internal	External
Sample Population 1			√
Sample Population 2	√		
L1 French (Sample Population 1)			√
L1 French (Sample Population 2)	√		
L1 German (Sample Population 1)			√
L1 German (Sample Population 2)		√	
Level 1 (Sample Population 1)	√		
Level 1 (Sample Population 2)	√		
Level 2 (Sample Population 1)		-	-
Level 2 (Sample Population 2)		√	
Total	4	2	3

Table 4-4: Summary of test results (vocabulary experiments)

Learner Groups	Baseline	Internal	External
Sample Population 1			
Test		√	
Sample Population 2			
Test 1	√		
Test 2	√		
L1 French (Sample Population 1)			
Test		√	
L1 French (Sample Population 2)			
Test 1	√		
Test 2	√		
L1 German (Sample Population 1)			
Test	√		
L1 German (Sample Population 2)			
Test 1			√
Test 2		√	
Level 1 (Sample Population 1)			
Test		√	
Level 1 (Sample Population 2)			
Test 1			√
Test 2			√
Level 2 (Sample Population 1)			
Test	√		
Level 2 (Sample Population 2)			
Test 1	√		
Test 2	√		
Total	8	4	3

In Table 4-4, the results indicate that the groups following baseline instruction attain higher average accuracy scores more frequently than the other two instructional groups. In second place comes the external-focus group followed by the internal-focus group who attain the lowest score. It would appear then, that for the initial stage of vocabulary learning, no instruction or self-generated instruction is more helpful than focussing on the spelling, i.e. the opposite to the grammaticality experiments. Although the differences between the groups does not reach significance, these results nevertheless indicate that FOA is an influential factor in the learning process.

Chapter 5: Conclusion and outlook

In this final chapter of the thesis there will be a discussion of the core aspects of this study in relation to the results of the language experiments. These aspects include firstly, the variables which are specific to the SLL domain, secondly, the issue of transfer and thirdly, the direction for future research. In the first section of this chapter the particular variables involved in SLL are discussed in relation to the findings. With regard to the aspect of transfer, this study, which is the first exploratory study of its kind, has served to highlight the benefits of exploring the transfer of learning models from one domain to another and to shed light on the strengths and limitations of conducting this type of research. In the section on future research, several suggestions will be made with regard to SLL research and finally with regard to the relevance that this type of research may have for the area of language teaching.

In order to explore how focus of attention, defined within the parameters of a motor learning research model, could be transferred and replicated in SLL a set of language experiments were designed to address empirical questions with respect to the relationship between the wording of instructions inducing different foci of attention and the impact on learning outcomes. Based on the assumption that ML and SLL share common cognitive processes in the development of learning, it was predicted that attentional focus would impact on language learners in a way that was similar to learners of motor skills, i.e. the adoption of different attentional foci impacts on learning (H1). This prediction was centred on the beneficial effects of external-focus instructions compared with internal-focus or no instructions at all (H2).

The findings of the study, however, are not clear cut. FOA instructions would appear to have some influence on L2 learning but other variables such as test type, learner proficiency and practice opportunities are stronger predictors of learning outcomes. Nevertheless, there is some statistical evidence in support of the hypothesis that attentional focus has an effect on language learners when specific conditions are met. These conditions are that the number of trials reaches at least 60 in the GJ experiment and 100 in the vocabulary experiment. Other important criteria are the complexity of the language trials as well as the size and make-up of the sample population tested. Thus, there are areas and applications which look promising for future research based on the empirical evidence provided by this exploratory study. Furthermore this study represents a unique way of finding out more about the processes and the findings motivate important questions for future research.

5.1 Second Language Learning Variables

In Chapter 1, (Section 1.1), the common ground between SLL and ML was examined and compared. Similarities between both fields were extrapolated and aligned in order to set the stage for this cross-linguistic study. The common points have been discussed throughout the thesis particularly in relation to presenting a justified rationale for the research and creating the experimental design. Some of the limitations have also been highlighted in relation to the assimilation and strength of instructions and the SLL variables which are irrelevant in the case of ML research, i.e. language in which instructions are presented. For example, the phenomenology of SLL, first mentioned in Chapter 1, (p. 72) is revisited and elaborated upon with specific examples related to the present study.

5.1.1 The phenomenology of SLL

Sharwood Smith (1993) pinpointed the difficulties encountered with regard to instructional treatments relating to attention[64]:

(a) The researcher cannot be sure that learners notice what is intended;
(b) It is difficult to ascertain where attention is being focussed during the experiment;
(c) It is unclear how or at what stage the learning effect can be effectively measured.

With regard to point (c), this is an important issue in relation to the difference between ML and SLL. It is possible, for example, that an L2 learner, who is making more production errors than on previous occasions, is providing evidence of improvement. As mentioned in Chapter 1, learners characteristically backslide and restructure, creating and testing new hypotheses as their interlanguage develops. More errors could, for example, signify, that the learner is taking greater risks (e.g. gaining confidence) and venturing into new linguistic territory, for example, trying out new syntactical structures. In addition to this natural variability in performance, learner development is not always characterised by immediate learning effects – it may be that the positive effects of the FOA instruction is not immediately quantifiable. It may be, for example, that the benefits of external-focus instructions are not immediately evident or indeed evident after one or two weeks. This study has provided some evidence that attentional focus affects learning outcomes when certain conditions are met in the short-term, but, further research is needed to provide empirical evidence of the effects of this approach to learning on, for example, long-term retention of vocabulary. The

[64] This study is related to input enhancement (See Section 1.3.2).

difficulty resides in controlling for other variables which may impact on learning outcomes such as the effects of practice and the possibility of exposure to the same language trials between experiments.

It is also to be noted that L2 learners vary in their preference for deductive versus inductive learning (Ellis, 1994), therefore, it could be inferred that some learners may prefer and work better under internal-focus instructions rather than external-focus instructions or *vice versa*. This preference is related to cognitive style, for example field independent learners versus field dependent, as discussed by Cook (2008). Furthermore the aspect of preference may depend on the type of language activity concerned whereas this aspect is not an issue in ML. In their review of ML studies, Wulf and Prinz (2001) refer to one study involving learning how to balance on a stabilometer in which volunteers could choose which type of focus to adopt - most of the participants chose external-focus instructions:

> […] individual differences do not play a significant role in the relative effectiveness of an external versus internal focus of attention. Rather, the benefits of an external focus appear to be more general in nature. (Wulf and Prinz, 2001: 649-650)

It is not certain whether this would be the case for language learners and whether the answers would hold for all types of language activity, for instance, learning new rules of grammar, writing an essay or speaking with a native speaker. A more tenable explanation is that different attentional foci are appropriate in each case. In SLL the focus of attention is necessarily divided by different types of tasks, different task demands and different learner preferences. L2 proficiency is a balancing act requiring attention to these different aspects:

> Attention must be balanced between forms and meanings, between letters and sounds, between words and sentences. (Bialystok,1994:160)

In the next section, the issue of implicit and explicit learning (discussed in Section 1.3.3) is returned to in order to incorporate the findings of this present study into the discussion.

5.1.2 Implicit and explicit learning

Paradis (cited in Ellis,1994) claims that morphosyntax is related to procedural memory[65]. If morphosyntax is related to procedural memory, then it would follow that instructions inducing implicit processing presumably will result in better performance on grammaticality tasks involving morphosyntactical issues. In the experiments presented here, the results are somewhat mixed. Accessing procedural memory would result in faster completion times in the GJ – this prediction is borne out with regard to GJ1 where the external group is faster (especially in the practice) compared with the other two groups. However, the same result is not replicated in GJ2 - the external-focus group is slightly faster than the other two groups in the practice, is the same as baseline on Test 1 (but still faster than internal-focus) and is more or less on a par with baseline in Test 2 (the internal-focus group are fastest in this case). With regard to accuracy, whereas the external-focus group predominantly excel in the GJ Practice (French and German speakers), there is no clear pattern vis-à-vis the results for the tests.

On the other hand, the findings presented in this study provide some evidence that vocabulary is learned implicitly. It is possible that baseline instructions are more akin to external-focus instructions in that they tap into implicit rather than explicit processes. Internal-focus instructions, on the other hand, are clearly related to explicit learning. In the light of the findings

[65] Proceduralization is a component of automaticity and infers faster, implicit processing.

presented in Chapters 3 and 4, it would appear that learning new lexical items is facilitated by implicit learning as both baseline and external-focus groups perform better in the vocabulary tests than the internal-focus group. However, these results are somewhat inconclusive as the difference between the groups does not reach statistical significance.

There are various levels or stages involved in vocabulary learning. In the present study, the first stage – vocabulary recognition – was tested within a short time-frame. The effects of retention over time were not measured in this study nor were other stages of learning, for example, the appropriate use of vocabulary in context. It may be that explicit learning processes are more appropriate at later stages of vocabulary acquisition, i.e. semantic mapping (Ellis, 1994). Thus, even within the same dimension of language learning, i.e. vocabulary, there are various learning processes involved at different stages and in different contexts.

As the discussion continues with regard to implicit and explicit learning in SLL – particularly with regard to adults - the view proposed in this study is that both types of processing are part of L2 learning and are qualified by such factors as degrees of analysis, learner preference, time constraints, proficiency and task type. Whereas external-focus instructions show benefits in all domains of ML tested – perhaps because of the more generally implicit nature of this type of skill learning - the benefits of this type of instruction do not generalise to all areas of SLL, at least to the extent that they have been tested in this present study. The L2 learner requires a balance of approaches:

> Metalinguistic and cognitive knowledge are as essential as communicative effectiveness; indeed they are crucial tools for allowing learners to follow an individual path of learning […]. (Denby *et al*. 1999: 68)

Since both elements – explicit and implicit learning – are essential parts of SLL, it is likely that external-focus instructions will show benefits in those aspects of L2 learning which engage implicit learning processes. As stated by Reber with regard to all complex skills:

> In the real world nearly all complex skills are acquired with a blend of the explicit and the implicit, a balance between the conscious/overt and the unconscious/covert. (Reber, 1989:224)

5.1.3 Summary

In this section the variables particular to SLL learning environments have been compared and contrasted with ML. This discussion centres on the differences between the two fields and thus is directly relevant to the transferability of the experimental design from SLL to ML. The discussion commences with regard to the difficulties involved in this type of SLL research. In addition to internal problems related to experimental design, i.e. ascertaining where attention is being focussed, the SLL researcher faces the thorny issue of assessing learning performance. L2 learner success is difficult to measure as inaccuracies may, in some cases, signify positive interlanguage development. Moreover, it is difficult to determine the optimum stage of testing as the positive effects of some instructional techniques may not surface until a much later stage. The success of instructions and teaching methods is also dependent upon learner preferences for one style over another and the variability in appropriateness of one style over another depending upon the aspect of language concerned.

With regard to implicit and explicit learning, the complex nature of SLL is highlighted and in particular, the difficulty of measuring these processes is examined. The findings of the language experiments are discussed within this context and contrasted with the ML findings. Whereas in the ML experiments, implicit learning is clearly related to success in performance, this does not apply in a general sense to SLL. Several points of interest concern the contrast between performance in the grammaticality and vocabulary experiments in relation to the implicit or explicit processes induced by the instructions. For example, as far as vocabulary learning is concerned, the groups following instructions inducing implicit memory processes – i.e. baseline and external-focus – reveal a more successful pattern of accuracy compared with the group following internal focus instructions, i.e. explicit instruction. However, although implicit learning may be more befitting during the first stage of vocabulary learning, it is possible that explicit learning may be more appropriate at later stages.

5.2 Factors Relating to Transfer

One of the arguments[66] voiced against the viability of this transfer model is that SLL involves far more cognitively complex operations than ML. However, Wulf's explanations for the advantages of an external over an internal focus of attention is proposed at a cognitive rather than a motor level. The advantage of external FOA instructions is directly related to automaticity (i.e. enhanced by external-focus) versus the constraint and restrictions to performance induced by adopting a consciously controlled internal focus. Although the essential differences between the two fields have been acknowledged from the outset, it is the points of inter-section which are explored in this study. The findings of this study reveal that there are limitations to transferring the ML model but equally there are also advantages. In each one of the sections which follow the positive outcomes

[66] This point was made at the Eurosla Conference (2008) following a presentation of this study. (See Kelly-Coll in the References section).

of the transfer as well as the shortcomings and incompatibilities between the two fields are outlined.

5.2.1 Experimental design

In this study, the four language experiments were devised in such a way as to emulate the ML experiments, but there are obvious differences in the set-up. For example, the language experiments comprised a practice and test condition both with FOA instructions and both at the same sitting. The language experiments involved learner exposure to new language trials – except in the case of the practice session – whereas in the ML experiments practice and test involved the same movement, e.g. short (90 second) repetitions of the task, e.g. balancing on the stabilometer or hitting tennis balls across a court. These are intrinsic differences between the two fields of learning and were thereby ruled out in the transfer. Repetitive practice on the same language trial throughout the experiment would be more in line with behaviourist models of learning such as the audio-lingual method (Section 1.3.4). The FOA instructions were delivered in written format and repeated in both practice and test in a bid to manipulate learner FOA as intended according to the instructional group the subject was assigned to. The repetition of the instructions in the SLL environment was motivated by the need to reduce – to the extent that is possible – learner tendencies to adopt or revert to their own cognitive styles.

Another issue related to the experimental design is that of feedback. As mentioned in Section 3.2, the addition of feedback may possibly have evoked an external-focus of attention for all treatment groups. Whereas in the SLL language experiments feedback was equal across groups (i.e. it was informative rather than directive); the feedback in the Shea and Wulf (1999) experiment was directive. In the SLL experiments, on the other hand, the feedback after each trial was informative and the final feedback at the end of the learning session included a reminder of focus. In this respect the SLL experiment was a closer replication of another ML experiment – Freedman *et al*.'s (2005) speech experiment. It is unclear in the language experiments whether the feedback did in fact produce the effect of focussing subject attention on the end goal, i.e. attaining a correct score, or arguably, that subjects were intrinsically focussed on the goal (i.e. success) regardless of the instruction that followed.

The addition of feedback in the SLL experiments to all groups may provide part of the explanation for the close mean accuracy scores – all groups attained relatively close mean scores in both the grammaticality judgement experiments and the vocabulary learning experiments. This variable needs to be further investigated in future research designs. For example, it would be interesting to compare FOA groups with and without feedback to investigate the interaction between feedback and FOA instructions in SLL.

5.2.2 Instructions

There are several possible reasons which provide explanations as to why the findings in this study did not replicate those derived from the ML studies. Some of these reasons may also be related to both the delivery and wording of the instructions. In the first instance, there are two aspects in relation to the delivery: the mode of delivery (oral versus written verbal messages), and the language of the delivery (L2 versus L1). The delivery mode for the instructions in the ML experiments involved the researcher(s) verbally instructing each individual subject whereas in the SLL experiments, with the exception of the phonology trial (Section 2.3.5), instructions were graphically displayed on a computer screen.

With regard to the language in which the instructions were delivered, this is a particularly crucial aspect vis-à-vis SLL. The L2 is commonly used as a medium for instruction in most SLL studies. Nevertheless, in some studies, the L1 is used, for example, in the post-hoc interview to obtain feedback from subjects in Pilot Trial 1 (Section 2.3.1). The questions remain, however, as to whether presenting the instructions in the subjects' L1 would have influenced the uptake of the instruction by the subjects and whether the mode in which the instructions were delivered influenced assimilation.

With regard to the wording chosen for the instructions, as mentioned in Chapter 2, every effort was made to align the instructions with those of the Wulf model and to present the instructions in as clear and uncomplicated a manner as possible in the L2. This was a particularly challenging objective with regard to the external-focus instructions in the case of both experiments. To meet the criteria of remoteness and task-relevance (i.e. based on the Wulf model) and to operationalise "the effect of an action on the environment" (Chapter 2: Section 2.1.2) in L2 language activities proved to be a very difficult task. On the other hand, operating the ML principles in the phonology experiment involved less difficulties in terms of finding equivalents and more difficulties in terms of technicalities (e.g. choice of software for the spectrogram; choice of artificial words for the content of the experiment) and resources (e.g. availability of research support staff). The comparative ease of transferring the ML experiments to the domain of phonology also marks the closeness of these fields relative to the more cognitive domains of grammar and vocabulary learning. As mentioned at the outset, the objective of the study was to attempt to transfer the ML model to the non-motor skill areas of SLL.

The findings of this study indicate that:

(a) The relatively greater difference between ML and non motor-skill elements of SLL may mean that operationalising the Wulf model involves finding equivalents for the external-focus instruction which refer to more distal effects than the instructions used in this study;
(b) More research is needed in the area of L2 pronunciation adapting the Wulf model;

Conversely, it may be that the subjects did understand the instructions and did follow them as intended by the researcher and the answer might, quite simply be that instructions relating to attentional focus have no bearing with regard to L2 learning. However, this is unlikely to be the case derived from the evidence provided in this study since the trends illustrated in the charts (Chapters 3 and 4) show a clear *albeit* not statistically significant, difference between treatment groups.

Nevertheless, it may be that the strength or impact of the instructions was weakened by the approach adopted in this study. For instance, it is possible that the instructions chosen for these experiments were inappropriate in terms of the degree of internal or external focus induced. During the development of the Wulf model of FOA, Wulf and her colleagues discovered that giving instructions with different degrees of external focus had a more immediate impact on learning outcomes. For example, with regard to the experiment involving balancing on a stabilometer (described in Section 1.2.1), the researchers found that giving instructions related to an increased distance from the original external-focus markers resulted in better performance. It would be interesting to find out whether transferring this aspect of the design to SLL would result in more significant differences between the treatment groups. The question is, though, how to replicate "increasing the distance" in terms of SLL instructions. (Some suggestions are offered in Section 5.3)

Another important difference between ML and SLL in relation to instructions is that in the ML experiments, the instructions are delivered verbally and enacted physically whereas in SLL, language is both the medium of delivery and enactment. This aspect reflects an essential differentiation between the two fields in terms of how the cognitive and motor or physical aspects are weighted and was discussed in Section 1.1.4. Evidently, the motor aspects – with the exception of the pilot trial in pronunciation – are not tested in the language experiments. The fact that only the cognitive aspects of ML are extricated for this study may also have a bearing on the results. This is an intrinsic difficulty related to all language research (Crystal, 1987; Seliger and Shahoma, 1989).

Finally, it would be worthwhile to also discuss the equally thorny issue of subject amenability to instruction in more general terms. As mentioned in Chapter 1, skills are regarded as open systems and therefore are malleable and can be developed, i.e. in response to instruction. However, assimilation of instructions and enactment following instruction is a complex issue (Section 1.1.4). How can a researcher know that the subject has followed the instruction as intended? What self-motivated strategies do subjects bring to the task? This is an issue which is crucial to both SLL and ML. Learners with more experience have built up their own learning strategies. Older learners are more inclined to adopt their own fail-safe way of doing things rather than taking a risk and trying a new way. Adult learners are particularly prone to these variables. It would be interesting to find out whether different outcomes would be found when conducting these experiments with younger or less experienced L2 learners. It is unclear, for example, whether other groups of L2 learners are more inclined to be reliant on instruction. For example, Wulf (1998) suggests that there may be more sensitivity to instructions when learning a new task compared with well-practised skills. This point ties in with the type of task selected for the experiments which will be discussed in the next section.

5.2.3 Task type

The language experiments conducted for this study can be classified according to two dimensions, firstly the dimension of condition: i.e. practice or test, and secondly, the content: i.e. the pre-test featuring multiple-choice grammar exercises, L2 grammaticality judgements and vocabulary recognition. Importantly, the findings of the four language experiments converge on the significant difference in individual performance based on task type. The statistical analyses provide evidence of strong individual variability in relation to the task and with respect to practice and test conditions.

The fact that task type is a significant factor in variability and ultimately, in learning outcomes above and beyond the effect of instructions administered to each group suggests that task type is a more reliable predictor of L2 success than is FOA – at least as far as grammaticality judgements and vocabulary learning is concerned. In general terms, the same learners performed much better in vocabulary learning (both practice and test) than in grammaticality judgements. Indeed, there was a vast difference between the scores on both types of experiment suggesting that learning new lexical items is much easier than judging the acceptability of L2 sentences. This is also an interesting finding as the vocabulary learning experiment involved an entirely different task than one the subjects might be familiar with. The artificial words were created exclusively for the experiment and were not viewed by any of the subjects prior to the experiments. The grammaticality judgement, on the other hand, is reminiscent of other grammar activities which the subjects would be familiar with, e.g. ESL materials. In addition, based on observation of the subjects during the experiments, they seemed to be far more motivated and enjoyed the fun aspect of the vocabulary experiment in comparison with the grammar.

The elements of newness, fun and motivation are to be honed and should be incorporated into any future research projects. First of all, evidently these aspects facilitate recruitment of volunteers which is important as large numbers are necessary for the sample for validation and reliability purposes. Secondly, it is important because it may allow the researcher to carry out longer or more challenging trials and to maintain the same group of volunteers over several sittings. As suggested earlier, it would be worthwhile to investigate the learning effect over time, for example, to carry out a post-test after 3 weeks or more. And, thirdly, these aspects can enhance the learning experience both from the point of view of the subjects and for the researcher(s)! Dealing with motivated learners facilitates the objective of re-testing subjects, for example.

5.2.4 Language learners

It would be interesting to devise L2 language experiments for other populations of L2 learners, e.g. a child population to investigate whether children would be more sensitive to attentional focus instructions. Birdsong (1994: 171) cites Newport's (1990) "less is more hypothesis" which claims that "the limited information processing capacities of children are an advantage, not a liability, in language learning". External-focus instructions may be more beneficial than internal-focus instructions for this group of learners and perhaps the learning outcomes would be more immediately observable than has been the case for the adult learners. Indeed, it could be proposed that Asher's TPR model is an example of one type of external-focus instruction which has proven to be successful amongst children in particular.

Equally valuable would be to look at expert groups such as translators and interpreters and to investigate whether instructions inducing different attentional focus have any bearing on experts working in highly stressful environments. It would be useful too to attest whether external-focus strategies are already being adopted in practical applications in this domain. In short, the direction of the research should be amplified to include other learner groups and other learning environments.

5.2.5 Summary

In this section, the findings of the present study and the issues related to transfer - experimental design, instructions, task type and language learners - have been discussed within the framework of this study. The discussion summarised some of the issues relating to the strengths and weaknesses of the current research model. Other issues have been raised in this section regarding the problematic of task familiarity and the possible unintentional effects of feedback. In addition, some suggestions for future research have been put forward which address the points raised in this section, for example, testing the FOA model on other learner populations. This area is further developed in the next section.

5.3 Future Research

As denoted by the title, this study is at an exploratory stage. The findings presented in this thesis represent the first endeavours to transfer and replicate the Wulf model in SLL. These preliminary findings do not present clear-cut answers to the research questions posed, for example, in most of the studies it was found that FOA instructions did not have a statistically significant effect on learning outcomes. However, there is some evidence which lends support to the main hypothesis of the study (H1), but not in support of the external-focus hypothesis (H2). As discussed thus far, these findings motivate important questions for future research in SLL and some suggestions are made here. In addition, it is important to note that ML research into FOA effects is ongoing and it is probable that more will be learned as this research develops and is tested in ever more diverse areas of human learning.

5.3.1 Research opportunities

In a future study, it would be interesting to explore rule-learning within the current research framework in order to investigate whether FOA instructions impact on learning and using new L2 rules. In this study subjects were tested on familiar grammatical features, such as the use of articles, prepositions and pronouns. A semi-artificial grammar could be created to test the learning of new rules. This experiment could include a quasi-experimental design with a classroom-based approach adopted for teaching the rules and a laboratory set-up for testing learning outcomes. Semi-artificial languages based on lesser-used languages are particularly apt for this type of research, e.g. Alanen's (1995) use of an artificial version of Finnish and Leonard-Cook's (2008) use of semi-artificial version of Persian. An artificial version of Gaelic could be crafted for a future study in Ireland. The utilization of semi-artificial languages enhances the validity of the research as they are based on natural language use as opposed to Reber's (1989, Reber *et al*., 1991) artificial languages which use strings of letters juxtaposed. In addition, by using a semi-artificial language, the researcher is less restricted with regard to research tools selected for the purposes of testing.

It would be worthwhile investigating the extent to which the mode of delivery influenced learning outcomes. Along the same lines, it would also be interesting to discover whether the mode of delivery influences subject uptake of the instruction – i.e. the strength of the instructions. It may be useful to explore whether subjects are more willing to follow instructions *verbatim* when the instruction is delivered verbally and individually to each subject. The aspect of human intervention could be investigated to find out whether verbal instructions facilitate uptake compared with following instructions displayed on a screen. Another aspect related to the assimilation of the instructions is familiarity with the task. For example, it would be interesting to find out the extent to which subjects follow or ignore instructions when they are familiar with a task. In the language experiments, several subjects expressed surprise when the instruction screens were repeated after the practice session. The application of eye-tracking technology could provide further insight into these aspects by testing whether different FOA instructions correlate with different focus.

The L1 is commonly used for think-aloud protocols (See Jourdanais, 2001 for a review). Think-aloud protocols are a psycholinguistic research tool which typically involves subjects recording their own thoughts as they carry out an experiment. Researchers gather the data and analyse it in order to find out what subjects were thinking about during the experiment, what strategies they adopted to deal with the task (e.g. mnemonic techniques for vocabulary learning), and to investigate whether subjects used metalinguistic rules to determine their answers. There are some limitations to using think-alouds, such as how the dual-task affects performance on the primary task and the reliability of subject’s comments. Nevertheless, it may be useful to use this tool in a future study for two main reasons: firstly, it might provide further information regarding uptake of the instruction as intended in the experimental set-up, and secondly, it could be incorporated into an experimental design to investigate whether an additional task (i.e. the protocol) externalises the subjects' focus of attention and what impact this might have on the overall learning outcome. After all, it could equally be argued that a think-aloud protocol invokes internal-focus since it entails conscious introspection while carrying out a task[67].

Possible suggestions for "increasing the distance" would be to direct the subject's focus of attention (via the instruction) away from the sentence level of analysis. For example, in the GJ, the external-focus instructions referred to whether the sentence required any changes and subjects were informed that they could either delete or add another word. A more distant approach would be to ask the subjects if they think that the sentence was said or written by a native speaker of the language or a non-native/language learner. Similarly, in the vocabulary experiment, instead of asking the subjects to think of an image of the word (e.g. in the learning phase of the experiment), they could be instructed to imagine that they have a photographic memory and to take a photo of the word. Further investigation along these lines could elucidate whether the small group differences resulting from these experiments were directly related to the degree of focus induced by the instructions.

To sum up, some ideas for future research include replication of the language experiments conducted in this study with variations, for example:

- Replicating the same experiments with different degrees – more distal – of FOA instructions;
- Comparing experiments conducted with and without feedback;

[67] From this point of view, a think-aloud protocol is not unlike Gallwey's (1982) example from tennis – if your opponent is winning, when changing courts, ask how s/he is performing such a great forehand. This will make your opponent think about the detail of their actions and possibly start to mess up.

- Finding out whether learners have a preference for internal or external focus instructions in SLL;
- Using eye-tracking techniques to attain more data on where learners focus their attention during the experiments and whether their FOA is significantly different in the three instructional treatments;
- Conducting a post-test three-weeks after the initial experiment;
- Adding more trials to both the GJ and VOC experiments to further investigate the relationship between number of trials and FOA;
- Replicate the GJ and VOC with the instructions in the L1 and or presented orally;

And, introducing new types of language experiments:

- Learning new grammar rules – using a semi-artificial language;
- Experimenting with different modes of delivering instructions (verbal, one-to-one);
- Experimenting with different learner groups;

Given the optimal results of pilot trial in phonology, further investigation should be encouraged. As pointed out in Chapter 2 (Section 2.3.5), these results are regarded as optimal within the framework of the Wulf model as not only was the effect of attentional focus on learner outcomes significant (H1), but also the external-focus instruction resulted in better performance (H2) compared with baseline and internal-focus. Indeed, consistent with Wulf's predictions, the internal-focus instruction appeared to have a negative impact on learner L2 pronunciation.

5.3.2 Implications for teaching

In the ML arena, the robust findings emanating from the Wulf model have strong implications for the teaching of sport as well as for therapeutic environments, such as speech and occupational therapy. Wulf (2007) claims that, in spite of the robustness of the research findings, the move towards applying the results remains slow. Nevertheless, the Wulf model is finding its way into third-level textbooks (Magill, 2007), which implies that, at least, for future generations of professionals working in the area of motor skills, this insightful approach to learning will be taken into consideration and perhaps applied in practical settings.

Given that the SLL research is still at an initial stage, the implications of this research for the training of language teachers and trainers is yet to be established. It is clear from the research carried out thus far that the implications for teaching are far-reaching since the core aspect of the research is related to the wording of instruction. Therefore, it may be expected that this research could lead to:

- Changes in classroom behaviour especially with regard to the language teacher. Whereas recent research findings in developing learner autonomy have contributed welcome and fruitful changes to pedagogical practices, the role of the teacher has been somewhat subsumed. This research brings the focus back to the role of the teacher and to the importance of how to direct learner’s attention in a way which facilitates rather than constricts learning;
- Changes to the presentation of instructions in text-books and other language learning materials;
- Changes in web-based teaching and learning media with an increased use of visualisation techniques.

5.3.3 Summary

In this section, the future direction and practical applications of this research are summarised. Drawing on the findings of this study reported in Chapters 3 and 4, and the discussion of these findings with regard to the Wulf model and the variables particular to SLL, several suggestions for future research have been catalogued. The direction of future research may involve a replication of the same experiments using different language learning groups and the application of contemporary technologies, such as eye-tracking. Equally, the direction may involve a revision of the current experimental design to examine more closely the variables of instructions (e.g. degrees of distance or mode of delivery), learning activity (e.g. phonology or learning new grammar rules) and testing conditions (e.g. feedback or post-testing or learner preference). The importance of researching the area of L2 pronunciation was also emphasised. Although a more detailed discussion on L2 pedagogy is not within the scope of this study, the important relationship and implications of FOA research on teacher training, materials and classroom techniques was also briefly discussed in this section.

5.4 **Outlook**

This study brings a new and unexplored research paradigm to the field of SLL. In Chapter 1, the recent research findings from the field of motor learning (ML) were introduced and discussed. The Wulf model which provides robust evidence for the beneficial effects of adopting an external-focus when learning or relearning motor-skills provided the launching pad for the language experiments described in this study. In particular, a recent study (Freedman et al., 2005 and 2007; Maas et al. 2008) investigating attentional focus with a view to improving current therapeutic treatments for individuals with apraxia of speech was found to be particularly relevant to the language learning domain. In addition, the research literature in cognitive science, psycholinguistics and more recently SLL, provided ample grounds for the exploration of learning from a more general cognitive perspective.

The study is characterised by:

(1) The large number of L2 learners (n = 140) from different L1 backgrounds tested;
(2) The methodological approach which was adapted from the Wulf model and current psycholinguistic methods used in SLL research;
(3) The methods, experimental design and instruments which were extensively tested (n = 163) prior to the experiments;
(4) The laboratory conditions and contemporary software technology used to ensure the reliability of the findings.

Given the cross-disciplinary nature of this research, some obstacles arose with regard to transferring the principles from the ML field of research to SLL. These obstacles were addressed in Chapter 2 and include, for example, the difficulty in determining external-focus instructions for the SLL areas explored in this study. Other difficulties arose from the phenomenological nature of language learning such as the variability and complexity of influences on learning outcomes, the variability in learner performance across different tasks, and the amenability of learners to instructions. The L2 learners tested in this study were intermediate learners of English and this factor rendered certain variables, in particular, learner history of exposure to the L2, difficult to control for in the grammar experiments. Every endeavour was made to take account of these limitations throughout the study. Despite the limitations, it is hoped that this study nonetheless provides an original contribution to current SLL research. The importance of instruction and attention in the learning processes involved in SLL, undoubtedly validate this argument. Furthermore, this study highlights the heuristic value of looking to other fields of learning to further research and to test new empirical questions in the domain of SLL.

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Appendices

Appendix A - Materials

A1- Pre-test

In each question, only one of the four answers is correct. Choose the correct answer and fill in the square next to it. Fill in only one square for each question. The example in the box shows you what to do.

This ____________ a book

- (●) is
- ( ) am
- ( ) be
- ( ) are

1: Tony is looking at _____

- ( ) she
- ( ) he
- ( ) here
- (●) her

2: What's that girl?

- ( ) It's a student.
- ( ) She's student
- ( ) She's a student girl.
- (●) She's a student.

3: 'Whose flowers are they?' 'They're ____________

- ( ) to Mary.
- ( ) of Mary.
- (●) Mary's.
- ( ) Maries.

4:

- ( ) Sally's sister pretty and they are too.
- (●) Sally's pretty and they are too.
- ( ) Sally's pretty and they're too.
- ( ) Sally's pretty but they are.

5:

- ( ) That girl is some of my friends.
- (●) This girl is one of my friends.
- ( ) This girl's are friends.
- ( ) That girl is me friend.

6: Where ________________ on Saturdays.

- ( ) do go John
- ( ) John goes
- ( ) John does go
- (●) does John go

7:

- Go there to they.
- Go there to them.
- Go here to us.
- Go here to we.

8: 'Do you like that shop?' 'Yes, I ___________ every week.

- come there
- come here
- go here
- go there

9: I feel very well because I went to bed very early ______________ .

- last night
- tonight
- in the night
- this night

10: My brother was __________________ all week.

- at the home
- at home
- in home
- in the home

11: James _______________ to play football tomorrow.

- is going
- can
- will
- shall

12: Jack is writing _____________

- with pen
- on paper
- out of a pen
- by a pen

13: This is an old photograph of me when I ______________________

- have short hairs.
- had short hairs.
- had short hair.
- had short hairs.

14: When we got to school, we ______________ the bell.

- heard
- were hearing
- were listening
- listened

15: 'Did you see the man on top of the church last Saturday?'
'No, why __________________________

- was he here?
- has he been here?
- has he been there?
- was he there?

16: This is _______________ that.

- the same as that
- the same that
- the different from
- different that

17: When ________________, give her this book.

- ○ Alison will arrive
- ○ is Alison arriving
- ◉ Alison arrives
- ○ Alison arrive

18:

- ○ What shoes are they made?
- ○ What shoes are made of?
- ○ What are made of shoes?
- ◉ What are shoes made of?

19: _____________ lovely food!

- ◉ What
- ○ Which a
- ○ What a
- ○ Which

20: I'm going to give _________________________ .

- ○ to him a record
- ◉ him a record
- ○ some record to him
- ○ a record him

21: How's the baby?

- ○ He's Alison's.
- ◉ She's very well.
- ○ She's a girl.
- ○ That's the baby.

22: His daughter is _____________________ .

- ◉ as old as yours
- ○ as old as your one
- ○ so old as your one
- ○ so old as yours

23:

- ○ Was the French women old?
- ○ Was the French women an old?
- ◉ Were the French women old?
- ○ Were the French women some old?

24: He has previously had a car but it _____________ several times during the spring.

- ○ was breaking down
- ○ was breaking up
- ◉ had broken down
- ○ had broken up

25: We ____________ my cousin since last Christmas.

- ○ aren't seeing
- ○ haven't seen
- ○ don't see
- ○ didn't see

2

1: There are twelve of us, so ____________ get into the car at the same time.

- ( ) we may not all
- ( ) all we may not
- ( ) all we can't
- (•) we can't all

2: Her children tell her that _____________ old to drive a car.

- ( ) she's getting so
- ( ) she gets too
- ( ) she gets so
- (•) she's getting too

3: When there's a public rocket service to the moon, her father has promised __________________ her there.

- ( ) bringing
- ( ) taking
- (•) to take
- ( ) to bring

4: _______________ at the moment, I'll go to the shops.

- ( ) As it doesn't rain
- ( ) For it doesn't rain
- ( ) For it isn't raining
- (•) As it isn't raining

5: In a shop ___________ customers.

- ( ) it is important pleasing
- (•) it is important to please
- ( ) there is important to please
- ( ) there is important pleasing

6: Your bicycle shouldn't be in the house! ______________________.

- ( ) Get out it!
- ( ) Put it off!
- ( ) Take away it!
- (•) Take it out!

7: He's a good guitarist, but he plays the piano __________ .

- ( ) quiet well
- (•) much better
- ( ) too hardly
- ( ) very good

8: Molly doesn't eat fish. ____________________

- ( ) John doesn't that either.
- ( ) So doesn't John.
- ( ) John doesn't too.
- (•) Neither does John

9: She always buys ___________ my birthday.

- ◉ something awful for
- ○ anything nice to
- ○ anything nice for
- ○ something awful to

10: She hardly ever eats _____________ potatoes.

- ○ neither bread nor
- ◉ bread or
- ○ neither bread or
- ○ or bread or

11: I ___________ to your letter of the 15th.

- ◉ would like to reply
- ○ like to reply
- ○ would like replying
- ○ am wanting to reply

12: Your letter _______________ .

- ○ has arrived two days ago
- ◉ arrived two days ago
- ○ has arrived since two days
- ○ arrived since two days

13: If I _____________ about it earlier I would have told you.

- ○ knew
- ○ would know
- ◉ had known
- ○ would have known

14: I'll ring you as soon as I _____________ there.

- ◉ get
- ○ shall get
- ○ will get
- ○ will have got

15: John Marshall is a friend of mine. You _______________ him last year when you were in England.

- ○ may meet
- ○ can meet
- ○ can have met
- ◉ may have met

16: He didn't thank me for the present. That's ___________ annoyed me.

- ◉ what
- ○ the which
- ○ that which
- ○ the thing what

17: I'll have to buy ___________ trousers.

- ○ two
- ○ a couple of
- ◉ a pair of
- ○ a

18: She looks _____________ .

- pleasantly
- that she's pleasant
- to be pleasant
- pleasant

19: I've been looking for you _____________.

- (•) everywhere
- for all places
- in all places
- anywhere

20: Send him to the baker's ____________ the bread.

- for buying
- (•) to buy
- for to buy
- in order he buys

21: He didn't know _____________ or go home.

- if to wait
- (•) whether to wait
- if that he should
- to wait

22: If you ________________ help you, you only have to ask me.

- (•) want me to
- want that I
- are wanting me to
- want I should

23: 'I'm going to the theatre tonight.' 'So ____________ .

- do I
- will I
- (•) am I
- I will

24: He wants to get a better __________ and earn more money.

- employ
- work
- employment
- (•) job

25: I didn't hear what he was ______________.

- speaking
- talking
- (•) saying
- telling

3

1: I wish I ____________ suggest something more suitable, but this is all we have.

- ( ) should
- ( ) can
- (•) could
- ( ) would

2: _____________ for her birthday.

- ( ) $50 they were given to her
- ( ) she was been given $50
- (•) She was given $50
- ( ) There were given to her $50

3: I __________________ since breakfast and I'm very tired.

- ( ) travel
- ( ) am travelling
- ( ) was travelling
- (•) have been travelling

4: His telegram said, 'I _______________ on the 7th.

- ( ) I will be arrive
- ( ) will be arrived
- (•) I am arriving
- ( ) would arrive

5: I don't think we've met before. You're confusing me with _____________.

- ( ) one other
- (•) someone else
- ( ) other person
- ( ) some other

6: __________________ open the door for you?

- ( ) Do you want that I
- ( ) Will I
- (•) Shall I
- ( ) Would you like that I

7: He _______________ in his homework.

- ( ) did a lot of faults
- (•) made a lot of mistakes
- ( ) did a lot of mistakes
- ( ) made a lot of faults

8: Will you be coming to the meeting? ____________________

- ( ) I'm afraid so.
- ( ) I'm sorry not.
- (•) I'm afraid not.
- ( ) I'm sorry that no

9: He was a good runner so he _____________ escape from the police.

- (•) was able to
- ( ) succeeded to
- ( ) could
- ( ) might

10: ________________ a good thing they didn't catch you.

- That's
- It's
- What's
- There's

11: That's the course of studies _____________ .

- I'm interested in
- what I'm interested on
- I'm interested on
- what I'm interested in

12: I would like _______________ it again.

- that you read
- you to read
- you reading
- you read

13: He came to the party. _____________ he hadn't been invited.

- in case
- even
- in spite of
- although

14: He didn't take the flat because he couldn't afford the _____________ .

- rent
- hire
- salary
- fare

15: He stayed under water for two minutes and then swam to the _______________ .

- sea
- level
- surface
- ground

16: She was sitting ____________ on the park bench.

- by herself
- for herself
- only herself
- in her own

17: We were in the station for at least half an hour waiting _________________ start.

- for the train
- the train to
- the train's
- for the train to

18: How long does the train take to _____________ to London?

- make
- reach
- get
- arrive

19: Everyone in the factory has to be _____________ by 8 o'clock.

- at work
- in job
- in work
- at job

20: We talked about a lot of things ____________ the way to the office.

- ( ) through
- (•) on
- ( ) by
- ( ) in

21: I ______________ you before now but I've been too busy.

- ( ) must have rung
- (•) should have rung
- ( ) had to ring
- ( ) ought to ring

22: My boss never gives me clear instructions. But you _________________ the same problems with yours too.

- (•) must have
- ( ) ought to have
- ( ) have to have
- ( ) can have

23: Dinner will be ready____________ but we have time for a drink before then .

- ( ) currently
- ( ) lately
- ( ) suddenly
- (•) presently

24: We have__________ for a new secretary but we haven't had any replies yet.

- ( ) announced
- ( ) advised
- (•) advertised
- ( ) noticed

25: 100 competitors had______________ the race.

- ( ) taken part
- (•) entered for
- ( ) put themselves for
- ( ) put their names for

4

1: I've ____________ for the job and I hope I get it.

- succeeded
- presented
- applied
- appointed

2: I never expected you to turn _____________ at the meeting. I thought you were abroad.

- in
- around
- up
- on

3: As far as he's concerned, one piece of music is very much like________________.

- an other
- one other
- other
- another

4: She was wearing _______________ beautiful clothes that I envied her.

- a so
- so
- such
- such a

5: I woke up in the middle of the night and couldn't _______________________ again.

- put myself to sleep
- get back to sleep
- put myself for sleeping
- get back to sleeping

6: I crossed the room and _____________________ a light shone through the window.

- while doing like that
- as I did like that
- as I did so
- at doing so

7: I wish I _______________ on the time the film started before we came out .

- would check
- had checked
- would have checked
- have checked

8: I'll ask the waiter for the bill when you _______________ your coffee.

- will have finished
- will finish
- have finished
- shall finish

9: There was a suitcase ____________ mine on the luggage rack.

- (•) like
- ( ) as
- ( ) similar than
- ( ) the same that

10: He ______________ out of the window for a moment and then went on working.

- ( ) regarded
- (•) glanced
- ( ) viewed
- ( ) glimpsed

11: I'd like to take ____________ of this opportunity to thank you all for your co-operation.

- (•) advantage
- ( ) occasion
- ( ) benefit
- ( ) profit

12: Our main concern is to raise voters' _____________ of living.

- ( ) condition
- (•) standard
- ( ) capacity
- ( ) degree

13: For heaven's ____________ , don't make a noise.

- ( ) behalf
- ( ) reason
- (•) love
- (•) sake

14: He reminds me ______________ someone I knew in the army.

- (•) of
- ( ) to
- ( ) from
- ( ) with

15: He was ________________ that he called the doctor.

- ( ) having such ache
- ( ) in such ache
- (•) in such pain
- ( ) with such pain

16: I daren't ____________ to upset her.

- (•) do anything
- ( ) to do something
- ( ) do nothing
- ( ) to do a thing

17: We've ___________ sugar. Ask Mrs. Jones to lend us some.

- ( ) run away with
- ( ) run down
- ( ) run off
- (•) run out of

18: I ___________ you that the goods will be delivered next week.

- ( ) confirm
- ( ) undergo
- (•) assure
- ( ) insist

19: The Second World War _____________ in 1939.

- (selected) broke out
- broke open
- broke up
- broke off

20: We can never relax in this office. New problems are continually ___________ .

- coming out
- (selected) coming up
- raising
- presents

21: This test _____________ a number of multiple-choice questions.

- composes of
- (selected) consists of
- composes in
- consists in

22: Hot metal _____________ as it grows cooler.

- (selected) contracts
- compresses
- reduces
- condenses

23: He thinks about nothing but playing golf. He's completely ____________ to it.

- overcome
- ascribed
- tempted
- (selected) addicted

24: He's always __________ the Government but he never votes in the elections.

- running out
- calling off
- running down
- (selected) calling out

25: I'm sorry to ______________ you while you're working but I must ask you a question.

- molest
- (selected) bother
- interfere
- intrude

A-2: Questionnaire

Questionnaire

SUBJECT Nº: ______________________________

Name: ______________________________

Email: ______________________________

Age: ______________________________

How many years have you been studying English?

____

What is your mother tongue?

____

What other languages or dialects do you speak fluently?

____

What other languages are you learning at the moment in addition to English?

____

Date of arrival in Ireland:

____

…………………………………………………………………………………

Thank you.

A-3: List of artificial words (Pilot Trial 4)

1. Accommodation = Tussodor
2. Animal = Arnacle
3. Automobile = Virporeter
4. Blade = Hanne
5. Building = Thanort
6. Car = Vip
7. Cat = Sook
8. Computer = Menide
9. Cottage = Herint
10. En-Suite = Pell
11. Feline = Harbinger
12. Food = Popsey
13. Garden Spade = Mubhannet
14. Guest-House = Tuss
15. Home = Heiloringe
16. Hotel = Hostellian
17. House = Linta
18. Keyboard = Lool
19. Laptop = Jig
20. PC = Nawker
21. Persian = Hassryian
22. Renault = Rayknow
23. Roof = Lintel
24. Shovel = Footnoose
25. Spa Hotel = Donk
26. Spade = Hannet
27. Tools = Noosies
28. Vehicle = Assorting
29. Wheel = Viple
30. Whiskers = Sookles

A-4: Cloze-test (Pilot Trial 4)

Subject No.: ___________

Practice Sentences before test:

1. There is smoke coming from the chimney on that __________________
2. When a black ________________ crosses your path, it's a sign of good luck.

Start time 11:

Vocabulary Test:

Fill in the gaps with an appropriate word from the artificial language words provided in the box:

RAYKNOW	DONK	MUBHANNET	POPSEY
TUSSODOR	NAWKER	LOOL	VIPLE
JIG	RANIP	HOSTELLIAN	VIP

1. I booked the _____________ on the web but when I arrived at my destination, they had no record of it.
2. My friend bought a new ____________ last year and she's already thinking of trading it in for a newer model.
3. The best place to buy a _________________________ is in the DIY store near the centre of the city.
4. Passengers are no longer allowed to use a _____________ during take-off or landing.
5. My ___________ is an absolute disaster – I've had to bring it to the garage this year at least five times to get it repaired.
6. The invention of the ________________________ was a landmark in the history of the human race.
7. Tourists are often surprised to find how expensive ______________________ is in Ireland.
8. There is something wrong with my _______________. I can't seem to write the letter [s]!
9. ________________ holidays are the most fashionable type of holidays in Hungary at the moment.
10. It's much better to seek the advice of a computer technician when something goes wrong with your _____________ rather than trying to fix it yourself.

A-5: L2 Sentences for GJ1 Practice

Grammatical Category	L2 Sentences
Preposition	He is thinking completing all the work by New Year.*
Article	He has a reputation for being a bit of a flirt.
Preposition	Last year I applied for a job at our local post office.
Pronoun	I'm going to give it him a present tomorrow for his birthday.*
Article	She would love to see the U2 in concert during her stay.*
Pronoun	She gave him the ring and he put it on.

A-6: L2 Sentences for GJ1 Test

Grammatical Category	L2 Sentences
Pronoun	The map was on the table so she handed to him.*
Pronoun	The birthday cake, when she emerged with it, was lopsided.
Pronoun	They promised to bring it to her in the afternoon.
Article	The Erasmus students were exhausted after their first week in Ireland.
Article	Afterwards, I went on to do the further studies in Art History.*
Article	I love the Mediterranean food, especially with a glass of wine!*
Article	Funding for a major investment has now been made available.
Preposition	They walked down some side streets to find an inviting restaurant.
Preposition	I'm going in Ireland next year to improve my English.*
Preposition	Lissadell house in Sligo is set 23 acres of land.*

* indicates incorrect sentences.

A-7:L2 Sentences for Pilot Trial 6 and GJ2 Practice

No.	Pronouns
1	I apologised for not contacting her before with my new address
2	She picked up the book and put away before the next class.*
	Articles
3	We have meetings on the last Tuesday of every month.
4	My chemistry teacher gave our class a surprise test the last Monday.*
	Prepositions
5	I'll look over your essay before you hand it in.
6	If you wish a reply, please email me as soon as possible.*
	Verb Tense
7	Last night, the old lady died peacefully in her sleep.
8	Yesterday as she was tidying, the books fell off into the shelf.*
	Questions
9	Have the guests been served their tea yet?
10	Will Harry be to blamed for the car accident?*

A-8: L2 Sentences for Pilot Trial 6 and GJ2 Test

No.	Pronouns
1	She took the picture and put it on the notice board.
2	A tornado usually touches down more than once before it disappears.
3	They promised to bring it to her in the afternoon.
4	They say that eating fruit is good for you.
5	My mother and I give each other a hard time.
6	Sharon quickly wrote out the cheque but didn't sign.*
7	The map was on the table so she handed to him.*
8	He took the ball and threw to Tom by mistake.*
9	I can't go to the supermarket until you give me the money to me.*
10	The student who she is in your class lives next door.*
	Articles
11	After a life like that he will go straight to hell.
12	They went to the library yesterday to study for the exams.
13	At the moment, Tom is reading a book in the bathtub.
14	I like going to the zoo with my children once a year.
15	The Erasmus students were exhausted after their first week in Ireland.
16	The physical beauty is something that doesn't last forever.*
17	The nature is under constant threat from climate change.*
18	I love the Mediterranean food especially with a glass of wine.*
19	I wanted to do further studies in history of Spain.*
20	I would like to buy big luxurious apartment before I'm thirty.*
	Prepositions
21	She lived on nothing but bananas and milk for a week.
22	It's too cold in winter to swim in the sea.
23	Our neighbours have been quarrelling for over a year.
24	She had to bring up her two daughters alone.
25	I applied for a job but was never called for an interview.
	Prepositions
26	He has worked for us ever since he left from school.*
27	This yellow plastic bottle gives off a weird smell out.*
28	When the firemen arrived, they climbed the ladder up.*
29	Sarah has been sitting in the waiting room hours.*
30	I am quite capable going there on my own.*
	Verbs
31	Angela is wearing the dress I gave her last year.
32	Mr. Murphy's son always hid his money under his mattress.
33	Kevin will go to the United States next year to study.
34	I requested that he be present at the funeral.
35	He is relocating to Dublin city later this month.
36	A bat flew our attic last night and I was scared.*
37	Unfortunately, Mrs Newport will is leaving the birthday party early.*
38	Tom working in his office on the tenth floor right now.*
39	The children playing in the garden till dark these days.*
40	The little boy is speaking to his teacher is about the zoo.*

	Questions
41	Do the students understand what they have to do?
44	Does Janet visit her parents often?
45	Are you really going to wear that dress tonight?
46	Is Sandra waiting for in the car?*
47	Will is Harry wearing his new shirt to the party?*
48	Janet swim in the race yesterday?*
49	John know the answer to that question?*
50	Did Bill dance to at the party last night?*
	Note: The asterisk (*) means that the sentence is not grammatical.

Adapted from Tarone (1985) and DeKeyser (2001).

A-9: Word-Pairs for Vocabulary Practice (VOC1)

1. treth = bottle
2. atuse = freedom
3. throp = voice
4. rense = learn
5. dilt = nurse
6. shile = cooker

A-10: Word-pairs used in the VOC1 Learning Phase (Test)

Abstract word-pairs	Non-abstract word-pairs
wuve = happiness roon = tasty honish = ugly gloont = love dax = hatred filk = sadness	smet = hotel pone = wheel lorp = car tibe = house toly = doctor pern = food

A-11: Word-pairs used in the VOC1: Test

Word-Pairs Tested	Correct Answer Correct = 1 Incorrect = 2
RIVE = FOOD	2
TOLY = DOCTOR	1
DREN = HAPPINESS	2
LORP = CAR	1
POM = WHEEL	2
RALP = HOUSE	2
DAX = HATRED	1
GLON = LOVE	2
ROON = TASTY	1
FILK = SADNESS	1
PERNT = UGLY	2
SMET = HOTEL	1

A-12: Word-Pairs for Vocabulary Practice (VOC2)

Word-pairs for first learning phase: **(Practice)**
TRETH = BOTTLE DILT = NURSE SHILE = COOKER RENSE = PHOTO ATUSE = TABLE THROP = FOOT ZINEF = ELEPHANT LARPH = PUPPY XOIL = COW FERX = ZEBRA

A-13: Word-Pairs tested in Vocabulary Practice (VOC2)

Word-pairs tested in Practice session	**Correct Answer** **1 = correct** **2 = incorrect**	**Error**
TRETH = BOTTLE	1	-
DILT = NURSE	1	-
SHILE = COOKER	1	-
RENSE = PHOTO	1	-
ATUSE = TABLE	1	-
THROP = FOOT	1	-
ZINEF = ELEPHANT	1	-
LARPH = PUPPY	1	-
XOIL = COW	1	-
FERX = ZEBRA	1	-
XOIL = ZEBRA	2	Wrong match
LARPH = NURSE	2	Wrong match
THROP = COW	2	Wrong match
ZINEF = COOKER	2	Wrong match
ZIMP = FOOT	2	Not on list
TRETH = CROW	2	Not on list
DAX = SAUCER	2	Not on list
RINSE = PHOTO	2	Wrong spelling
ATUSH = TABLE	2	Wrong spelling
THROF = FOOT	2	Wrong spelling

A-14: Word-Pairs for Vocabulary Test (VOC2)

Word-pairs for second learning phase: (Test)
SMET = HOTEL
PONE = WHEEL
LORP = CAR
TIBE = HOUSE
TOLY = CHAIR
PERN = FOOD
VAD = ROOF
RONE = TELEVISION
TRONISH = STICK
GLINET = GARDEN
SLEN = MOUSE
SILGE = THIEF
SKREN = FISH
ANOR = SNAKE
ZEAN = GIRL
ZEAS = BOY
FEN = CAT
LOLISIN = PLANT
TRILIST = DOG
BROST = FOX

A-15: Word-Pairs tested in Vocabulary Test 1 (VOC2)

Word-pairs tested in Test 1	**Correct Answer 1 = correct 2 = incorrect**	**Error**
SMET = HOTEL	1	-
PONE = WHEEL	1	-
LORP = CAR	1	-
TIBE = HOUSE	1	-
TOLY = CHAIR	1	-
PERN = FOOD	1	-
VAD = ROOF	1	-
RONE = TELEVISION	1	-
TRONISH = STICK	1	-
GLINET = GARDEN	1	-
GREL = TRAIN	2	neither word on list
ZEAN = WOMAN	2	English word not on list
RONA = PLANT	2	Artificial word not on list
WUVE = FLAT	2	neither word on list
LORP = PRESIDENT	2	English word not on list
ANORE = SNAKE	2	wrong spelling
ZEANE = GIRL	2	wrong spelling
GLINETH = GARDEN	2	wrong spelling
PONEY = WHEEL	2	wrong spelling
SMETH = HOTEL	2	wrong spelling

A-16: Word-Pairs tested in Vocabulary Test 2 (VOC2)

Word-pairs tested in Test 2	Correct Answer 1 = correct 2 = incorrect	Error
SLEN = MOUSE	1	-
SILGE = THIEF	1	-
SKREN = FISH	1	-
ANOR = SNAKE	1	-
ZEAN = GIRL	1	-
BROST = FOX	1	-
TRILIST = DOG	1	-
LOLISIN = PLANT	1	-
FEN = CAT	1	-
ZEAS = BOY	1	-
SMET = HOTEL	1	-
PONE = WHEEL	1	-
LORP = CAR	1	-
TIBE = HOUSE	1	-
TOLY = CHAIR	1	-
ZEAN = BOY	2	wrong match
FEN = PLANT	2	wrong match
LOLISIN = BOY	2	wrong match
TRILIST = CAT	2	wrong match
BROST = DOG	2	wrong match
BRIST = TREE	2	neither word on list
BERN = RADIO	2	neither word on list
SKRAN = FISH	2	artificial word not on list
NORY = SNAKE	2	artificial word not on list
ZEAN = BIKE	2	English word not on list
SMAT = HOTEL	2	wrong spelling
TOLN = CHAIR	2	wrong spelling
PARN = FOOD	2	wrong spelling
VOD = ROOF	2	wrong spelling
FON = CAT		wrong spelling

Appendix B - Qualitative Data

Table B-1: Summary of Qualitative Data for Baseline Group (Sample Population 1)

Subject	Gender	L1	Age	Years studying English
101	female	French	21	9
102	male	+	18	10
103	male	+	20	6
104	male	+	21	9
105	male	+	20	8
106	female	+	21	9
107	female	+	20	12
109	male	+	21	13
110	male	+	20	13
111	male	+	21	8
113	female	+	22	11
114	male	Italian	25	11
115	female	+	21	11
116	male	German	28	14
117	female	Dutch	19	9
118	male	German	24	10
119	female	+	23	9
120	female	+	26	11
121	male	+	23	12
122	male	+	21	12
123	male	+	28	12

Table B-2: Summary of Qualitative Data for Internal-focus Group (Sample Population 1)

Subject	Gender	L1	Age	Years studying English
202	male	+	21	10
203	female	+	20	8
204	female	+	20	10
205	male	+	20	9
206	male	+	20	8
207	female	+	19	9
209	female	+	22	10
210	female	+	20	11
211	male	+	20	9
212	male	+	20	9
230	male	+	21	8
213	male	German	25	14
216	female	+	23	13
217	male	+	25	13
221	male	+	25	12
222	male	+	20	9
225	female	+	27	14
226	female	Italian	21	11
227	female	+	20	11
229	female	German	25	11

Table B-3: Summary of Qualitative Data for External-Focus Group (Sample Population 1)

Subject	Gender	L1	Age	Years studying English
301	male	French	21	10
302	female	+	22	10
303	female	+	20	9
304	male	+	20	9
305	male	+	19	8
306	male	+	21	12
308	female	+	19	9
309	female	+	20	9
310	female	+	21	10
311	male	+	20	11
312	female	+	21	10
330	female	+	20	6
314	female	Dutch	20	12
315	female	German	20	9
316	female	+	32	12
317	female	+	20	10
318	female	Italian	23	9
319	female	+	23	10
320	female	Dutch	18	7
321	female	+	21	9
322	male	German	25	12
323	male	+	28	12
324	male	Romanian	21	11
325	female	+	20	14

Table B-4: Summary of Qualitative Data for Baseline Group (Sample Population 2)

Subject	Gender	L1	Age	Years studying English
1001	male	French	19	8
1002	male	+	20	9
1003	female	+	20	9
1004	female	+	20	9
1005	male	+	21	9
1006	female	+	21	10
1007	female	+	20	9
1008	male	+	20	9
1009	female	+	21	10
1010	female	+	20	8
1011	female	+	20	9
1012	female	+	21	10
1013	male	+	20	10
1014	female	German	24	10
1015	female	+	20	8
1016	female	+	25	9
1017	female	+	21	8
1018	male	+	22	12
1019	female	+	27	6
1020	female	+	21	7
1022	male	Italian	25	7
1023	male	German	25	7
1024	female	Spanish	21	5
1026	male	+	21	6
1028	male	Czech	21	10

B-5: Summary of Qualitative Data for Internal-focus Group (Sample Population 2)

Subject	Gender	L1	Age	Years studying English
2001	female	French	20	9
2003	male	+	20	10
2004	male	+	20	9
2006	male	+	18	9
2007	male	+	20	9
2008	female	+	19	9
2009	male	+	19	8
2011	female	+	20	8
2012	female	+	19	9
2013	female	+	20	9
2014	female	German	21	10
2017	female	+	23	11
2019	male	+	26	8
2021	female	Italian	22	6
2022	female	+	23	8
2023	male	Czech	22	12
2024	male	+	23	11
2025	male	German	28	8
2026	female	Dutch	20	6

B- 6: Summary of Qualitative Data for External-focus Group (Sample Population 2)

Subjects	Gender	L1	Age	Years studying English
3001	male	French	19	9
3002	female	+	21	10
3003	male	+	21	8
3004	female	+	20	9
3005	female	+	21	10
3006	male	+	20	9
3007	female	+	19	9
3008	male	+	20	10
3009	female	+	21	8
3010	male	+	20	9
3011	female	+	20	8
3012	female	+	20	9
3013	female	+	19	14
3014	female	German	21	10
3015	female	+	24	8
3016	male	+	24	7
3017	female	+	22	11
3018	female	+	20	11
3019	female	+	25	11
3020	male	+	27	11
3021	female	+	21	8
3023	female	+	25	11
3024	female	Spanish	21	10
3025	male	+	23	14
3027	male	Czech	24	8
3029	female	Dutch/Croatian	21	12

Appendix C - Results for Sample Population 1 (2007)

C-1: Summary of Results for Sample Population 1 (2007)

	Group	Mean	Std. Deviation	N
PreTest	Baseline	.6010	.14131	20
	Internal	.6210	.13718	21
	External	.6746	.12466	24
	Total	.6346	.13567	65
GJPractice	Baseline	.6745	.15195	20
	Internal	.7000	.15281	21
	External	.7238	.18168	24
	Total	.7009	.16256	65
GJTest	Baseline	.5300	.17199	20
	Internal	.5333	.17416	21
	External	.5083	.14421	24
	Total	.5231	.16083	65
VOCPractice	Baseline	.7690	.17589	20
	Internal	.7662	.15998	21
	External	.7725	.16190	24
	Total	.7694	.16312	65
VOCTest	Baseline	.7590	.16914	20
	Internal	.7533	.19093	21
	External	.7533	.19144	24
	Total	.7551	.18183	65

C-2: ANOVA Tests of Between-Subject Effects (repeated measures)

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	147.633	1	147.633	3638.011	.000	.983
Group	.022	2	.011	.270	.764	.009
Error	2.516	62	.041			

C-3: Individual and Group Mean Scores on Pre-Test (Baseline: GJ1)

Subjects	A1	A2	A3	A4	Pre-Test Total
	[25]	[25]	[25]	[25]	[100]
101	16	20	16	13	65
102	12	12	9	8	41
103	18	18	13	6	55
104	19	20	18	12	69
105	22	20	13	10	65
106	9	9	11	6	35
107	17	19	17	14	67
109	17	13	9	9	48
110	21	17	15	14	67
111	18	15	12	13	58
n = 10					
114	16	14	11	2	43
115	15	18	17	6	56
116	16	11	14	10	51
117	24	19	20	22	85
118	16	19	13	16	64
119	17	12	14	13	56
120	17	19	12	11	59
121	22	25	21	21	89
122	20	20	19	21	80
123	16	9	13	11	49
n = 10					
n = 20					**59**

C-4: Individual and Group Mean Scores on Pre-Test (Internal-focus:GJ1)

Subjects	A1	A2	A3	A4	Pre-Test Total
	[25]	[25]	[25]	[25]	[100]
202	22	18	10	16	66
203	18	14	13	0	60
204	17	17	12	0	61
205	10	7	9	10	36
206	20	19	20	0	79
207	17	20	17	13	67
208	14	19	11	8	52
209	19	19	14	10	62
210	13	15	12	7	47
211	21	18	15	14	68
212	19	19	19	17	74
230	10	11	12	0	44
n = 12					
213	13	12	15	11	51
216	22	24	23	22	91
217	19	18	19	13	69
221	17	13	8	12	50
222	22	14	15	13	64
225	17	14	19	18	68
226	24	22	20	14	80
227	20	19	17	15	71
229	0	10	12	0	44
n = 9					
n = 21					**62**

C-5: Individual and Group Mean Scores on Pre-Test (External-focus:GJ1)

Subjects	A1	A2	A3	A4	Pre-Test Total
	[25]	[25]	[25]	[25]	[100]
301	21	19	16	7	63
302	20	12	13	10	55
303	13	18	9	9	49
304	19	17	12	11	59
305	19	18	12	8	57
306	19	19	13	9	60
308	21	23	20	14	78
309	17	20	17	13	67
310	20	19	14	9	62
311	18	15	11	0	59
312	16	17	18	0	68
330	23	20	19	17	79
n = 12					
314	22	24	22	23	91
315	19	14	12	5	50
316	23	19	18	16	76
317	19	21	20	16	76
318	0	16	0	0	64
319	0	13	0	0	52
320	23	18	18	19	78
321	21	21	19	18	79
322	19	19	17	18	73
323	15	14	12	11	52
324	22	21	19	0	83
325	22	23	22	0	89
n = 12					
n = 24					**64**

C-6: Individual Scores for the Baseline Group (GJ1)

Subjects	Pre-Test Total	GJ Practice	GJ Practice	GJ Test
	[100]	[6]	No. of cycles	[10]
101	65	47	5.0	40
102	41	83	1.0	40
103	55	67	1.0	60
104	69	50	2.0	50
105	65	83	1.0	60
106	35	50	3.0	50
107	67	83	1.0	20
109	48	67	1.0	50
110	67	67	1.0	80
111	58	58	2.0	40
n = 10				
114	43	44	3.0	50
115	56	50	2.0	60
116	51	75	2.0	80
117	85	100	1.0	90
118	64	83	1.0	50
119	56	67	1.0	50
120	59	58	2.0	40
121	89	83	1.0	70
122	80	67	2.0	50
123	49	67	1.0	30
n = 10				
n = 20	**63**	**70**	**1.70**	**52**

C-7: Response Times for the Baseline Group (GJ1)

Subjects	Start	Finish	Practice Time	Start	Finish	Test Time
101	46984	255330	208346	288881	355359	66478
102	53477	105252	51775	154419	247121	92702
103	35474	71867	36393	87645	161740	74095
104	44405	147127	102722	167717	245132	77415
106	34666	435813	401147	487956	579251	91295
107	38365	84365	46000	112381	198172	85791
109	36436	73315	36879	91714	162321	70607
110	31534	68673	37139	86677	154566	67889
111	29839	91693	61854	127020	182650	55630
114	51730	163642	111912	188667	268294	79627
115	37058	112543	75485	133870	192156	58286
116	30011	98649	68638	111672	168343	56671
117	32617	72935	40318	96711	161157	64446
118	41824	90574	48750	113614	192795	79181
119	74428	115176	40748	150882	239386	88504
120	40547	154384	113837	183584	276845	93261
121	41215	79448	38233	101381	168198	66817
122	98685	198224	99539	226884	300623	73739
123	43319	92020	48701	115850	186297	70447
n=20			**85544**			**75967**

C-8: Individual Scores for the Internal-focus Group (GJ1)

Subjects	Pre-Test Total [100]	GJ Practice [6]	GJ Practice No. of cycles	GJ Test [10]
202	66	67	2.0	70
203	60	58	2.0	40
204	61	67	2.0	60
205	36	50	5.0	40
206	79	100	1.0	70
207	67	67	1.0	30
208	52	67	1.0	30
209	62	42	2.0	60
210	47	67	1.0	40
211	68	58	4.0	30
212	74	83	1.0	60
230	44	61	3.0	50
n = 12				
213	51	67	1.0	60
216	91	83	1.0	100
217	69	67	1.0	60
221	50	67	1.0	60
222	64	50	3.0	50
225	68	100	1.0	50
226	80	83	1.0	70
227	71	83	1.0	60
229	44	83	1.0	30
n = 9				
n = 21	**62**	**70**	**1.71**	**53**

C-9: Response Times for the Internal-focus Group (GJ1)

Subjects	Start	Finish	Practice Time	Start	Finish	Test Time
202	42151	132996	90845	158403	251472	93069
203	61940	168753	106813	202032	294317	92285
204	37402	121560	84158	137943	214918	76975
205	51957	289690	237733	338962	403815	64853
206	43714	73704	29990	91000	147468	56468
207	59395	109730	50335	149665	242256	92591
208	51405	101157	49752	129751	193221	63470
209	53268	151378	98110	181314	256560	75246
210	45759	90831	45072	107199	164830	57631
211	36918	212880	175962	232367	309405	77038
212	43168	90479	47311	109247	203037	93790
213	39307	97642	58335	134553	235735	101182
216	55639	109952	54313	131855	215158	83303
217	45381	91492	46111	117459	200016	82557
221	52543	105677	53134	133979	224464	90485
222	59676	190170	130494	211481	278312	66831
225	52580	96375	43795	125352	210787	85435
226	43307	100789	57482	120751	191806	71055
227	54730	96841	42111	121128	204230	83102
229	56727	109750	53023	135190	225204	90014
230	58713	245576	186863	280935	377862	96927
n=21			**82940**			**80681**

C-10: Individual Scores for the External-focus Group (GJ1)

Subjects	Pre-Test Total	GJ Practice	GJ Practice	GJ Test
	[100]	[6]	No. of cycles	[10]
301	63	58	2.0	50
302	55	67	1.0	50
303	49	58	2.0	40
304	59	83	1.0	50
305	57	83	1.0	40
306	60	100	1.0	50
308	78	67	1.0	40
309	67	58	2.0	40
310	62	100	1.0	50
311	59	75	2.0	50
312	68	50	3.0	50
330	79	67	1.0	50
n = 12				
314	91	100	1.0	90
315	50	67	1.0	70
316	76	67	2.0	80
317	76	100	1.0	50
318	64	40	8.0	30
319	52	56	3.0	60
320	78	83	1.0	40
321	79	83	1.0	50
322	73	100	1.0	50
323	52	67	1.0	70
324	83	50	2.0	40
325	89	58	2.0	30
n = 12				
n = 24	**67**	**72**	**1.78**	**51**

C-11: Response Times for the External-focus Group (GJ1)

Subjects	Start	Finish	Practice Time	Start	Finish	Test Time
301	39108	131843	92735	167507	255874	88367
302	62441	103304	40863	133176	217814	84638
303	60673	150255	89582	183039	259117	76078
304	55843	89851	34008	118306	175999	57693
305	66092	112984	46892	148180	202301	54121
306	66632	120950	54318	207475	312305	104830
308	38193	87040	48847	107920	208541	100621
309	38374	102388	64014	123604	167779	44175
310	43590	83429	39839	108246	177123	68877
311	50250	119832	69582	139140	180212	41072
312	34910	171579	136669	212506	289176	76670
314	31479	65334	33855	85525	144036	58511
315	40667	80219	39552	101706	168489	66783
316	46755	130145	83390	160576	236334	75758
317	50745	81352	30607	107320	162951	55631
318	42663	350193	307530	376944	447203	70259
319	35847	192867	157020	228626	321231	92605
320	71079	133942	62863	177253	250947	73694
321	87265	131424	44159	152160	220542	68382
322	55606	93989	38383	118292	200738	82446
323	64551	93734	29183	118454	179300	60846
324	51399	141861	90462	173924	241027	67103
325	34933	101522	66589	125058	183600	58542
330	26760	62248	35488	79224	137207	57983
N=24			**73296**			**69990**

C-12: Individual Scores for the Baseline Group (VOC1)

Subjects	Voc Practice	Voc Practice	Voc Test
	[20]	No. of cycles	[30]
101	67	1	92
102	56	3	67
103	83	1	67
104	44	3	92
105	100	1	67
106	83	1	67
107	67	1	58
109	67	1	92
110	83	1	58
111	83	1	83
n = 10			
114	100	1	67
115	39	3	33
116	83	1	83
117	100	1	92
118	100	1	100
119	67	1	67
120	83	1	100
121	67	1	67
122	83	1	83
123	83	1	100
n = 10			
n = 20	**77**	**1.30**	**76**

C-13: Response Times for Vocabulary Experiment (Baseline: VOC1)

Subjects	Start	Finish	Practice Time
101	265805	289772	23967
102	154681	278407	123726
103	157075	180684	23609
104	180588	295651	115063
105	177864	201079	23215
106	390511	415246	24735
107	328918	356869	27951
109	361732	387619	25887
110	79361	101197	21836
111	249913	275256	25343
114	285946	314457	28511
115	201924	283730	81806
116	172014	194109	22095
117	224225	247425	23200
118	219186	246145	26959
119	306594	343777	37183
120	255229	283165	27936
121	315894	345526	29632
122	260347	287130	26783
123	292152	320967	28815
n=20			**47238**

C-14: Individual Scores for the Internal-focus Group (VOC1)

Subjects	Voc Practice	Voc Practice	Voc Test
	[20]	No. of cycles	[30]
202	100	1	92
203	67	1	83
204	67	1	83
205	100	1	100
206	83	1	83
207	67	1	58
208	67	2	100
209	83	1	75
211	100	1	83
212	67	1	75
230	42	2	58
n = 11			
213	83	1	92
216	100	1	83
217	83	1	100
219	67	1	92
221	67	1	67
222	67	1	67
225	83	2	50
226	83	1	25
227	50	2	50
229	83	1	83
n = 10			
n = 21	**77**	**1.19**	**75**

C–15: Response Times for Vocabulary Experiment (Internal-focus: VOC1)

Subjects	Start	Finish	Practice Time	Start	Finish	Test Time
202	212254	241198	28944	392745	456200	63455
203	309318	374676	65358	529391	591245	61854
204	205781	232037	26256	391011	443890	52879
205	161999	184558	22559	325796	370576	44780
206	143941	164308	20367	211139	253266	42127
207	128526	153118	24592	254173	303100	48927
208	164272	226750	62478	366010	421032	55022
209	126164	146164	20000	236066	282481	46415
211	73284	92883	19599	139121	187552	48431
212	192620	233435	40815	426599	486758	60159
213	171461	198421	26960	347207	402059	54852
216	179648	206058	26410	351093	403826	52733
217	178079	204318	26239	354908	403692	48784
221	135761	168620	32859	317574	402467	84893
222	191788	211644	19856	289595	333994	44399
225	130799	209469	78670	278907	331897	52990
226	120320	152912	32592	218239	269166	50927
227	72502	134725	62223	158100	203747	45647
229	218735	270429	51694	386986	465672	78686
230	186166	375764	189598	564898	687425	122527
n = 21			**42722**			**55658**

C-16: Individual Scores for the External-focus Group (VOC1)

Subjects	Voc Practice	Voc Practice	Voc Test
	[20]	No. of cycles	[30]
301	83	1	75
302	83	1	100
303	100	1	75
304	100	1	100
305	58	2	58
306*	100	-	75
308	100	1	75
309	83	1	25
310	61	3	83
311	83	1	92
312	67	1	83
330	83	1	100
n = 12			
314	83	1	92
315	58	2	75
316	100	1	83
317	67	2	92
318	58	2	58
319	46	4	58
320	83	1	50
321	58	2	67
322	100	1	100
323	83	1	67
324	83	1	67
325	67	1	58
n = 12			
n = 24	**77**	**1.48**	**75**

*Number of cycles data missing for subject 306

C-17: Response Times for Vocabulary Experiment (External-focus: VOC1)

Subjects	Start	Finish	Practice Time	Start	Finish	Test Time
301	110432	133455	23023	211741	257244	45503
302	154760	186503	31743	315107	379953	64846
303	162057	188808	26751	299605	364723	65118
304	84235	105456	21221	158597	200857	42260
305	93487	175321	81834	241608	294659	53051
308	131431	155047	23616	270420	332146	61726
309	47390	68094	20704	106781	147788	41007
310	221384	337446	116062	507539	561666	54127
312	427344	455359	28015	598188	658123	59935
314	185661	209405	23744	366202	417992	51790
315	256585	318888	62303	433877	492404	58527
316	207401	242201	34800	405462	465637	60175
317	208361	291320	82959	443157	493012	49855
318	162853	215108	52255	277186	323616	46430
319	214231	350740	136509	452114	503985	51871
320	236984	287799	50815	395557	451172	55615
321	231108	311618	80510	389473	446720	57247
322	191555	215619	24064	370304	423072	52768
323	210596	239555	28959	399135	455965	56830
324	141046	163622	22576	234469	297683	63214
325	135943	158967	23024	229220	275491	46271
330	147898	170042	22144	246969	288232	41263
n = 22			**46256**			**53610**

Note: response times data missing for subjects 306 and 311.

C-17: Summary of Response Times for GJ1 and VOC1 (Practice and Tests)

	Group	Mean	Std. Deviation	N
GJ Practice	Baseline	85544.75	85319.193	20
	Internal	82940.10	55956.752	21
	External	73296.82	62541.679	22
	Total	80399.48	67781.273	63
GJ Test	Baseline	75967.10	13691.046	20
	Internal	80681.29	13254.161	21
	External	69990.14	13929.345	22
	Total	75451.30	14133.767	63
VOC Practice	Baseline	47238.10	57424.468	20
	Internal	42722.00	38091.755	21
	External	46255.95	33442.462	22
	Total	45389.76	43141.573	63
VOC Test	Baseline	56591.65	12857.132	20
	Internal	55658.29	17450.736	21
	External	53610.41	7510.800	22
	Total	55239.46	13022.725	63

C-18: Tests of Between-Subjects Effects (ANOVA repeated measures)

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	1037341997411.454	1	1037341997411.454	465.612	.000	.886
Group	1529508452.940	2	764754226.470	.343	.711	.011
Error	133674540999.060	60	2227909016.651			

C-19: Summary of Number of Cycles GJ1 and VOC1 (Practice)

	Group	Mean	Std. Deviation	N
GJ Practice	Baseline	1.70	1.031	20
	Internal	1.71	1.146	21
	External	1.78	1.506	23
	Total	1.73	1.238	64
VOC Practice	Baseline	1.30	.733	20
	Internal	1.19	.402	21
	External	1.48	.790	23
	Total	1.33	.668	64

Appendix D - Results for Sample Population 2 (2008)

D-1: Summary of Results for Sample Population 2

	Group	Mean	Std. Deviation	N
PreTest	Baseline	.6069	.16121	26
	Internal	.6005	.14273	19
	External	.6364	.13862	25
	Total	.6157	.14718	70
GJPractice	Baseline	.7027	.08911	26
	Internal	.6968	.10827	19
	External	.6968	.07192	25
	Total	.6990	.08799	70
GJTest 1	Baseline	.5250	.10794	26
	Internal	.5289	.14464	19
	External	.5120	.11482	25
	Total	.5214	.11965	70
GJTest 2	Baseline	.6369	.10635	26
	Internal	.6432	.08988	19
	External	.6544	.11034	25
	Total	.6449	.10246	70
VOCPractice	Baseline	.8173	.10129	26
	Internal	.7832	.12601	19
	External	.7812	.11508	25
	Total	.7951	.11297	70
VOCTest 1	Baseline	.8115	.12985	26
	Internal	.7289	.16186	19
	External	.8020	.11409	25
	Total	.7857	.13677	70
VOCTest 2	Baseline	.8635	.08597	26
	Internal	.7842	.15421	19
	External	.8164	.11150	25
	Total	.8251	.11937	70

D-2: ANOVA Table of Tests of Between-Subject Effects

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	233.207	1	233.207	6515.768	.000
Group	.062	2	.031	.871	.423
Error	2.398	67	.036		

a Computed using alpha = .05

D-3: Individual and Group Mean Scores on Pre-Test (Baseline Group: GJ2)

Subjects	A1	A2	A3	A4	Pre-Test Total
	[25]	[25]	[25]	[25]	[100]
1001	22	23	21	14	80
1002	17	15	16	12	60
1003	15	19	12	10	56
1004	19	14	15	10	58
1005	12	17	15	11	55
1006	19	12	12	8	51
1007	16	16	11	8	51
1008	14	11	10	7	42
1009	12	12	4	3	31
1010	18	19	0	0	74
1011	18	12	12	0	56
1012	17	16	13	15	61
1013	9	8	9	7	33
1021	16	12	10	13	51
n = 14					**54**
1014	18	21	22	19	80
1015	24	23	22	21	90
1016	21	21	22	20	84
1017	19	20	16	18	73
1018	19	22	15	15	71
1019	18	10	16	10	54
1020	16	18	20	12	66
1022	17	15	16	13	61
1023	13	10	9	13	45
1024	22	23	16	18	79
1026	10	11	9	7	37
1028	22	18	21	18	79
n = 12					**68**
n = 26					**61**

D-4: Individual and Group Mean Scores on Pre-Test (Internal-focus:GJ2)

Subjects	A1	A2	A3	A4	Pre-Test Total
	[25]	[25]	[25]	[25]	[100]
2001	22	17	20	17	76
2003	19	14	10	14	57
2004	18	17	13	9	57
2005	19	16	9	5	49
2006	17	11	12	11	51
2007	15	15	10	13	53
2008	14	14	7	7	42
2009	10	11	10	7	38
2011	21	15	0	0	72
2012	16	15	15	14	60
2013	14	16	14	11	55
N = 11					55
2014	21	20	22	17	80
2017	18	20	20	15	73
2019	19	16	15	14	64
2021	18	15	14	9	56
2022	13	13	8	6	40
2023	17	21	19	19	76
2024	21	17	21	18	77
2025	13	10	5	10	38
2026	20	17	20	19	76
N = 9					**64**
N = 26					**60**

D-5: Individual and Group Mean Scores on Pre-Test: External-focus: GJ2)

Subjects	A1	A2	A3	A4	Pre-Test Total
	[25]	[25]	[25]	[25]	[100]
3001	20	17	20	13	70
3002	21	18	13	12	64
3003	15	18	14	7	54
3004	17	16	15	9	57
3005	19	16	14	10	59
3006	14	14	13	11	52
3007	16	17	18	10	61
3008	14	11	8	10	43
3009	12	8	10	7	37
3011	10	14	11	0	47
3012	20	16	14	0	66
3013	17	16	15	8	56
n = 12					**55**
3014	19	21	22	18	80
3015	21	22	23	21	87
3016	21	16	21	19	77
3017	20	18	20	18	76
3018	15	20	16	13	64
3019	16	14	17	8	55
3020	19	16	13	16	64
3021	14	13	14	0	56
3023	20	22	19	16	77
3024	16	12	10	7	45
3025	21	22	17	16	76
3027	22	20	22	18	82
3028	23	19	22	21	85
n = 13					**71**
n = 25					**63**

D-6: Individual Scores for the Baseline Group (GJ2)

Subject	Pre-Test Total	GJ Practice	GJ Practice	GJ Test 1	GJ Test 2	GJ Total
	[100]	[10]	No. of cycles	[20]	[30]	[50]
1001	80	70	1.0	60	70	65
1002	60	70	1.0	35	57	46
1003	56	63	3.0	50	70	60
1004	58	90	1.0	50	73	62
1005	55	70	2.0	40	53	47
1006	51	70	2.0	45	53	49
1007	51	55	4.0	50	67	59
1008	42	80	2.0	50	57	54
1009	31	70	1.0	40	53	47
1010	74	57	4.0	40	60	50
1011	56	70	1.0	60	53	57
1012	61	60	2.0	45	70	58
1013	33	57	4.0	40	50	45
1021	51	70	1.0	45	40	43
n = 14	**54**	**68**	**2.1**	**46**	**59**	**53**
1014	80	90	1.0	65	73	69
1015	90	80	1.0	55	80	68
1016	84	70	1.0	60	73	67
1017	73	70	1.0	45	63	54
1018	71	75	2.0	75	77	76
1019	54	60	2.0	65	77	71
1020	66	75	2.0	70	70	70
1022	61	70	2.0	60	63	62
1023	45	70	1.0	50	63	57
1024	79	70	1.0	70	77	74
1026	37	65	2.0	55	47	51
1028	79	80	1.0	45	67	56
n = 12	**68**	**73**	**1.4**	**60**	**69**	**64**
n = 26	**61**	**70**	**1.7**	**53**	**64**	**59**

D-7: Response Times for the Baseline Group (GJ2)

Subject	Start	Finish	Practice Time	Start	Finish	Test 1 Time	Start	Finish	Test 2 Time
1001	35398	109796	74398	137379	303391	166012	313055	528665	215610
1002	36965	114836	77871	143923	318176	174253	329696	573116	243420
1003	38344	250741	212397	273141	430867	157726	449779	672815	223036
1004	50418	140894	90476	174669	348071	173402	362455	613966	251511
1005	39274	214501	175227	244148	416384	172236	427903	635882	207979
1006	41641	196549	154908	222788	411552	188764	424224	669930	245706
1007	52727	307202	254475	328977	464670	135693	473550	660042	186492
1008	51556	171058	119502	197265	367534	170269	379790	624312	244522
1009	56508	126250	69742	154345	326356	172011	346948	606764	259816
1010	68118	397132	329014	435867	608071	172204	619942	876431	256489
1011	78729	162535	83806	190646	314499	123853	325058	511037	185979
1012	40044	158616	118572	177096	315525	138429	323059	533420	210361
1013	60220	358964	298744	403154	575245	172091	586285	813527	227242
1014	44873	130326	85453	157673	322528	164855	332032	579128	247096
1015	98471	150278	51807	168886	286595	117709	297587	465167	167580
1016	68508	133563	65055	168682	316151	147469	333239	578387	245148
1017	39742	104589	64847	127548	264649	137101	274953	481380	206427
1018	37436	174729	137293	203912	352276	148364	363924	597822	233898
1019	37197	195450	158253	216441	372119	155678	381910	624994	243084
1020	58757	216176	157419	244624	426074	181450	444394	687059	242665
1021	42614	116085	73471	179956	366929	186973	382513	648765	266252
1022	63003	229447	166444	274918	459698	184780	472962	745996	273034
1023	39677	126666	86989	154058	322085	168027	342996	579405	236409
1024	30557	94203	63646	116586	257078	140492	265621	463119	197498
1026	42604	139881	97277	159257	249078	89821	258390	387634	129244
1028	62382	144860	82478	175868	388518	212650	406342	701295	294953
n=26			**128829**			**159704**			**228517**

D-8: Individual Scores for the Internal-focus Group (GJ2)

Subjects	Pre-Test Total	GJ Practice	GJ Practice	GJ Test 1	GJ Test 2	GJ Total
	[100]	[10]	No. cycles	[20]	[30]	[50]
2001	76	80	2.0	60	77	69
2003	57	70	1.0	65	50	58
2004	57	80	1.0	45	50	48
2005	49	75	2.0	40	57	49
2006	51	70	1.0	30	60	45
2007	53	60	4.0	45	57	51
2008	42	53	3.0	40	60	50
2009	38	63	4.0	75	57	66
2011	72	70	1.0	60	57	59
2012	60	70	2.0	30	77	54
2013	55	63	3.0	50	67	59
n = 11	**55**	**69**	**2.2**	**49**	**61**	**55**
2014	80	90	1.0	60	73	67
2017	73	70	1.0	65	57	61
2019	64	90	1.0	60	70	65
2021	56	70	1.0	35	67	51
2022	40	80	1.0	40	77	59
2023	76	70	1.0	65	60	63
2024	77	50	2.0	45	60	53
2025	38	60	2.0	55	73	64
2026	76	65	2.0	80	73	77
n = 9	**64**	**72**	**1.3**	**56**	**68**	**62**
n = 20	**60**	**70**	**1.8**	**53**	**64**	**58**

D 9: Response Times for the Internal-focus Group (GJ2)

Subject	Start	Finish	Practice Time	Start	Finish	Test 1 Time	Start	Finish	Test 2 Time
2001	37411	188046	150635	206574	359144	152570	371864	591680	219816
2003	55006	122989	67983	148269	327595	179326	339611	594231	254620
2004	40485	106434	65949	128338	259580	131242	267468	440980	173512
2005	51526	229298	177772	257746	449839	192093	465679	695867	230188
2006	59189	134772	75583	163635	337793	174158	349137	599422	250285
2007	57142	317233	260091	346368	478429	132061	493885	689401	195516
2008	63973	293087	229114	315694	475882	160188	489321	680628	191307
2009	104690	382319	277629	428366	606796	178430	619100	850792	231692
2011	96020	166931	70911	194771	349409	154638	364896	615421	250525
2012	42503	187125	144622	214421	348707	134286	360179	566272	206093
2013	40356	223456	183100	249807	377548	127741	388396	583528	195132
2014	43799	115606	71807	138102	277636	139534	286692	457682	170990
2017	53938	132351	78413	159246	321287	162041	332023	554077	222054
2019	57110	140548	83438	168852	374255	205403	392511	676073	283562
2021	54598	110485	55887	131348	272850	141502	282130	488414	206284
2022	183682	283872	100190	333007	795525	462518	819205	1109134	289929
2023	47557	113300	65743	138676	283250	144574	298338	517503	219165
2024	60246	204963	144717	235650	365567	129917	381295	585674	204379
2025	106819	284894	178075	330669	514376	183707	538231	789904	251673
2026	43709	223482	179773	250426	407767	157341	419911	629427	209516
n=20			**133072**			**172163**			**222811**

D-10: Individual Scores for the External-focus Group (GJ2)

Subjects	Pre-Test Total	GJ Practice	GJ Practice	GJ Test 1	GJ Test 2	GJ Total
	[100]	[10]	No. cycles	[20]	[30]	[50]
3001	70	75	2.0	55	63	59
3002	64	50	4.0	55	53	54
3003	54	80	1.0	50	77	64
3004	57	65	2.0	50	57	54
3005	59	65	2.0	50	67	59
3006	52	75	2.0	50	67	59
3007	61	70	2.0	50	70	60
3008	43	57	3.0	35	57	46
3009	37	70	2.0	35	57	46
3011	47	70	2.0	35	43	39
3012	66	70	1.0	30	63	47
3013	56	60	2.0	35	60	48
n = 12	**55**	**67**	**2.1**	**44**	**61**	**53**
3014	80	65	2.0	55	80	68
3015	87	70	1.0	60	80	70
3016	77	75	2.0	50	63	57
3017	76	80	1.0	50	70	60
3018	64	70	2.0	60	53	57
3019	55	70	2.0	60	63	62
3020	64	70	1.0	65	57	61
3021	56	70	1.0	35	63	49
3023	77	70	1.0	70	80	75
3024	45	65	2.0	55	53	54
3025	76	80	1.0	70	77	74
3027	82	70	1.0	55	73	64
3028	86	80	1.0	65	90	78
n = 13	**71**	**72**	**1.4**	**58**	**69**	**64**
n = 25	**63**	**70**	**1.7**	**51**	**65**	**58**

D-11: Response Times for the External-focus Group (GJ2)

Subject	Start	Finish	Practice Time	Start	Finish	Test 1 Time	Start	Finish	Test 2 Time
3001	43631	182221	138590	207708	346618	138910	352602	566312	213710
3002	57266	327471	270205	349134	497580	148446	512556	746905	234349
3003	79413	163923	84510	193107	374289	181182	391184	658125	266941
3004	42627	181199	138572	210205	371496	161291	384952	619312	234360
3005	60949	204080	143131	224335	378810	154475	389370	612018	222648
3006	53708	187783	134075	211975	373825	161850	388800	594617	205817
3007	56804	171520	114716	222094	358394	136300	375673	599601	223928
3008	74529	309320	234791	353478	539903	186425	549887	805573	255686
3009	69232	225899	156667	252122	415044	162922	426884	655628	228744
3011	94017	258955	164938	285898	471187	185289	479603	729177	249574
3012	108788	172339	63551	193618	373776	180158	394895	646668	251773
3013	56161	181901	125740	206236	339688	133452	352104	548402	196298
3014	48422	186596	138174	212324	344642	132318	354178	526143	171965
3015	46478	123995	77517	150458	300822	150364	310053	516959	206906
3016	62963	229873	166910	256961	453279	196318	480382	774123	293741
3017	50060	123211	73151	149322	311656	162334	323192	565763	242571
3018	55731	221709	165978	253868	439397	185529	452245	719260	267015
3019	68564	233839	165275	259918	462807	202889	472919	718911	245992
3020	58886	119956	61070	139012	321055	182043	331247	580809	249562
3021	75763	139026	63263	164289	298255	133966	311695	523531	211836
3023	42934	115012	72078	138259	296815	158556	307550	502713	195163
3024	77590	221411	143821	263395	407409	144014	419745	651949	232204
3025	51973	131844	79871	154963	305233	150270	316641	526797	210156
3027	49171	136674	87503	173169	308334	135165	326190	541513	215323
3028	37686	103781	66095	125445	272003	146558	281779	444881	163102
n=25			**125207.7**			**160441**			2275746

D-12: Individual Scores for the Baseline Group (VOC2)

Subject	Voc Practice	Voc Practice	Test 1	Test 2	Test
	[20]	No. of cycles	[20]	[30]	Total
1001	90	1	85	90	88
1002	95	1	95	93	94
1003	90	1	95	80	88
1004	75	1	70	93	82
1005	85	1	75	90	83
1006	75	1	95	80	88
1007	100	1	65	77	71
1008	85	1	90	90	90
1009	80	1	55	73	64
1010	60	3	85	80	83
1011	70	1	75	87	81
1012	80	1	85	97	91
1013	95	1	85	83	84
1021	90	1	85	83	84
n = 14	**84**	**1.14**	**81**	**85**	**83**
1014	85	1	95	100	98
1015	80	1	85	83	84
1016	85	1	75	93	84
1017	68	2	65	70	68
1018	90	1	95	93	94
1019	85	1	85	90	88
1020	80	1	95	93	94
1022	62	3	80	97	89
1023	70	1	50	67	59
1024	75	1	95	90	93
1026	85	1	85	93	89
1028	90	1	65	80	73
n = 12	**80**	**1.25**	**81**	**87**	**84**
N= 26	**82**	**1.19**	**81**	**86**	**84**

D-13: Response Times for the Baseline Group (VOC2)

Subjects	Time	Start	Finish	Time	Start	Finish	Time
1001	88125	864822	949668	84846	963380	1070513	107133
1002	106638	820519	903878	83359	915125	1008932	93807
1003	122046	873300	980754	107454	994434	1138576	144142
1004	91133	810816	928396	117580	946827	1093462	146635
1005	94478	793242	894071	100829	907814	1026819	119005
1006	89134	816637	900379	83742	910827	1009576	98749
1007	85503	800118	885892	85774	897012	1000594	103582
1008	105006	836722	929248	92526	942511	1067373	124862
1009	98045	961059	1068080	107021	1076895	1217803	140908
1010	348486	1264890	1358455	93565	1371591	1498212	126621
1011	103344	971668	1064049	92381	1073425	1199278	125853
1012	98653	648881	740271	91390	748286	860283	111997
1013	112493	837737	943014	105277	956933	1084178	127245
1014	95421	790823	879972	89149	893091	993120	100029
1015	96398	885998	966397	80399	981756	1080538	98782
1016	109711	932156	1030250	98094	1050618	1182887	132269
1017	291130	1056101	1165379	109278	1177587	1302528	124941
1018	84670	844204	930186	85982	941274	1067175	125901
1019	119549	850800	940046	89246	946430	1054492	108062
1020	118861	893826	1000335	106509	1020478	1159755	139277
1021	115166	929963	1042745	112782	1061657	1230103	168446
1022	361464	1210364	1332505	122141	1361784	1501797	140013
1023	128285	885098	1000375	115277	1014359	1191986	177627
1024	111261	493680	585645	91965	597997	708057	110060
1026	113836	815036	941096	126060	951400	1095988	144588
1028	108093	865519	970364	104845	983612	1113849	130237
n = 26	**130651**			**99134**			**125799**

D-14: Individual Scores for the Internal-focus Group (VOC2)

Subjects	Voc Practice [20]	Voc Practice No. of cycles	Test 1 [20]	Test 2 [30]	Test Total
2001	100	1	95	97	96
2003	68	2	75	53	64
2004	85	1	75	67	71
2006	75	1	95	97	96
2007	52	3	50	50	50
2008	70	1	70	70	70
2009	65	1	55	73	64
2011	90	1	75	80	78
2012	95	1	55	83	69
2013	70	1	75	80	78
n = 10	**77**	**1.3**	**72**	**75**	**74**
2014	85	1	85	87	86
2017	85	1	90	100	95
2019	80	1	70	87	79
2021	58	5	40	50	45
2022	85	1	95	93	94
2023	70	1	65	80	73
2024	80	1	60	77	69
2025	90	1	70	73	72
2026	85	1	90	93	92
n = 9	**80**	**1.44**	**74**	**82**	**78**
N = 19	**78**	**1.37**	**73**	**79**	**76**

D-15: Response Times for the Internal-focus Group (VOC2)

Subjects	Start	Finish	Practice Time	Start	Finish	Test1 Time	Start	Finish	Test2 Time
2001	281335	379860	98525	815844	898129	82285	909505	1013101	103596
2003	308881	553326	244445	1000824	1106023	105199	1113463	1241077	127614
2004	290713	367078	76365	807571	873169	65598	888544	982044	93500
2005	277275	385625	108350	839873	971967	132094	990335	1197931	207596
2006	263349	354260	90911	818142	916333	98191	927612	1046811	119199
2007	280046	608167	328121	780195	867361	87166	878257	989199	110942
2008	301513	424902	123389	740669	840378	99709	851642	990822	139180
2009	368646	463717	95071	921759	1010014	88255	1018110	1129916	111806
2011	299513	407095	107582	867297	956288	88991	962784	1078686	115902
2012	273770	365705	91935	805923	911505	105582	924001	1047952	123951
2013	264753	357551	92798	788437	881858	93421	894530	1007903	113373
2014	274224	366542	92318	802249	892775	90526	905447	1015734	110287
2017	309792	410540	100748	850282	944950	94668	954309	1076736	122427
2019	325489	448767	123278	920932	1058194	137262	1075169	1227870	152701
2021	449583	922551	472968	1213090	1289761	76671	1294465	1426223	131758
2022	330902	438068	107166	935097	1029607	94510	1051975	1168548	116573
2023	263281	370400	107119	826185	921992	95807	941064	1074006	132942
2024	371396	477057	105661	934134	1022052	87918	1034132	1148993	114861
2025	273661	374538	100877	841469	955002	113533	966666	1111158	144492
2026	167851	287817	119966	523428	614723	91295	628259	756048	127789
n = 20			**139380**			**96434**			**126024**

D-16: Individual Scores for the External-focus Group (VOC2)

Subjects	Practice	Practice	Test 1	Test 2	Test
	[20]	No. of cycles	[20]	[30]	Total
3001	95	1	75	87	81
3002	80	1	90	97	94
3003	70	1	65	77	71
3004	90	1	85	83	84
3005	90	1	70	70	70
3006	68	2	95	93	94
3007	75	1	55	63	59
3008	65	1	75	83	79
3009	80	1	85	87	86
3011	65	2	90	87	89
3012	75	1	70	60	65
3013	90	1	85	73	79
n = 12	**79**	**1.16**	**79**	**79**	**79**
3014	68	2	75	70	73
3015	95	1	85	87	86
3016	95	1	90	87	89
3017	90	1	85	87	86
3018	60	2	85	87	86
3019	85	1	80	97	89
3020	57	3	70	63	67
3021	85	1	80	80	80
3023	80	1	90	93	92
3024	85	1	90	90	90
3025	70	1	55	63	59
3027	70	1	80	87	84
3028	70	1	100	90	95
N = 13	**78**	**1.30**	**82**	**83**	**83**
N=25	**78**	**1.23**	**80**	**81**	**81**

D-17: Response Times for the External-focus Group (VOC2)

Subjects	Start	Finish	Practice Time	Start	Finish	Test 1 Time	Start	Finish	Test 2 Time
3001	274377	350232	75855	562661	628692	66031	636628	721843	85215
3002	209042	311088	102046	743579	843785	100206	856041	967079	111038
3003	233220	326803	93583	785404	868875	83471	880907	1005993	125086
3004	278026	367495	89469	798089	896150	98061	905446	1012259	106813
3005	279127	395619	116492	826212	922785	96573	932976	1060460	127484
3006	290690	490714	200024	941466	1034135	92669	1050198	1164802	114604
3007	232290	335150	102860	479497	562886	83389	572982	721233	148251
3008	322307	443406	121099	899613	1008121	108508	1025480	1167059	141579
3009	206023	305300	99277	528764	622953	94189	629976	738581	108605
3010	249257	335878	86621	594062	669228	75166	677259	777096	99837
3011	264530	521384	256854	985510	1090290	104780	1101474	1232285	130811
3012	298239	391422	93183	532732	614714	81982	627370	735049	107679
3013	235180	329705	94525	515939	598609	82670	611808	722557	110749
3014	227795	409233	181438	705197	792332	87135	804668	909402	104734
3015	302051	399376	97325	848626	936448	87822	953327	1067883	114556
3016	257997	346956	88959	802343	897878	95535	908694	1033925	125231
3017	322203	406970	84767	847922	935249	87327	945200	1056127	110927
3018	321410	577161	255751	1036409	1147125	110716	1163988	1306143	142155
3019	295306	389559	94253	857560	972484	114924	979684	1113632	133948
3020	224207	607045	382838	809792	919262	109470	928254	1066090	137836
3021	285564	380858	95294	823875	916305	92430	927569	1032975	105406
3023	318520	442325	123805	895704	998757	103053	1014405	1146337	131932
3024	303692	438874	135182	904644	1010018	105374	1034258	1197983	163725
3025	221530	310537	89007	742065	826640	84575	837776	984973	147197
3027	295706	403064	107358	866606	956957	90351	965292	1076826	111534
3028	260044	356123	96079	767397	860772	93375	880676	1003314	122638
n = 26			**129382**			**93453**			**121907**

D-18: Summary of Response Times for GJ2 and VOC2

Group	Test	Mean	Std. Deviation	N
Baseline	GJPractice	128829	74469	26
	GJTest1	159704	25998	26
	GJTest2	228517	35526	26
	VOC Practice	130651	76428	26
	VOC Test 1	99134	13001	26
	VOC Test 2	125799	21068	26
	Total	145439	62827	156
Internal	GJPractice	133071	69670	20
	GJTest1	172163	71977	20
	GJTest2	222811	32773	20
	VOC Practice	139379	98297	20
	VOC Test 1	96434	16709	20
	VOC Test 2	126024	23780	20
	Total	148314	71189	120
External	GJPractice	125207	54074	25
	GJTest1	160440	21471	25
	GJTest2	227574	30010	25
	VOC Practice	129382	71324	26
	VOC Test 1	93453	11697	26
	VOC Test 2	121906	17996	26
	Total	142443	58268	153
Total	GJPractice	128749	65654	71
	GJTest1	163473	42846	71
	GJTest2	226578	32509	71
	VOC Practice	132617	80324	72
	VOC Test 1	96332	13723	72
	VOC Test 2	124455	20625	72
	Total	145175	63638	429

D-19: Summary of Number of Cycles GJ2 and VOC2 (Practice)

Group	Test	Mean	Std. Deviation	N
Baseline	GJPractice	1.77	.992	26
	VOC Practice	1.19	.567	26
	Total	1.48	.852	52
Internal	GJPractice	1.80	1.005	20
	VOC Practice	1.37	1.012	19
	Total	1.59	1.019	39
External	GJPractice	1.72	.737	25
	VOC Practice	1.23	.514	26
	Total	1.47	.674	51
Total	GJPractice	1.76	.902	71
	VOC Practice	1.25	.691	71
	Total	1.51	.840	142

Appendix E - Other Analyses (Sample Populations 1 & 2)

E-1: Summary of Results for L1 French (Sample Population 1)

	Group	Mean	Std. Deviation	N
Pre-Test	Baseline	.5700	.12009	10
	Internal	.5967	.12702	12
	External	.6300	.08842	12
	Total	.6006	.11190	34
GJ Practice	Baseline	.6550	.14160	10
	Internal	.6558	.14872	12
	External	.7217	.16420	12
	Total	.6788	.15119	34
GJ Test	Baseline	.4900	.15951	10
	Internal	.4833	.15275	12
	External	.4667	.04924	12
	Total	.4794	.12500	34
VOC Practice	Baseline	.7330	.16214	10
	Internal	.7583	.17755	12
	External	.8342	.15132	12
	Total	.7776	.16496	34
VOC Test	Baseline	.7430	.13985	10
	Internal	.8042	.13554	12
	External	.7483	.20736	12
	Total	.7665	.16307	34

E-2: ANOVA – Tests of Between-Subjects Effects (French L1s)

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	73.362	1	73.362	2636.733	.000
Group	.048	2	.024	.865	.431
Error	.863	31	.028		

a Computed using alpha = .05

E-3: Summary of Results for L1 French (Sample Population 2)

	Group	Mean	Std. Deviation	N
PreTest	Baseline	.5421	.13377	14
	Internal	.5610	.11685	10
	External	.5550	.09644	12
	Total	.5517	.11465	36
GJPractice	Baseline	.6800	.09430	14
	Internal	.6790	.08452	10
	External	.6725	.08411	12
	Total	.6772	.08588	36
GJTest 1	Baseline	.4643	.07449	14
	Internal	.5000	.14907	10
	External	.4417	.09252	12
	Total	.4667	.10488	36
GJTest 2	Baseline	.5900	.09679	14
	Internal	.6120	.09659	10
	External	.6117	.08809	12
	Total	.6033	.09184	36
VOCPractice	Baseline	.8357	.10995	14
	Internal	.7700	.15048	10
	External	.7858	.10638	12
	Total	.8008	.12126	36
VOCTest 1	Baseline	.8143	.11998	14
	Internal	.7200	.15492	10
	External	.7833	.11934	12
	Total	.7778	.13226	36
VOCTest 2	Baseline	.8543	.07013	14
	Internal	.7500	.15930	10
	External	.8000	.11560	12
	Total	.8072	.11997	36

E-4: ANOVA - Tests of Between-Subjects Effects (French L1s)

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Observed Power(a)
Intercept	110.263	1	110.263	4451.973	.000	1.000
Group	.033	2	.016	.662	.523	.152
Error	.817	33	.025			

E-5: Summary of Results for L1 German (Sample Population 1)

	Group	Mean	Std. Deviation	N
PreTest	Baseline	.6400	.15078	7
	Internal	.6243	.15904	7
	External	.6933	.15253	6
	Total	.6505	.14887	20
GJPractice	Baseline	.7143	.09307	7
	Internal	.7386	.16129	7
	External	.7650	.18534	6
	Total	.7380	.14292	20
GJTest	Baseline	.5286	.17043	7
	Internal	.5857	.21157	7
	External	.5833	.18348	6
	Total	.5650	.18144	20
VOCPractice	Baseline	.8086	.11320	7
	Internal	.8086	.11320	7
	External	.6467	.12209	6
	Total	.7600	.13346	20
VOCTest	Baseline	.8329	.13475	7
	Internal	.7743	.17096	7
	External	.6933	.21040	6
	Total	.7705	.17301	20

E-6: ANOVA - Tests of Between-Subjects Effects (German L1s)

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	48.162	1	48.162	1533.756	.000	.989
Group	.018	2	.009	.286	.755	.033
Error	.534	17	.031			

E-7: Summary of Results for L1 German (Sample Population 2)

	Group	Mean	Std. Deviation	N
PreTest	Baseline	.7038	.15127	8
	Internal	.6375	.18373	4
	External	.7067	.11247	9
	Total	.6924	.13740	21
GJPractice	Baseline	.7375	.08763	8
	Internal	.7750	.15000	4
	External	.7111	.04167	9
	Total	.7333	.08563	21
GJTest 1	Baseline	.6063	.10155	8
	Internal	.6000	.04082	4
	External	.5611	.10240	9
	Total	.5857	.09239	21
GJTest 2	Baseline	.7200	.06347	8
	Internal	.6825	.07632	4
	External	.6767	.10344	9
	Total	.6943	.08364	21
VOCPractice	Baseline	.8038	.07726	8
	Internal	.8500	.04082	4
	External	.7944	.14449	9
	Total	.8086	.10551	21
VOCTest 1	Baseline	.8063	.16353	8
	Internal	.7875	.10308	4
	External	.8222	.06667	9
	Total	.8095	.11360	21
VOCTest 2	Baseline	.8613	.11862	8
	Internal	.8675	.11026	4
	External	.8344	.10818	9
	Total	.8510	.10793	21

E-8: ANOVA - Tests of Between-Subjects Effects (German L1s)

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	71.018	1	71.018	1986.712	.000	.991
Group	.011	2	.006	.154	.858	.017
Error	.643	18	.036			

E-9: Summary of Results for Level 1 Proficiency Group (M ≤ 55%) (Sample Population 1)

	Group	Mean	Std. Deviation	N
PreTest	Baseline	.4600	.06758	7
	Internal	.4629	.05559	7
	External	.5160	.02302	5
	Total	.4758	.05728	19
GJPractice	Baseline	.6471	.13549	7
	Internal	.6600	.09781	7
	External	.6300	.05523	5
	Total	.6474	.10066	19
GJTest	Baseline	.5143	.15736	7
	Internal	.4429	.12724	7
	External	.5800	.13038	5
	Total	.5053	.14327	19
VOCPractice	Baseline	.7929	.14009	7
	Internal	.7271	.18246	7
	External	.7500	.16628	5
	Total	.7574	.15698	19
VOCTest	Baseline	.7514	.10590	7
	Internal	.8214	.16324	7
	External	.9340	.10854	5
	Total	.8253	.14370	19

E-10: ANOVA - Tests of Between-Subjects Effects (Level 1 Proficiency)

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	38.663	1	38.663	2584.987	.000	.994
Group	.056	2	.028	1.858	.188	.188
Error	.239	16	.015			

E-11: Summary of Results for Level 1 Proficiency (Sample Population 2)

	Group	Mean	Std. Deviation	N
PreTest	Baseline	.4500	.08832	10
	Internal	.4529	.07432	7
	External	.4757	.06528	7
	Total	.4583	.07574	24
GJPractice	Baseline	.6670	.07528	10
	Internal	.6414	.08630	7
	External	.6957	.07277	7
	Total	.6679	.07740	24
GJTest 1	Baseline	.4800	.07888	10
	Internal	.4786	.14392	7
	External	.4571	.10579	7
	Total	.4729	.10424	24
GJTest 2	Baseline	.5600	.10604	10
	Internal	.6443	.08039	7
	External	.5957	.10814	7
	Total	.5950	.10202	24
VOCPractice	Baseline	.8500	.08819	10
	Internal	.7243	.12634	7
	External	.7400	.09055	7
	Total	.7813	.11361	24
VOCTest 1	Baseline	.7700	.15312	10
	Internal	.7286	.17525	7
	External	.8286	.10351	7
	Total	.7750	.14670	24
VOCTest 2	Baseline	.8260	.08475	10
	Internal	.7657	.15672	7
	External	.8771	.06550	7
	Total	.8233	.11060	24

E-12: ANOVA - Tests of Between-Subjects Effects (Level 1 Proficiency)

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	69.603	1	69.603	3294.186	.000	.994
Group	.030	2	.015	.699	.508	.062
Error	.444	21	.021			

E-13: Summary of Results for Level 2 Proficiency Group (M > 55%) (Sample Population 1)

	Group	Mean	Std. Deviation	N
PreTest	Baseline	.6769	.10719	13
	Internal	.7000	.08566	14
	External	.7163	.10447	19
	Total	.7002	.09907	46
GJPractice	Baseline	.6892	.16342	13
	Internal	.7200	.17383	14
	External	.7484	.19599	19
	Total	.7230	.17839	46
GJTest	Baseline	.5385	.18502	13
	Internal	.5786	.18051	14
	External	.4895	.14489	19
	Total	.5304	.16848	46
VOCPractice	Baseline	.7562	.19662	13
	Internal	.7857	.15093	14
	External	.7784	.16483	19
	Total	.7743	.16703	46
VOCTest	Baseline	.7631	.19910	13
	Internal	.7193	.20009	14
	External	.7058	.18099	19
	Total	.7261	.18927	46

E-14: ANOVA - Tests of Between-Subjects Effects (Level 2 Proficiency)

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	106.925	1	106.925	2216.888	.000	.981
Group	.010	2	.005	.105	.900	.005
Error	2.074	43	.048			

E-15: Summary of Results for Level 2 Proficiency (Sample Population 2)

	Group	Mean	Std. Deviation	N
PreTest	Baseline	.7050	.10936	16
	Internal	.6867	.09139	12
	External	.6989	.10420	18
	Total	.6978	.10091	46
GJPractice	Baseline	.7250	.09194	16
	Internal	.7292	.10967	12
	External	.6972	.07371	18
	Total	.7152	.08959	46
GJTest 1	Baseline	.5531	.11614	16
	Internal	.5583	.14275	12
	External	.5333	.11376	18
	Total	.5467	.12037	46
GJTest 2	Baseline	.6850	.07545	16
	Internal	.6425	.09845	12
	External	.6772	.10532	18
	Total	.6709	.09359	46
VOCPractice	Baseline	.7969	.10619	16
	Internal	.8175	.11741	12
	External	.7972	.12179	18
	Total	.8024	.11320	46
VOCTest 1	Baseline	.8375	.11030	16
	Internal	.7292	.16161	12
	External	.7917	.11913	18
	Total	.7913	.13262	46
VOCTest 2	Baseline	.8869	.08056	16
	Internal	.7950	.15866	12
	External	.7928	.11801	18
	Total	.8261	.12487	46

E-16: ANOVA for Test of Between-Subjects

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	162.514	1	162.514	4968.230	.000	.991
Group	.069	2	.034	1.048	.359	.046
Error	1.407	43	.033			

E-17: Summary of Linguistic Analysis for GJ1

GJ1	Baseline	Internal	External
Articles	52%	53%	**44%**
Prepositions	55%	49%	**49%**
Pronoun	**53%**	**61%**	**63%**

E-18: Summary of Linguistic Analysis for GJ2

GJ2	Baseline	Internal	External
Articles	48%	49%	**47%**
Prepositions	49%	40%	**52%**
Pronoun	57%	45%	**53%**
Verbs	**65%**	**49%**	**58%**