Incidental, explicit, and implicit language learning during meaning-based exposure: Their effectiveness and relationship to individual cognitive abilities

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ABSTRACT

Incidental, explicit, and implicit language learning during meaning-based exposure: Their effectiveness and relationship to individual cognitive abilities

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Isolated grammar tasks develop different types of learning: incidental (pick up grammar), explicit (conscious learning) and implicit (unconscious learning). Cognitive abilities affecting the accuracy of these types of learning have been discussed (Robinson, 1997a). We know much less about learning during meaningful tasks, common in second language classrooms, during which language is used to understand or communicate information. This study employed tasks of this type to further knowledge of the: a.) incidental acquisition of form, b.) possibility of simultaneous explicit and implicit learning, c.) quantitative differences between explicit and implicit accuracy, d.) role of learner cognitive abilities on quantity and type of learning, and e.) effects of classification of type of learning on the results.

Eighty-one Anglophone adults completed two crosswords and two reading passages presented using a semi-artificial language (Rebuschat, 2008), which ensured experimental control, and between-participant equal vocabulary knowledge. After, participants completed a surprise, timed grammaticality judgement test to measure learning. Type of learning (explicit and/or implicit) was assessed using three awareness measures (confidence ratings, source attributions, and verbal reports). Participants' working memory, inductive ability, processing speed, and verbal reasoning were measured.

The results demonstrated participants incidentally acquired some of the language. The majority of participants (n = 63) learnt the language explicitly and implicitly, and explicit learning was slightly more accurate. Cognitive abilities were unrelated to incidental

acquisition, and the accuracy of explicit and implicit learning. However, inductive ability predicted the quantity of language processed explicitly positively and implicitly negatively.

The findings further knowledge of the effectiveness of incidental, explicit, and implicit learning during language use. They demonstrate for the first time that adults learn language form using explicit and implicit processing simultaneously when focused on meaning. The small differences in accuracy of explicit and implicit learning suggest that when learning form is a by-product of understanding, implicitly-learnt information may be as accurate as explicitly-learnt information. Furthermore, as cognitive abilities did not affect the accuracy of incidental, explicit, and implicit learning, learning form whilst using may not disadvantage certain learners. However, as ability to induce patterns affects how information is processed, learners may benefit from practising pattern induction.

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Investigating Type of Learning (Implicit and Explicit) During Incidental Exposure to a Novel Language

This thesis investigated adult second language learning. The five research aims were to explore a.) the quantity of incidental syntactic learning that occurs when adults complete language tasks for meaning, b.) the possibility that individuals learn language explicitly and implicitly simultaneously, c.) methodological issues relating to the measurement of type and quantity of explicit and implicit learning, d.) differences between explicit accuracy and implicit accuracy after incidental exposure; and e.) the relationship between a number of cognitive abilities, and type and quantity of learning/accuracy during language use.

It is widely-believed that languages are best learnt through use. This belief has led to the creation of immersion programmes that focus on language use rather than language learning by teaching content in the second language (L2), and the adoption of functional and communicative-based syllabuses by schools throughout the world. Learning by using is a form of incidental language learning as our focus of attention is on one thing (e.g. solving a mathematics problem, or discussing differences between similar pictures) whilst possibly learning another thing (i.e. grammar, lexis, pragmatics, and pronunciation) (Schmidt, 1994). Research conducted in classrooms that privilege language use over learning language as an object has demonstrated that incidental learning can occur as measured by global improvements in general language proficiency (e.g. Lyster, 2007; Netten & Germain, 2005; Spada & Lightbown, 1989).

In addition, incidental learning of specific aspects of languages (e.g. plurality in English, or morphosyntactic rules of Samoan) has also been documented in research that has presented the targeted features via controlled language tasks where participants process language on a

sentence-by-sentence basis (Robinson, 1997a, 2005; Shintani & Ellis, 2010). However, real language use frequently involves the processing and production of connected discourse when, for example, one reads a newspaper article, watches television, or writes an e-mail. It is therefore an empirical question as to whether incidental learning of individual linguistic features can occur when participants receive short, intense exposure to input via listening and reading aloud for global message comprehension only (language use). The first objective of this study addresses this question. Understanding the possibility and quantity of incidental learning of form when participants are focused on comprehending whole texts can further understanding of the picking up of grammar under these conditions, the very conditions that Krashen argued were necessary for learners to become competent users of a language (1982).

Incidental learning as described above ignores whether the learning occurred with or without conscious awareness; in other words, whether learning occurs explicitly or implicitly (Reber, 1967). Explicit learning is believed to occur when one is aware of what one is learning. It demands attentional resources, and involves conscious[1] strategies such as problem-solving and/or hypothesis-testing. Implicit learning is believed to occur when one is not aware of what one is learning. It occurs without attention, and without conscious strategies (DeKeyser, 2003, Dienes & Perner, 1999; Robinson, 1997a; Paradis, 2009; Williams, 2009). This distinction suggests that under incidental conditions, humans can learn form explicitly and/or implicitly whilst using language. However, extant research investigating explicit learning and implicit learning has dichotomised them in one of two ways: a.) by using different task types that are categorised as explicit learning tasks or implicit learning tasks (e.g. Kaufman, DeYoung, Gray, Jiménez, Brown, & Mackintosh, 2010), or b.) by classifying learners as having demonstrated

[1] The word 'conscious' is used throughout this thesis as follows: in relation to learning, conscious learning (i.e. explicit learning) is learning that we know is occurring. Conscious knowledge (i.e. explicit knowledge) is knowledge that we know that we know. In other words, for something to be conscious, we need to have a higher-order thought concerning this something (Rosenthal, 1986).

explicit learning or implicit learning based on measures of learner consciousness (Bell & Collins, 2009; Hama & Leow, 2010; Leow, 2000; Williams, 2005). In these studies, one cannot learn some information explicitly and some information implicitly simultaneously: a person is either an explicit learner (processes explicitly) or an implicit learner (processes implicitly). However, normal individuals, as opposed to individuals with certain memory impairments, are able to learn information explicitly and implicitly using declarative and procedural memory (Paradis, 2009), and it is assumed that explicit learning and implicit learning can indeed occur simultaneously (DeKeyser, 2009; Dienes & Perner, 1999; Stadler & Frensch, 1998). The second aim of this study was to examine whether participants demonstrated the use of one or both types of learning processes. In other words, are explicit and implicit learning dichotomous or do they form a continuum? Understanding this is crucial in explaining how languages are learnt, and whether one should expect learners to use input for two different types of learning or just one.

In order to achieve the second aim in relation to the possible simultaneity of explicit and implicit learning, it was necessary to employ an awareness measure that permitted a continuous classification. As extant measures assume a dichotomy, a continuous awareness measure was introduced in the present research. This measure classified participant learning and subsequent accuracy based on off-line verbal reports and performance on the test of learning. All information on the verbal reports that could affect performance on the test of learning was highlighted. This information was then used to predict each participant's performance on the test of learning. Finally, each item on the test of learning was classified as a response due to explicit learning (predicted based on verbal report) or implicit learning (not predicted or contradictory based on verbal report). As this measure has never been used, it was necessary to understand its utility to explicit and implicit learning research. Thus, the third aim of the present

study was methodological in nature: to understand whether a dichotomous measure of awareness and a continuous measure of awareness led to the same research conclusions. Investigating this methodological issue can contribute to our understanding of how to measure whether participants have learnt explicitly/and or implicitly (awareness). It also addresses the significance that may need to be attributed to the employed awareness measure(s) in interpreting results from individual studies.

It is also important to consider the accuracy of the two types of learning. Extant research has documented explicit and implicit learning gains (Bell & Collins, 2009; Leow, 2000; Rebuschat, 2008; Williams, 2005), but superior performance is demonstrated by learners that pay attention to the linguistic feature in the input (possibly still implicit learning or low-level explicit learning) and/or consciously reflect on the linguistic feature's meaning and use (explicit learning). However, none of this research has been conducted using tasks that involve fluent comprehension and/or production. In real-world language learning contexts, it is this type of input that may provide learners with the opportunity to meaningfully engage in the L2 whilst reaping the benefits of implicit learning processes. Indeed, N.Ellis (2005) suggested that "implicit learning of language occurs during fluent comprehension and production. Explicit learning of language occurs in our conscious efforts to negotiate meaning and construct communication." (p. 306). The fourth aim of the present study was to investigate whether, as hypothesised by N.Ellis, only implicit learning would occur due to the nature of exposure or whether both types of learning would occur. Furthermore, if both types of learning occurred, would explicit learning still be more accurate than implicit learning when the exposure tasks require comprehension of meaning only? Understanding the differences in effectiveness (accuracy) of explicit learning and implicit learning is important pedagogically as it highlights whether target features need to be focused on explicitly during language use and, from a

theoretical perspective, the findings address N.Ellis' hypothesis. In addition, it has been suggested that implicit learning takes more time than explicit learning as implicit learning is driven by frequency coupled with a person's existing knowledge (N.Ellis). Investigating whether there are differences between the accuracy of explicit learning and implicit learning can shed light on the issue of whether more time is needed for initial implicit learning than initial explicit learning.

Extant explicit and implicit learning research in Second Language Acquisition (SLA) and cognitive psychology has found differences between participants in terms of how they learn, and in terms of the accuracy of what has been learnt explicitly or implicitly (Bell & Collins, 2009; Hama & Leow, 2010; Leow, 2000; Rebuschat, 2008; Robinson, 1996, 1997a, 2005; Williams, 2005). Using a variety of aptitude measures, researchers have begun to investigate which cognitive abilities predict quantity of explicit learning versus quantity of implicit learning (cognitive psychology research), and whether cognitive abilities play a role in the likelihood with which an individual will learn implicitly or explicitly (SLA research). Research that aims to explain these learner differences based on aptitude is important theoretically and pedagogically. It has been suggested that aptitude only plays a role in explicit learning (Reber, 1967; Krashen 1982) and that aptitude differences may be nullified when the focus is on meaning (Zobl, 1992). However, research has demonstrated that implicit learning may also be affected by aptitude (DeGraaff, 1997; Kaufman et al., 2010; Robinson, 1997a) and that learning when focused on meaning does not negate aptitude differences (Ranta, 2002; Robinson). Understanding whether aptitude plays a role in explicit learning and implicit learning when participants use language can help clarify these contradictory positions, particularly with respect to aptitude's role during meaning-focused exposure. From a pedagogical perspective, understanding the role of aptitude on incidental, explicit, and implicit learning during language use can provide information on

whether meaningful tasks can be used to create optimal conditions for all language learners or whether certain strategies could be used by pedagogues to reduce aptitude differences when fluently communicating.

The fifth aim of the present research was to shed light on these issues by investigating the role of cognitive abilities on incidental learning, explicit learning, and implicit learning when exposure focuses on meaning. The four cognitive abilities that were investigated have been found to play a role in either explicit learning (working memory and inductive language learning ability [Bell, 2009; Kaufman et al., 2010; Robinson, 1997a]) or implicit learning (verbal reasoning and processing speed [Kaufman et al.]).

In order to achieve the above-mentioned aims, eighty-one Anglophone participants were exposed to an artificial language that uses English lexis with quasi-German syntax (adapted from Rebuschat, 2008). The syntax is governed by two rules adapted from German: in main clauses, the verb phrase always comes in second position (e.g. *Always eats Sarah chocolate*); in subordinate clauses, the verb phrase always comes in final position (e.g. *because she chocolate loves*). As the language uses English lexis, participants were able to use language to complete meaningful tasks. Participants completed four tasks under incidental learning conditions (i.e. the process and outcome of the task focused on meaning only; the participants' task was to comprehend the input to answer meaningful questions [Robinson, 2005; Schmidt, 1994; Williams & Kuribara, 2008], and they were not informed there was an underlying grammatical system in the input on which they would later be tested [Hulstijn, 2003; Rebuschat, 2008; Williams & Kuribara]). After exposure, participants completed a surprise grammaticality judgement test to measure what they had understood about the language system. After the testing, participants completed a post-exposure questionnaire to provide information on the

structural knowledge they had constructed during the experiment. Finally, participants completed the four cognitive ability measures.

The findings from this research contribute to our understanding of how adults learn syntactic information when this syntactic information does not need to be understood for successful task completion (comprehending a story and solving a crossword puzzle). More specifically, the findings shed light on the quantity of incidental syntactic learning that can be expected to occur during language use. Incidental learning is further divided into whether participants learnt explicitly or implicitly, which provides crucial information on the existence of implicit adult second language learning, the possibility that individuals can use both explicit and implicit learning mechanisms simultaneously, and the differential effectiveness of explicit and implicit learning (resulting accuracy). The cognitive ability data further understanding of the relationship between type and quantity of learning, and aptitude for language learning. Furthermore, the use of a continuous and a dichotomous measure of type of learning (awareness) highlights methodological challenges when classifying how adults learn, and how research findings may need to be interpreted alongside the measure of awareness that was employed.

Chapter One: Types and Quantities of Language Learning and Cognitive Abilities

The research reported in this dissertation focuses on learning in adult second language acquisition. It addresses: a.) the quantity of incidental acquisition of language syntax that occurs when adults use language for general comprehension; b.) the type (explicit and/or implicit) and subsequent differences between quantity of explicit learning and implicit learning that occur during incidental exposure; c.) methodological issues of measuring whether learning occurs explicitly and/or implicitly, and d.) the relationship between a number of cognitive abilities, and type and quantity of learning during language use.

This chapter begins with a general definition of learning before discussing our current state of knowledge concerning incidental learning and highlighting the incidental research gap this study fills: research into incidental acquisition of specific linguistic features when adults use language for global comprehension. As incidental learning is being further divided into whether it occurs explicitly or implicitly in order to understand whether these two types of learning can co-occur and whether there are differences in their effectiveness (in terms of accuracy), I will then define explicit learning and implicit learning, discuss research evidence concerning the possibility of implicit learning and its effectiveness when compared with explicit learning, and the different means of establishing type of learning (explicit and/or implicit) to highlight that an investigation into their co-occurrence and effectiveness is warranted. Finally, based on the findings that individuals do not all learn using the same type of learning, and they do not always learn the same amount, I will discuss individual factors that are believed to affect both explicit and implicit learning.

1.1 What is learning?

Considering the ubiquity of the term *learning* in both academic (3,550,000 results in 0.14 seconds, Google Scholar, 2011) and non-academic circles (1,100,000,000 results in 0.10 seconds, Google, 2011), and considering that it is the focus of my research, I was surprised when I felt unable to provide a comprehensive definition. The Oxford English Dictionary defines learning as "knowledge or skills acquired through experience or study or by being taught". Klein (2012) and Atkinson, Atkinson, Smith, and Bem (1993) focus on there being a behavioural change, which Klein attributes to resulting from experience. This behavioural change may have occurred, but it may not ever be demonstrated. For example, one may learn how to give cardiopulmonary resuscitation, but one may never need to demonstrate this learning. The behavioural change may also occur due to other learning or a mixture thereof (Atherton, 2011). In behavioural research, this change is documented through quantitative measures that record reductions in reaction times, increases in accuracy scores, or changes in frequency scores. For research purposes, it is important to ensure that the cause of learning is known, and that factors that may play a role in the learning be identified. To ensure the cause of learning has been correctly identified, control groups are used that do not receive the information/exposure that is believed to cause the learning. Differences between the control group and the experimental groups can thus be interpreted as learning. In the present study, learning is defined as knowledge of aspects of the syntax of a semi-artificial language that can only be explained by participants' exposure to that language (e.g. stimuli consisting of English lexis containing syntactic deviations, such as, *Yesterday shopped Anne for milk*). Based on a control group that rejected all of the stimuli as being ungrammatical, and the improbability that participants had interacted with similar stimuli before, any difference in the experimental group's behaviour in comparison with the control group behaviour can be classified as learning.

The above definition of learning refers to a development, a change. However, this development can occur in a number of different ways. In the Second Language Acquisition (SLA) literature, a number of different types of learning have been defined and investigated: explicit, implicit, item, system, rule, chunk, inductive, deductive, intentional, and incidental. Each type of learning tends to be paired with its counterpart, so discussions focus on explicit learning and implicit learning, or item learning and system learning, for example. It is possible to distinguish between the pairs of types of learning although confusion occurs particularly when one type of learning has been defined in a number of ways. Overall, explicit and implicit learning refer to how learning occurs; how the brain processes information whilst learning. Item (chunk) and system (rule) learning refer to what has been learnt, which could have occurred explicitly or implicitly. Inductive and deductive learning usually refer to how the information to be learnt is presented; deductive learning gives the learner an explanation of what is to be learnt with later practice, inductive learning provides practice and then may or may not elicit/provide explicit information. Intentional and incidental learning refer either to learning with or without effort to learn, or to learning with knowledge or without knowledge that one will be tested.

In this study, three types of learning are being investigated: incidental, explicit, and implicit. Incidental learning refers to all learning that occurs regardless of the learning processes employed by the participants (Paradis, 2009; Robinson, 2005; Shintani & Ellis, 2010). In this sense, incidental learning is operationalised through the choice of task and instructions to participants. Incidental learning can then be further divided into whether it occurred explicitly (consciously; with awareness) or implicitly (unconsciously; without awareness) (Bell & Collins, 2009; Leow, 2000; Paradis, 2009; Rebuschat, 2008; Williams, 2005). As the initial objective of this research was to investigate incidental learning of syntax by adults during language use, I will now discuss theory and extant research on the incidental learning of specific language features.

1.2 Incidental Learning

The term incidental learning (or incidental acquisition [Loewen, Erlam, & Ellis, 2009; Shintani & Ellis, 2010]) has been used in a number of different ways. In the psychology literature and in SLA studies, in particular of vocabulary, incidental learning has been compared to intentional learning at a methodological level (Hulstijn, 2003). In this sense, incidental learning means that research participants are presented with a task without being informed that they will later be tested on something contained in the task (e.g. participants rate words on a scale of pleasantness [task], but then are later given a surprise test asking them to recall the words [Craik & Lockhart, 1972]). Intentional learners are informed that they will later be tested.

Another definition of incidental learning again compares it to intentional learning, but the focus is on whether a person deliberately attempts to store the information in memory (intentional) or not (incidental). To my knowledge, no research on the acquisition of L2 grammar has used these definitions together. Rather, the term incidental learning has been used alone to refer to the learning of one thing when the focus of attention is on something else (Hulstijn, 2003; Schmidt, 1994; Shintani & Ellis, 2010); this is the definition that is employed in the present study. As mentioned above, incidental learning does not focus on how the person processes the information to be learnt. Rather, it relates to the goals of the task and a person's understanding of these goals (i.e. instructions). Researchers investigating incidental learning therefore need to create task conditions that require participants to focus attention on something other than the researcher's focus. This does not preclude manipulation or processing of the form during exposure, but if learning is to be discussed in terms of its occurring incidentally, this processing/manipulation cannot be the aim of the task for the learners.

Understanding whether incidental learning of form occurs and its effectiveness has direct implications for language teaching. Krashen (1982) proposed a dichotomy between

learning (intentional teaching and learning of form) and *acquisition* (incidental picking-up of form whilst communicating). He believed that *acquisition* was superior to *learning* as this reflects the type of knowledge that is needed in real communication. In addition, he posited that there could be no interface between the two. Even though Krashen's dichotomy is more relevant to the implicit (acquisition)/explicit (learning) divide, his arguments have engendered a host of teaching methodologies and programmes that are based on the notion of incidental learning (immersion programmes and content-based instruction, Knell et al., 2007; French and English immersion programmes throughout Canada, Lyster, 2009; intensive language programmes, Netten & Germain, 2005). In addition, most SLA theories posit a large role for incidental learning as students are not believed to learn all L2 grammar intentionally (N.Ellis, 2001; Long, 1991; Schmidt, 1990; VanPatten & Williams, 2007). Despite the widespread agreement that incidental learning is an essential and important way for people to learn languages, there is little research documenting its existence for specific linguistic features or its effectiveness, nor is there much research that helps us understand how it may be manipulated or promoted (Hulstijn, 2003; Shintani & Ellis, 2010).

The majority of existing studies of the incidental learning of grammar have found pre- to posttest improvements by both children and adults (e.g. Rebuschat, 2008; Robinson, 2005; Shintani & Ellis, 2010). An example of adult incidental acquisition was documented by Robinson (2005). He investigated whether Japanese university-aged participants with no knowledge of Samoan could incidentally learn three rules of Samoan morphosyntax, a VSO language. The three rules were:

1. ergative (subject) marker: Verb + <u>*e*</u> + Subject + Object (morphology)
    a. *ave <u>e</u> le tama le taavale* (drove + ergative + the boy + the car): the boy drove the car

2. adverbial marker: Verb + Subject + *i* + Adverbial (morphology)
    a. *taalo le tama i le paka* (play + the boy + locative + the park): the boy plays in the park
3. direct object nouns suffixed to the verb: Verb&Object + Subject (syntax)
    a. *ave-taavale le tama* (drive-car + the boy): the boy drives the car

Participants rote learnt Samoan vocabulary before completing 10 training trials, each consisting of 45 sentences. Each sentence was presented for 10 seconds and participants were asked to respond to a meaningful question that could be answered by focusing on vocabulary alone (e.g. *the boy plays in the park* [input]; *does the boy swim in the sea?* [meaningful question]). They were then informed of the accuracy of their meaningful response (*correct* or *incorrect*). The findings showed that incidental learning had occurred for all three rules on items that had been presented during training (e.g. item learning). However, for new items, participants were only able to correctly accept grammatical items and reject ungrammatical items at above-chance levels for the adverbial rule (addition of *i* before the adverbial). Reaction to the other two rules was as follows. For the syntactic shift (object movement), participants rejected 76% of ungrammatical items and 78% of grammatical items; i.e. they believed V&O+S to be incorrect[2]. For the ergative rule, participants rejected 32% of ungrammatical items and 72% of grammatical items; participants preferred items without an ergative marker. In other words, overall, incidental learning was limited to item learning for two rules and system learning for one rule: the locative rule.

These results demonstrate that when adults process language sentence-by-sentence for meaning, they are capable of incidentally learning some aspects of grammar. Research that has investigated the incidental learning of grammar whilst learner attention is focused on another

[2] It is not clear from the research report what the difference is between the new grammatical and ungrammatical items for the subject-object inversion rule.

aspect of grammar, however, has found different results. Loewen et al. (2009) investigated whether adult students of English could incidentally learn third person –*s*. Participants were provided explicit instruction and input-based practice activities on the use of the indefinite article (*a/an*), but this input also provided at least 74 examples of third person -*s*. Participants were tested before and after exposure on two measures that had been created to differentially require the deployment of explicit knowledge (untimed grammaticality judgement test) and implicit knowledge (elicited oral imitation test). The results demonstrated no pre- to posttest improvements for third person –*s*.

These conflicting findings could be explained by the different task types. In Loewen et al.'s (2009) research, focusing learner attention on one grammatical feature did not lead to the incidental acquisition of another grammatical feature. On the other hand, the participants in Robinson's (2005) research had their attention focused on understanding the meaning of individual sentences during exposure. The results demonstrated that incidental item acquisition occurred of three grammatical features, and incidental system acquisition occurred of one grammatical feature. Other research that has focused participant attention on meaning has also documented the incidental acquisition of form (Bell & Collins, 2009; Rebuschat, 2008). In addition, Bell and Collins demonstrated incidental learning with a task that had a meaningful outcome unrelated to language form, the completion of a crossword as opposed to a controlled language task that required the processing of individual sentences for meaning (Rebuschat; Robinson).

In all of the extant research (except Bell & Collins, 2009), participants have been exposed to the target language form whilst completing controlled language activities that have not had a meaningful target outcome (Loewen et al., 2009; Robinson, 2005). However, language learning involves language use that requires fluent comprehension and/or production

of whole texts. Bell and Collins demonstrated that incidental learning of a clue to French grammatical gender could occur when Anglophone participants with low-level French completed a crossword. However, in this research, participants largely focused their attention on understanding each word contained in the clues due to their level of French proficiency. In addition, the learning was item-based rather than system-based (possibly due to length of exposure, which was quite short). It therefore remains an empirical question as to whether adults are able to incidentally learn specific grammatical forms of a system when their sole purpose for completing the task is the meaningful outcome, i.e. when they are using language as opposed to actively trying to comprehend it. Understanding whether incidental acquisition of form occurs when adults use language is important as it can demonstrate whether adults are able to learn form when they are not focusing on learning language: when adults are language users, are they also able to be language learners of specific forms? It is important to point out that research documenting incidental learning in content-based classrooms demonstrates the possibility of incidental learning (as measured by global improvements in proficiency), but not in relation to the learning of a specific language form after short, intense exposure. Therefore, the first research question is:

1. Does incidental acquisition of two unknown word-order rules occur when adult learners use language?

1.3 Explicit and Implicit Learning

Understanding the quantity and quality of incidental learning of syntax during language use furthers knowledge of how adult learners pick up linguistic features in the input. However, it does not provide information on whether participants learn the syntax consciously and/or unconsciously, and whether there are accuracy differences between these two types of learning;

issues that are fundamental questions for explaining how languages are learnt, and should subsequently be taught. Conscious processing of a linguistic feature is termed explicit learning and unconscious processing is termed implicit learning (DeKeyser, 2003). In order to discuss whether adults are able to learn language in these two ways, it is first necessary to establish that implicit learning exists. The onus is on proving the existence of implicit learning as the existence of explicit learning, a type of learning that requires attentional resources and involves conscious strategies such as problem-solving and hypothesis-testing, is accepted. I will now discuss theory and research related to proving the existence of implicit learning. The reporting of research results naturally engenders the reporting of differences between the effectiveness of explicit and implicit learning. After concluding that there appear to be two means of learning information and that explicit learning, as measured, has led to greater accuracy improvements, I will discuss how extant research has classified participants in terms of type of learning (explicit [aware] and/or implicit [unaware]). This information is essential in order to motivate the investigation in the present study of whether adults are able to learn explicitly and implicitly simultaneously, and whether one type of learning is superior to the other (in terms of accuracy).

1.3.1 Proving the existence of implicit learning: Cognitive psychology

Since the 1960s, much research has been conducted to prove the existence of implicit learning by operationalising it as a process that occurs either without attentional resources or without awareness (Shanks, 2003). In the present literature review, implicit learning as learning without attentional resources will not be discussed. There appears to have been a shift away from defining implicit learning as not needing the executive function of attention as research points towards the necessity of focal attention to the relevant stimuli for memory encoding before any learning can occur (Carr & Curran, 1994; Kaufman et al., 2010; Perruchet & Gallego,

1997; Shanks, 2003). Importantly, this does not discount two types of learning. Rather, it limits when learning can commence either implicitly or explicitly: not until the stimuli has received focal attention. Furthermore, in the SLA literature, it is widely-accepted that attentional resources are essential for second language learning (Godfroid, 2010; Robinson, 2003; Schmidt, 2001; Williams, 2009), and extant SLA research investigating the possibility of the implicit learning of grammar has operationalised implicit learning at a level of consciousness rather than attention (Gass, Svetics, & Lemelin, 2003 reported their research in relation to focal attention, but attention and awareness were confounded).

In cognitive psychology research, two research paradigms have been particularly fruitful in establishing implicit learning: Reber's artificial grammar learning (1967) and sequence learning based on a serial reaction-time task (Nissen & Bullemer, 1987), although dynamic control tasks have also frequently been employed (Berry & Broadbent, 1995).

In a typical experiment of the implicit learning (learning without consciousness) of artificial grammar strings (Reber, 1967), participants are asked to memorise strings of letters that consist of a finite-state language of five letters that follow a Markovian grammar (i.e. the probability of a letter appearing depends entirely on the previous state).

Participants are told to memorise the strings of letters. However, after exposure, they are informed the strings followed a set of rules and they then have to judge the grammaticality of new strings. Participants consistently behave at above-chance levels without being able to verbalise the contents of their knowledge; they have implicitly learnt information about the grammar that permits above-chance performance. Initially, it was believed that participants had implicitly learnt abstract rules about the underlying structure of the letter strings (Reber, 1967, 1989), but later research showed that above-chance performance can occur when participants are sensitive to patterns in the input (e.g. the doubling of certain letters) (Knowlton & Squire,

1996), without necessarily having learnt the abstract rule. This sensitivity was firstly discussed in terms of explicit knowledge concerning bigrams and trigrams based on post-exposure questions. However, later research demonstrated that not all behaviour could be explained by explicit knowledge. Rather, participants acquire some information that appears to be predictive dependencies: where certain bigrams or trigrams may come within a string (permissible locations), or alternation patterns amongst bigrams and trigrams within a string (Knowlton & Squire). This type of acquisition has been demonstrated with participants that have impaired declarative memory, that is, they are unable to learn explicitly (Knowlton & Squire, 1996). In normal populations, it has been demonstrated with transfer sets that employ different letters to the training set (Knowlton & Squire; Matthews, Buss, Stanley, Blanchard-Fields, Cho, & Druhan, 1989) and when the letters from the training set are changed to tones in the testing set (Altmann, Dienes, & Goode, 1995).

The introduction of serial-reaction time tasks in the 1980s (Nissen & Bullemer, 1987) allowed for further investigation of implicit learning. A serial-reaction time task consists of a stimulus that appears briefly on a computer screen in a number of locations (typically four, Robertson, 2007). Participants are required to press a computer key that corresponds to the stimulus' location (i.e. each location is allocated a computer key). Unbeknownst to the participants, the order in which the stimuli appear is governed by a sequence. As participants proceed through the key presses, their reaction times diminish. This is a normal practice effect. However, when the sequence is interrupted (i.e. when the location of the object appears out of sequence), participant reaction times become significantly longer. Participants appear largely unable to verbalise the contents of the knowledge that causes this slowdown, which suggests that implicit learning of some sort has occurred.

To summarise, research in cognitive psychology has demonstrated that adults are capable of creating knowledge without being aware of what they have learnt. Despite lively debate concerning the contents of this learning (Jiménez, 2003, Johnstone & Shanks, 2001, Reber, 1993; Shanks, 2005), at these early stages of learning, it is unlikely that abstract rules are formed. Rather, it appears that a sensitivity to statistical regularities is being acquired, which allows participants to classify the acceptability of letter strings at above-chance levels of performance, or causes a slowdown in participant reaction times when a stimulus is presented in a location outside of an expected sequence.

The results from the research reported above are important as they document the existence of a type of learning by adults that does not require conscious knowledge of what has been learnt. However, letter strings and letter positions are not the same as language as they do not carry meaning and they likely lead to different types of processing. The processing of letter strings can occur using bottom-up, data-driven processing, but the processing of language also requires top-down, conceptually-driven processing (Robinson, 2005). As such, the above research findings do not demonstrate whether adults are able to implicitly learn language, which is key to understanding how second language learning occurs. Two areas of inquiry have investigated whether implicit language learning can occur. Firstly, I would like to present findings from research into statistical language learning conducted by psychologists in order to demonstrate that an implicit learning mechanism appears to be an effective means of learning certain parts of language. I will then turn to a thorough discussion of implicit learning in SLA.

1.3.2 Implicit (statistical) learning

The interest in the possibility of statistical language learning arose from research demonstrating that humans are able to detect statistical relationships in non-linguistic domains.

This area of inquiry investigated non-deliberate learning (information acquisition) to understand whether certain fundamental aspects of our experiences are stored in memory by an implicit process (automatically encoded). Hasher and Zacks (1984) summarised research that had demonstrated humans' ability to store frequency events in the input regardless of task differences and participant individual differences, which they conclude is likely due to frequency being processed implicitly as opposed to explicitly.

This sensitivity to frequency in the input led to investigations in relation to language. Initial research focused on describing language in terms of statistical properties in order to understand whether distributional information of aspects of language could explain their acquisition. Despite initial scepticism due to theories of language acquisition that focused on the importance of semantics and innate learning mechanisms (Chomsky, 1965; Pinker, 1984), it became apparent that distributional information can provide much information on many aspects of language (Maratsos & Chalkley, 1982; Redington, Chater, & Finch, 1998). Once it was evident that computational models could use information on distribution to learn certain aspects of language, researchers began investigating whether humans also possess this computational ability, which would be expected based on non-linguistic frequency research. Work conducted by Saffran and colleagues has demonstrated this possibility with humans from as young as eight months old. Saffran, Aislin, & Newport (1996) found that eight-month old infants could segment speech sounds based only on the statistical relationships between adjacent sounds. The infants heard four three-syllable nonsense words presented in a continuous speech stream for two minutes. The important statistical information was transitional probabilities; the likelihood syllable pairs within a word would be heard together was higher than for syllable pairs that did not form words (1.0 versus 0.33). After training, the infants were tested using the familiarisation-preference procedure, which operationalises

learning as a difference between sustained visual fixation on a blinking light on trained stimuli (the target of learning) and highly-similar stimuli. In experiment 1, the highly-similar stimuli included syllables from the training, but no syllable pairs; in experiment 2, the stimuli included syllable pairs from training, which addresses the question of whether the infants had actually learnt information concerning word boundaries. In both experiments, there was a significant mean difference in listening time (i.e. sustained fixation on the blinking light) with trained items being processed more quickly.

Speech segmentation of input can be achieved by focusing on the surface structure of the input in terms of the structure occurring as a string of words. However, many aspects of language are abstract, which means that statistical information on strings of words (syllables/letters) could not provide the necessary information to acquire these language features. Language syntax, for example, is an abstract concept as a word's placement within a sentence does not solely depend on the previous word and the following word. Therefore, the question remains as to whether the implicit learning detailed above could also occur for abstract language features, those features that statistical information induced through processing strings of words could not explain. Later research has demonstrated that certain aspects of syntax can also be acquired based on correlated cues and predictive dependencies.

Morgan, Meier, and Newport (1987) investigated whether morphological and prosodic cues at the phrasal-level are essential for the acquisition of syntax to understand whether abstract aspects of language can be learnt through distributional information provided by cues. In experiment one, they assigned 39 English-speaking university undergraduates to one of three conditions: monotone prosody, arbitrary prosody inconsistent with phrase structure, and prosody consistent with phrase structure. The arbitrary prosody group was included to ensure that it is prosody of phrase structure as opposed to prosody alone that is learnt. The prosodic

cues used were vowel lengthening, pitch discontinuities, and pausing. The participants were exposed to an artificial finite language system (Morgan & Newport, 1981) that contained both unconditional (static) and conditional aspects of sentence structure (dependencies amongst word classes: i.e. if a type A word is present, it can't be preceded by a type C word. If a type B word is present, it must be preceded by a type C word). The participants listened to and read forty sentences presented individually. They were then asked to make certain judgements to demonstrate what they had learnt. The predictions that all participants would learn unconditional aspects of the grammar, but only the phrase prosody participants would learn the conditional aspects of the grammar were borne out; the way in which sentences are pronounced affects learning. In two further experiments that followed the same design, the utility of function words and morphological markers as phrasal cues were investigated. As in the above experiment, the results were the same. The authors concluded that prosody, morphology, and function words act as cues to phrase structure, which is particularly helpful in the learning of conditional aspects of phrase structure as this is when the dependency information is needed.

Later research has furthered our understanding of how these cues can be useful for the acquisition of hierarchical phrase structure. The above research demonstrated that prosody, function words, and morphology can be used by humans to learn both unconditional and conditional phrase structure rules. However, there is also important distributional information within phrases in terms of the likelihood and possibility of certain word types occurring together within different phrase types (e.g. the occurrence of a noun does not signal the occurrence of *the* or *a*, but the occurrence of *the* or *a* does signal the occurrence of a noun [example provided by Saffran, 2001, p. 495]). Saffran (2001) investigated whether predictive dependencies in terms of statistical information within phrases could predict learning. Using the same grammar as Morgan et al. (1987), Saffran asked 29 English monolingual undergraduate students to listen

to the artificial language. Fourteen participants formed an intentional condition; they were informed that they were to listen to nonsense words with no meaning that followed a set grammar on which they would later be tested. Fifteen participants formed an incidental condition; they were asked to draw a computer-generated picture whilst listening to a nonsense language in the background (but they were informed they would be tested on the nonsense language). Five additional participants completed the testing without having heard the nonsense language to ensure that any above-chance experimental participant performance was due to exposure. Exposure lasted for two 28-minute sessions over a two-day period in which participants listened to 100 sentences four times. The results showed that the participants in the incidental and intentional conditions behaved in the same way, and they were significantly more accurate at making grammaticality judgements than the control group. These findings demonstrate that when consistent predictive dependencies are present in the input, participants are able to use this statistical information to learn phrasal grouping. In addition, when other linguistic factors that may affect acquisition are partialled out (chunk strength [frequency with which words co-occur in training], similarity to training items), grammaticality (in terms of the predictive dependencies) still accounts for performance. The finding that the incidental group behaved in the same way as the intentional group suggests that this statistical processing may occur automatically and without consciousness (although the participants in the incidental group were aware they were to be tested on the language so they may have used some intentional learning processes). Another important contribution of this research is that it helps explain why language learners (at any age) do not frequently create incorrect phrasal units based on the input as predictiveness not co-occurrence drives learning.

In conclusion, research conducted to understand the structure of language, and the information in the input that predicts structure has demonstrated that humans are capable of

extracting statistical information from the input based on correlated cues (prosody, function words, morphology) and predictive dependencies within phrases. It can be assumed that this statistical learning occurs implicitly as it has been demonstrated with babies, and under incidental learning conditions. Furthermore, this research has used an artificial finite language system that reflects natural language boundaries. This research was conducted to understand the utility of predictive dependencies to the learning of language structure, but it also sheds light on implicit language learning. The field of SLA has also conducted research to understand whether implicit language learning exists.

1.3.3 Explicit and implicit learning: SLA

In SLA, demonstrating the existence of implicit learning (i.e. the existence of a type of learning that occurs without consciousness) has received little research attention. Rather, research has assumed different types of learning and investigated whether one type of learning is superior to another without ensuring that the explicit learners did not also learn implicitly, and the implicit learners explicitly (DeGraaff, 1997; DeKeyser, 1995), or investigated the contents of knowledge in terms of its being implicit or explicit (e.g. Ellis, Loewen, Elder, Erlam, Philp, & Reinders, 2009). In this review, I will discuss the few studies that have attempted to prove the existence of implicit learning.

1.3.4 The existence of implicit learning: SLA

Research that has investigated the possibility of implicit learning of a second language has largely been conducted by Ronald Leow and John Williams (and their colleagues and students). Their research methodologies have differed, but both shed light on the issue of whether learning can occur without conscious awareness.

Leow's work has focused on learning without awareness of aspects of Spanish grammar by Anglophone university students. His initial research (1997) explored the role of awareness on learning in order to investigate Schmidt's Noticing Hypothesis (1990), which states that a language feature must receive attention before it can become available for learning. Leow asked participants to complete a crossword task that required the processing of Spanish preterite irregular stem-changing verbs (a spelling change, e.g. *m<u>e</u>ntir* [to lie], *m<u>e</u>ntí* [I lied], but *m<u>i</u>ntió* [he lied], examples taken from Leow, p. 562). Awareness was measured on-task with a think-aloud protocol and off-task with two probe questions (immediately after crossword completion, and after the posttest). Leow categorised participants into one of three categories:

1. +Cognitive or Behavioural Change + Meta-awareness + Morphological Rule
2. +Cognitive or Behavioural Change + Meta-awareness - Morphological Rule
3. +Cognitive or Behavioural Change - Meta-awareness - Morphological Rule

Subsequent analyses were largely limited to two categories (1 and 2 vs. 3). He found that participants that had meta-awareness ± a morphological rule outperformed participants that had only noticed the form (i.e. cognitive or behavioural change). Based on the think-aloud data, Leow suggested that participants that had meta-awareness processed the data more conceptually (top-down) than the other participants that he suggested used bottom-up, data-driven processing.

This research demonstrated that awareness is not unitary and learners that achieve higher levels of awareness are more accurate on an immediate posttest. Yet, the research design meant that all participants had paid attention to the target feature as they had manipulated the stem of the verb either whilst correctly entering it into the crossword (previously-known) or when entering another a word that crossed the verb where the spelling change occurred, which would lead participants to either notice a mistake with their verb

spelling or to notice that the initial letters in the verb could not be spelt in the same way as the infinitive. Leow (2000) adapted the crossword so it could be completed without participant awareness of the spelling change in the stem of certain irregular preterites in order to investigate the necessity of noticing (i.e. whether learning without attention can occur). The change consisted of using crossword clues relating to final verbal morphology as the focus for the learners. The answers to these clues intercepted at the point of the irregular preterite spelling, but as participants did not need to enter the irregular spelling, they did not have to pay attention to it for task completion. After completing the crossword, 16 participants were coded as having some awareness of the spelling change and 16 participants were coded as being unaware. On a subsequent posttest, the aware participants were significantly more accurate at recognising and producing these irregular verbs than at the pretest. For the unaware participants, there were no significant pretest to posttest differences. Leow interpreted the results as supporting the importance of awareness for further processing.

Later work conducted by Leow and colleagues (Hama & Leow, 2010; Leow, 1997, 2000; Rosa & Leow, 2004a, 2004b; Rosa & O'Neill, 1999) has largely found no dissociation between awareness and learning. In addition, this research has demonstrated the importance of allowing participants to interact with the input incidentally as opposed to being allocated to treatment groups that receive different types of orienting tasks to complete, which the majority of explicit and implicit learning research in SLA has done (e.g. DeGraaff, 1997; DeKeyser, 1995; Robinson, 1996). Rosa and O'Neill investigated the role of awareness and type of treatment on intake. Participants were divided into one of four treatment groups: ±formal instruction (written grammatical explanation) and ±rule-search (either instruction to search for a rule or instruction to memorise information about the sentences during task completion). A fifth group acted as a comparison group by completing the task without formal instruction or information to either

search for rules or memorise sentences (however, as the task focused on the target linguistic feature, this group could not be classified as an incidental group as defined in the present study). All participants completed a problem-solving task that required them to match main and subordinate clauses of conditional sentences. In order to accurately match the two clauses, the contrary-to-fact conditional needed to be processed. Awareness was measured via an on-line think-aloud protocol. The awareness data were used to classify participants into three awareness levels: no verbal report (unaware), aware noticing (exhibited some sort of attentional focus on the conditional), and aware understanding (created a rule/hypothesis about the conditional). Overall, the instructed learners outperformed the non-instructed learners, but all learners, including those in the comparison group, showed significant pre- to posttest improvements. The level of awareness reached by participants was affected by the treatment condition. Participants that were formally instructed or told to search for rules showed higher levels of awareness, but there were participants in each condition at each level of awareness. In addition, the comparison group, who completed the task without instructions, outperformed the treatment group that were told to memorise the sentences (-formal instruction and -rule-search). This research highlights the fact that instructions on how to complete a task can negatively affect learning as asking participants to memorise the sentences led to less learning of the target feature than allowing participants to complete the task as they wished. Interestingly, implicit treatment groups in SLA and in Reber's artificial grammar learning paradigm are frequently instructed to memorise whilst interacting with the input (Robinson, 1997a; Rosa & O'Neill). However, these instructions may disadvantage implicit group participants as research has shown that simple rehearsal is inferior to elaboration of some sort. Arguably, when participants are told to memorise items in the input, it is likely that a rehearsal strategy will be used and as such, the likelihood of this information entering long-term memory

may be reduced (Bower & Winzenz, 1970). These results highlight the importance of not assigning participants to an implicit condition that includes instructions to memorise. Rather, all participants should interact with the input in the same way. Awareness measures can then divide learners as having learnt implicitly or explicitly.

It is important to mention that one study conducted using Leow's methodology found a dissociation between awareness and learning. Bell and Collins (2009) investigated the role of awareness of morphological/phonological word-ending clues of French grammatical gender. Unlike Leow's (1997, 2000) crossword that required participants to focus on one aspect of grammar whilst also providing incidental exposure to another aspect of grammar, Bell and Collins created a crossword that was to be completed by focusing on meaning. To my knowledge, this is the first awareness research following Leow's methodology that asked learners to focus on meaning whilst the researchers' interest lay in the processing of form, which would be considered incidental learning (Schmidt, 1995). Despite Leow's crossword also permitting incidental learning, the participants were in a form-focused mind-set as the crossword consisted of clues that asked them about grammatical forms. The participants in Bell and Collins, Anglophones with low-proficiency in French, had no reason to focus on grammar as no grammar was needed for crossword completion. Much like a crossword done in a first language (L1), the aim was to find a word to fit a definition. The input of interest, masculine nouns ending in *eau* and feminine nouns ending in *elle*, was provided in an answer key that included each word alongside an image depicting the meaning of the word (at no point were the learners given explicit information on gender). Awareness was measured via an on-line think-aloud and two off-line probe questions. Eighteen participants noticed something about gender whilst eighteen participants did not. Despite these differences, all participants were significantly more accurate on the posttest with words that had appeared in the crossword, but no

significant differences were found between the words in the pretest that were also in the posttest (system learning). In other words, all participants appeared to have item learnt[3] from the crossword exposure, but this was not sufficient for system learning, which would have been evident if the words that featured in both the pretest and the posttest were more accurately assigned gender at the posttest (as no input had been provided for these words).

In this research, it was not possible to divide awareness into the two levels of noticing and understanding as only one participant could formulate a rule after exposure, and only two more could do so after the posttest. The important finding though is that whilst participants interact with language for meaning, awareness (as measured) may not be necessary for some item learning to occur. In terms of explicit and implicit learning, this can be interpreted in a number of ways: a.) implicit item learning occurred (Robinson, 2005); b.) explicit item learning occurred whereby participants simply remembered in declarative memory the determiner and the noun without any level of analysis of what the determiner actually meant in terms of gender (Paradis, 2009); or c.) all participants noticed the items as they had to pay selective attention to them in the crossword as they read them in the answer key and wrote them in the crossword. The awareness measures used were not sensitive enough to pick up this type of noticing, but Schmidt's modified *Noticing Hypothesis* (e.g. Schmidt, 2001) would consider this to be noticing. The learning that occurred after noticing could have been explicit or implicit, with the possibility that those learners that were coded as being aware learnt explicitly after noticing and those learners coded as being unaware learnt implicitly after noticing. This final interpretation demonstrates the importance of not equating noticing with explicit learning as many

[3] It is important to note that this item learning may not have led to retention in long-term memory due to the short exposure the participants received and the documented difficulty of acquiring grammatical gender.

researchers believe that noticing is necessary for any type of input to become available for both explicit and implicit learning (Kaufman et al., 2010; Robinson, 2003; Williams, 2009).

To summarise, the majority of research that has used the methodology introduced by Leow (1997) has found that awareness is necessary for learning and that higher levels of awareness (rule formation) are usually associated with higher levels of posttest performance. Evidence for implicit learning (or item memorisation) comes from research that investigated the learning of form by participants that were engaged in a meaningful task (i.e. learning noun gender in French from reliable input cues, Bell & Collins, 2009). These contradictory findings suggest that when participants are focused on meaning, implicit learning of form can occur. However, when they are focused on form, implicit learning of another form may not be possible.

Work conducted by Williams and his students/colleagues has demonstrated that implicit learning can occur for syntax (Rebuschat, 2008; Williams & Kuribara, 2008) and aspects of language that encode both form and meaning (form-meaning connections) (Williams, 2005).

Williams' work has focused on the implicit learning of form-meaning connections in a miniature noun-class system. The noun-class system consists of four determiners that mark distance (*gi*, *ro* = near; *ul*, *ne* = far) and animacy (*gi, ul* = animate; *ro, ne* = inanimate). Participants are only taught the distance aspect of the system. Over a number of trials, participants read sentences presented in English that include one of the four determiners (e.g. *after my meal I went to the sink and washed ro cup*, Williams, 2005, p. 304). Participants have to press a key corresponding to the meaning of the determiner in terms of distance. Both the determiner and the sentence demonstrate the distance relationship. Participants are never informed of the importance of animacy. However, after training, they complete a surprise test in which they have to select from one of two determiners based on animacy only to complete a sentence. All participants consistently perform at above-chance levels on the surprise test

despite not being able to verbalise information related to the importance of animacy post-exposure (i.e. implicit learning). Performance is better in the test on trained items, but even for new items, above-chance performance has been found.

Hama and Leow (2010) replicated Williams' (2005) study, but they found no evidence of implicit learning. However, in Williams' study, on the posttest, participants only had to make a decision with regards to animacy (two-choice test items). Hama and Leow's participants had to process for animacy *and* distance during testing. Leung and Williams (2011) believe the change from a two-choice response to a four-choice response could explain the difference in findings. They suggest that the participants may have focused at the sentential level to establish the distance relationship at the expense of focusing on the noun phrase, which needed to be processed to establish the animacy relationship. As participants were informed of the importance of distance, but not animacy, it seems reasonable to suggest that processing of the sentence as opposed to the noun phrase would be prioritised as the sentence, not the noun phrase, determines the distance relationship in terms of meaning. In addition, contrary to Williams' implicit learners, Hama and Leow's implicit (non-)learners did not behave significantly more accurately during the test on trained items for animacy despite hearing these items six times. This finding, accompanied with the difference in what needed to be processed to complete the training task, demonstrates that the research methodology used in Hama and Leow may have unfairly drawn attention away from animacy. These contradictory findings and possible explanation are important as they demonstrate that even though implicit learning appears to exist, it may only be possible to document it using highly controlled experiments that do not allow for the interference of unrelated language features.

To summarise, it appears that humans are capable of finding statistical regularities in the input without their paying attention to what these regularities mean. SLA research has also

demonstrated that participants are able to learn about the structure of language without being able to report this information, and mere exposure without awareness can lead to superior performance from pretest to posttest on discrete-item measures (Bell & Collins, 2009; Rosa & O'Neill, 1999). However, in experiments that have divided participants based on whether they have learnt explicitly or implicitly, accuracy scores for the explicit learners are generally higher (Leow, 2000; Rebuschat, 2008).

The above information concerning the possibility of implicit learning was essential in order to motivate the current research objectives in relation to explicit learning and implicit learning: to further understanding of whether adults are able to learn syntax explicitly and implicitly simultaneously during language use, and whether one type of learning is superior to another. To address these issues, it is vital to understand how extant research has classified participants in terms of type of learning as this highlights why SLA research has not investigated the co-occurrence of these two types of learning within-subjects. It also offers an insight into why explicit learners may be more accurate than implicit learners as issues with classification could be over-estimating the number of explicit learners and under-estimating the number of implicit learners. Therefore, I will now present extant methods of classification alongside a discussion of their advantages and disadvantages.

1.4 Measures of Awareness

Measuring whether learning can occur explicitly and/or implicitly can be done using a number of methodological tools. These tools can be used as learning occurs (on-line) or used after learning occurs (off-line). They can be objective (researcher-driven) or subjective (participant-driven). Four measures have been used in research into the implicit learning of languages: post-exposure verbal reports (probe questions), think-aloud protocols, confidence

ratings minus response bias (Signal Detection Theory, Macmillan & Creelman, 2005), and source attributions.

1.4.1 Post-exposure verbal reports

Initial implicit learning studies using Reber's artificial language learning paradigm either included no tools for measuring type of learning (e.g. Reber, experiment 2[4], 1967) or post-exposure questions to elicit verbalisable knowledge (e.g. Reber, experiment 1, 1967). Post-exposure questions range from general (e.g. do you have any idea of the rigorous rules used to form the stimulus items?) to more specific (e.g. what letters or groups of letters may sentences begin or end with? or; can sentences end with a P? [Reber, 1967]). Post-exposure questions are a subjective, off-line measure of the contents of consciousness and they are still frequently used (Bell & Collins, 2009; Dienes, Broadbent, & Berry, 1991; Williams, 2005). However, their utility has been widely criticised. Firstly, an essential factor in any measure of awareness is that it is exhaustive in eliciting all explicit learning (it "must be sensitive to all of the conscious knowledge the participant is in possession of", Shanks, 2005, p. 207): the sensitivity criterion (Shanks & St. John, 1994). As responses to post-exposure questions are elicited after encoding occurs, they are open to memory decay. Indeed, Hama and Leow (2010) used both an on-line think-aloud protocol during training and testing, and an off-line probe question. They found that two participants discussed the importance of animacy, the learning target, during the testing think-aloud protocol ("the *gi* rabbit because it's close and an animate object", Hama & Leow, p. 484), but did not include any information on animacy in responses to the probe question ("the thing that I did is that I associated the first two, *ne* & *ul*, with far away and *gi* & *ro* with near and I had that ingrained in my mind", p. 485). The problem of exhaustiveness does not just relate to

[4] It may be that data were collected, but there is not mention of these data in the article.

memory decay as participants may consciously withhold some information that is controlling their behaviour. Information that participants hold with low confidence (e.g. a hunch) may be more likely to be withheld than information held with high confidence (Shanks, 2005). To my knowledge, there is no direct research investigating whether different types of post-exposure question can lead to more or less information being reported. However, research that has used extensive questioning or that has motivated participants to report information in some way (e.g. Schmidt & Dark, 1998, required participants to report a certain number of pieces of information) often appears to elicit more information than when participants are simply asked to recall what they think they understood. Another issue related to the criterion of exhaustiveness is the wording employed in the post-exposure questions. Lovibond and Shanks (2002) criticise post-exposure questions that; a.) are confusing for participants to understand, b.) have an internal response bias due to the encouragement of false positive responses (or false negatives presumably), and c.) include questions pertaining to other areas of the experiment alongside the questions on awareness. Bell (2009) asked participants: "What do you think the linguistic purpose of the task was?". The aim of the question was to understand whether participants had understood that French noun endings predict noun gender (*-eau* = masculine; *–elle* = feminine). However, many of the participants had difficulty understanding the term "linguistic purpose". Using a less technical term may have elicited more information.

Another important issue that needs to be considered is whether the information that the experimenter is attempting to elicit in the post-exposure questions is indeed the information that is controlling participant behaviour in the test of learning: the information criterion (Shanks & St. John, 1994) or correlated hypotheses (Adams, 1957; Dulany, 1961). Shanks and St. John demonstrate the importance of meeting the information criterion using results from a frequently cited study of implicit learning (Lewicki, Czyzewska, & Hoffman, 1987).

In Lewicki et al.'s study, participants were trained on a serial-reaction time task presented on a computer screen divided into quadrants. Participants had to press a computer key corresponding to the quadrant in which a stimulus appeared. Over time, participants speeded up significantly and when the rules were changed, the reaction times were significantly longer. The location of the stimulus on the trial of interest, the seventh trial, could be predicted based on its location on the first, third, fourth, and sixth trials, and this is the information Lewicki et al. attempted to elicit. However, simply using information of location on the sixth trial could help participants speed up their response as the sixth trial doubled the likelihood of the stimulus appearing in one of two locations on the seventh trial. In this situation, it is clear that the information that the researchers were eliciting was not the only information that participants could have been employing to make decisions.

In relation to the information criterion, another important issue that has not currently been addressed relates to a potential mismatch between the information a participant reports using and the information the participant actually used. It is assumed that the reported information controls behaviour. However, during pilot testing for the current research, analyses of behaviour during the testing phase and post-exposure question responses demonstrated a disparity. A participant reported using the following rule: "My rule was that sentences of the following form were valid: Time adverb + subject + object + verb + conjunctive + verb + subject + object". However, the test of learning had no items of this sentence type. If the metalanguage used is loosely interpreted and the focus is placed on the verb being placed in final position in the first clause and second position in the second clause, the participant correctly accepted 8/12 items, but also incorrectly accepted 6/12 items that were created to test understanding of this verb placement rule. In this particular situation, it could be that the participant's behaviour is being controlled by other sources of knowledge as well. Indeed, this points towards a larger

problem in the interpretation of probe question data: if a participant formulates a correct rule, the participant is labelled as an explicit learner (has conscious knowledge), and it is assumed that this information controlled all behaviour. However, there are a number of reasons why this logic does not stand. Firstly, if this were true, results on learning tasks that do not employ time limits should contain very few errors (obviously in relation to the stated rule only if more than one rule is at play) as participants have sufficient time for their behaviour to be controlled according to the rule. When time limits are imposed, more errors are foreseeable for two reasons; it is widely-believed that time limits a.) favour the use of implicit knowledge, and b.) explicit knowledge takes longer to access than implicit knowledge[5]. However, when performance by explicit learners is included in published research, it is not categorical (Leow, 1997; Rebuschat, 2008). Based on research, this is to be expected as there have always been documented divides between the ability to state a rule and the ability to use it correctly (e.g. Green and Hecht, 1992). Nevertheless, in terms of categorising participants based on type of learning, when a correct rule is provided, the possibility of implicit learning is withdrawn. To my knowledge, no research has attempted to divide participant behaviour on the test of learning based on probe question responses, but it would seem that behaviour that contradicts the structural knowledge reported could very well be driven by implicit learning.

Another problem with labelling a participant as having only learnt explicitly based on probe questions is that participants may have formulated the rule after training (during testing or in answering the probe questions). The initial responses during testing may be based on information that has been learnt implicitly. As Williams (2009) points out, it is possible for 'insight' to occur, the process of implicit knowledge (or something that has been learnt implicitly)

[5] These two points may seem to be identical, but I believe there is an important difference here. The fact that time limits favour the use of implicit knowledge does not preclude its use when there are no time limits.

becoming explicit. In fact, findings from Hama and Leow (2010) support this argument as think-aloud protocols from training revealed no aware learners, but think-aloud protocols recorded during testing did, that is, they had become aware during testing not training so their initial testing responses may not have been based on knowledge they had learnt explicitly.

Despite the above criticisms, the inclusion of post-exposure questions is strongly advised. Firstly, they are a practical means of measuring awareness. Participants can respond to written questions without the experimenter being present, which allows for group testing. Secondly, in research that has included other measures alongside post-exposure questions, the post-exposure questions appear to have been either more sensitive (Bell, 2009) or nearly as sensitive (Hama & Leow, 2010; only including a post-exposure question would have led to two participants out of nine being incorrectly labelled as unaware [in addition all participants that were aware from the other measure of awareness, a think-aloud, were only labelled as aware during the test of learning, not during training). Finally, not including post-exposure questions could lead to over-estimating the amount of knowledge that has been created implicitly (just as including them can lead to the under-estimation of quantity of implicit knowledge). In the SLA literature, post-exposure questions tend to be coupled with another measure of awareness (Bell & Collins, 2009; Leow, 2000; Rebuschat, 2008; Rosa & O'Neill, 1999), and using multiple measures has been recommended (Hama & Leow, 2010; Schmidt, 2001).

1.4.2 (Think-aloud) protocols

A think-aloud protocol is an on-line, subjective measure of awareness that can be written or verbal. Whilst being exposed to the input of interest, participants are asked to state aloud (or write down) all their thoughts, which are later analysed for evidence of awareness. As they are concurrent, they are believed to capture information that off-line measures may miss,

thus they are more likely to fulfil the sensitivity criterion (Shanks & St. John, 1994). They have been used in a number of explicit and implicit learning experiments in the field of psychology and SLA, but they are used differently in the two fields. In psychology research, protocols accompany learning conditions and/or stimuli that are designed to investigate either explicit learning or implicit learning. In SLA research, protocols are used to establish type of learning. Findings from explicit learning experiments in psychology demonstrate hypothesis-testing and relatively slow processing of the information. Protocols from implicit learning experiments include obscure information and relatively quick processing (Shanks & St. John, 1994). In psychology implicit learning research, the rules to learn do not carry linguistic meaning as they do in SLA implicit learning research.

In the SLA literature, think-aloud protocols have had mixed success at establishing type of learning. Rosa and O'Neill (1999) found 27 participants aware at the level of understanding (a mention of a rule related to the target structure), 20 participants aware at the level of noticing (a mention of the target structure), and 20 participants that reported no awareness (no reference to the target structure). The training task provided participants with one phrase of a complex sentence. Participants then had to choose the corresponding phrase to complete the sentence correctly. This decision was based on the target feature, the Spanish contrary-to-fact conditional. As such, it is actually surprising that 20 participants did not mention anything relating to the structure or the rule.

Using a task that does not require the form to be processed for task completion, but is still focused on grammar, also successfully identified aware learners from think-aloud protocols. Leow (2000) asked Anglophone participants to complete a crossword that focused on verb inflections in the past simple in Spanish. However, the responses to the crossword clues intersected first syllables in other clues that contained a spelling change (from a regular pattern

to an irregular pattern); this was the feature of interest for the researcher. Analyses of the think-alouds showed 16 aware participants and 16 unaware participants.

SLA research that has included tasks that do not require the target feature to be processed and that do not use a grammar-based task have been less successful at using think-aloud protocols to establish type of learning. Bell (2009) asked 36 Anglophone participants to complete a crossword that focused on vocabulary in French. Unbeknownst to the participants, all the crossword answers were either masculine words ending in *–eau* or feminine words ending in *–elle*. The words alongside the determiner marking gender were provided in an answer key. No participants showed any signs of awareness at this stage (e.g. no mention of gender or no added stress on the determiner or the noun ending).

Similar results were also obtained by Hama and Leow (2010), who told participants to process determiners in sentences for the importance of distance (one linguistic feature) whilst also providing input on another target feature (the importance of animacy). During training, no think-aloud protocols demonstrated aware learners. However, the think-aloud used during testing found eight participants out of thirty-four that showed signs of awareness. Out of these eight participants, six mentioned the same critical information on a post-exposure question.

The above SLA research findings demonstrate that including concurrent verbal reports to establish each participant's type of learning may not be as useful as often suggested. Their utility could depend on the type of training task participants complete. Hama and Leow's (2010) finding of participants that became aware during testing is also important. If think-alouds are used, it may be useful to include them during training and testing as information that has been learnt explicitly may not be discussed at the time of encoding. However, it is crucial to bear in mind that participants that report information at the time of testing may have also learnt implicitly, but that this information may become explicit when completing a test that focuses

specifically on the linguistic feature of interest. In other words, information that has been learnt implicitly may lead to later explicit learning. Without such a focused test, it may be that participants continue to process the information implicitly. Unfortunately, in order to document quantity of learning, focused tests are needed and as such, the importance of implicit learning and its possibilities in terms of quantity of learning (accuracy) may be underestimated.

The above discussion has focused on the ability of think-aloud protocols to establish type of learning. However, there is another important question surrounding their use: does the thinking aloud affect the cognitive processes used whilst learning (*reactivity*, Ericsson & Simon, 1984)?

Findings from research investigating the reactivity of think-aloud protocols in SLA have been contradictory. Leow and Morgan-Short (2004) reported research conducted with English-speaking first-year college-level learners of Spanish. Participants read a text for both meaning (comprehension) and form (unknown verb forms). Half of the participants were instructed to think aloud. All participants were then tested on text comprehension, and intake and written knowledge of the Spanish impersonal imperative, which had been underlined in the reading text for half of the participants. Quantitative data analyses showed that there were no significant differences, either facilitative or non-facilitative, for the participants that had thought aloud.

Conflicting results have been reported by other researchers (Bowles, 2008; Sachs & Polio, 2007; Sanz, Lin, Lado, Bowden, & Stafford, 2009). Sanz et al. conducted two experiments. Findings from one experiment complement Leow and Morgan-Short's (2004) findings, but results from the second experiment are contradictory as participants that thought aloud were more accurate on the posttest than participants that did not think aloud. A major difference between the two experiments is the degree of explicitness of the treatment. In experiment one (no reactivity), participants were provided with explicit rules. In experiment two (reactivity

observed), participants were not explicitly taught. The authors suggest that the reactivity of think-aloud protocols may be dependent on task demands. In addition, they believe that thinking-aloud may promote metalinguistic reflection as a qualitative analysis of the verbalisations highlighted that over 80% of them were metalinguistic in nature. Latencies on the grammaticality judgement posttest were also significantly slower for the think-aloud group when compared to the non-think-aloud group. Longer reaction times suggest the use of more conscious knowledge as it is widely believed that explicit knowledge takes longer to access than implicit knowledge[6]. Hence, asking participants to think-aloud may encourage conscious learning.

Encouraging conscious learning is undesirable in research that is investigating whether different types of learning occur during incidental acquisition. However, in the SLA literature, the use of an on-line measure is encouraged (Hama & Leow, 2010; Schmidt, 2001), and results from research that does not include an on-line measure have been criticised (e.g. Hama & Leow's replication of Williams, 2005, included an on-line measure of awareness).

A final issue with think-aloud protocols relates to a similar issue raised in relation to post-exposure questions; does one reference to the target feature mean all learning is explicit only? If a participant makes any reference to the structure of interest during a think-aloud (and this during training or testing in experiments that have included think-alouds in both), they are considered to have learnt explicitly. In some research, the degree of explicitness has also been established based on whether a rule about the feature is formulated (aware understanding, Leow, 2000; Rosa & O'Neill, 1999) or not (aware noticing, Leow; Rosa & O'Neill). As with post-exposure questions, this assumption that learning is therefore explicit could lead to

[6] This research did not investigate type of learning, but significant differences in posttest reaction times could be interpreted as being due to the type of knowledge that was being accessed; the non think-aloud learners may have been using more intuition.

underestimation of implicit learning. Categorising learners as being aware when they notice the feature in the input is problematic. Participants have been coded as noticing a feature in the input if they make any reference to the feature. In Rosa and O'Neill, participants were coded as having noticed if they made any reference to the target feature (conditional verb forms) by either pausing after reading a target verb form or reading it then making a comment on it (without providing a rule). They wished to capture any "indication that focal attention was being directed toward the specific verb form in the clause" (p. 529). However, researchers do not discount the need for focal attention if anything is to be learnt, whether explicitly or implicitly (Kaufman et al., 2010; Robinson, 2003; Williams, 2009). Coding learners as aware based on focal attention alone is problematic. In addition, evidence of focal attention plus a report of having seen the target feature (as opposed to just reporting a specific item) may not preclude implicit learning as both implicit and explicit processes may be being used concurrently.

1.4.3 Confidence ratings

Another means of measuring awareness that has been investigated in the cognitive psychology literature is the use of confidence ratings. Confidence ratings require participants to rate how confident they are that their grammaticality judgements are accurate. It has been shown that asking participants to rate their confidence from guessing to completely confident during testing can demonstrate the type of knowledge that has been created. If accuracy correlates with confidence, it can be inferred the knowledge is held explicitly, but if participants are equally confident with accurate and inaccurate decisions, it can be assumed that the knowledge is unconscious (zero-correlation criterion, [Dienes, Altmann, Kwan, & Goode, 1995]). In addition, if scores are above chance, but participants believe they are guessing, knowledge is unconscious (guessing criterion, [Dienes et al., 1995]). Confidence ratings have successfully

been used in a number of implicit learning research experiments (Cheesman & Merikle, 1986; Dienes et al.; Dienes & Scott, 2005; Dienes & Seth, 2010), including one study addressing the acquisition of a second language (Rebuschat, 2008).

Requiring participants to rate their confidence does not address the issue that participants may interpret their confidence differently (response bias). However, Kunimoto, Miller, and Pashler (2001) suggested that it is possible to reduce response bias by analysing accuracy scores and confidence ratings using measures designed to remove background noise. Kunimoto et al. used a Signal Detection Theory (Green & Swets, 1966) measure, *d'*, that is believed to separate bias from response. Subsequent research employing this measure in sequence learning experiments (Tunney & Shanks, 2003) and language learning experiments (Rebuschat, 2008) has demonstrated that this is a sensitive awareness measure. Another advantage with confidence ratings calculated using *d'* is that they classify participants along a continuum ranging from most implicit to most explicit. Even though a participant is still an explicit learner (positive *d'* score) or an implicit learner (negative *d'* score), it demonstrates that participants behave in different ways in terms of how implicit or how explicit their learning is. Both of these advantages are, of course, based on the assumption that explicit learning drives the relationship between accuracy and confidence.

Of course, if one is to have confidence in confidence ratings, one needs to assume that confidence is linked to accuracy based only on explicit learning. However, an oft-cited example of where this is not the case is with regards to first languages. L1 speakers are accurate and confident at labelling a sentence as grammatical or ungrammatical, but they are not likely to hold explicit knowledge as to why this is the case. This contradicts the rationale behind using confidence ratings as L1 speakers are accurate and confident, but their knowledge is implicit. In research using natural languages, the use of confidence ratings alone may not be warranted.

However, the inclusion of another measure, source attributions, to corroborate the findings from confidence ratings addresses this problem.

1.4.4 Source attributions

One way to complement confidence ratings is to include source attributions. Dienes and Scott (2005) suggested that if a participant is not only asked how confident he/she is, but the source of this confidence (i.e. on what this confidence is based: rule, memory, intuition, guess), it is possible to determine the type of knowledge possessed.

The rationale behind this approach stems from the type of knowledge that is created during training (i.e. learning) and the type of knowledge used during testing. During testing, participants use judgement knowledge. Judgement knowledge compares the test items with the training items to see whether the underlying structure is the same or not. However, during training, participants are creating structural knowledge: knowledge of the structure of the input, which could relate to chunks (memorised sets of words), rules, or frequency patterns. Any analysis that uses accuracy and confidence only (the zero-correlation and guessing criteria, and *d'*) reflects judgement knowledge not structural knowledge as they are asking how confident a participant is in the accuracy of his/her judgement. If structural knowledge is conscious, then judgement knowledge must be conscious, but if structural knowledge is unconscious, judgement knowledge could be either conscious or unconscious. In the organigram below (figure 1), the divide of interest occurs at the level of structural knowledge only. If structural knowledge is conscious, knowledge created during training is explicit. If structural knowledge is unconscious, knowledge created during training is implicit. As is demonstrated in the organigram, if only information on confidence is used, participants that are using intuition may be misclassified as

explicit learners when they are actually using explicit judgement knowledge, but implicit structural knowledge.

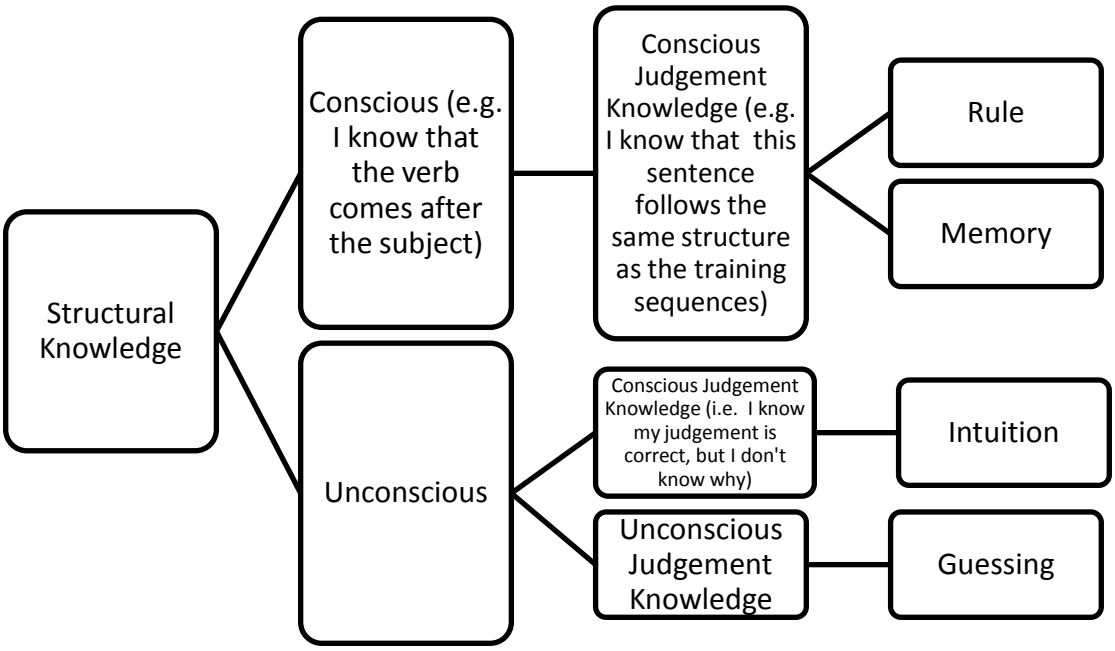

Figure 1

Different types of knowledge and learning

Therefore, if participants have learnt implicitly, their structural knowledge will be unconscious, but their judgement knowledge may be conscious (source attribution = intuition) or unconscious (source attribution = guessing). If participants have learnt explicitly, their structural knowledge and their judgement knowledge will both be conscious. Dienes and Scott (2005) investigated whether their arguments about structural and judgement knowledge were tenable. Participants were trained and tested on an artificial grammar. During testing, they judged an item and then attributed a source to their judgement (guess, intuition, rule, or memory). Results showed that they performed above baseline regardless of source attribution, which was interpreted as demonstrating that the participants had both conscious and

unconscious structural knowledge. More importantly, performance was similar when participants believed they were using intuition or guess, and performance was similar when they believed they were using a rule or memory. This divide between the two types of knowledge supports their framework.

As is clear, there is no ideal means of establishing awareness. In the SLA literature, awareness has been measured using off-line measures such as probe questions (e.g. Robinson, 1996; Williams, 2005) and on-line measures such as think-aloud protocols (e.g. Leow, 2000). Much discussion has centred on the importance of including as many measures of awareness as possible if learning is to be discussed (e.g. Bowles & Leow, 2005; Hama & Leow, 2010). As awareness is a learner-internal process, but measures are based on learner behaviour, triangulating awareness data seems to make sense. However, there are serious concerns about the use of on-line measures (as discussed above). In addition, the classification of awareness in SLA is problematic for three reasons.

Firstly, all of the above measures except source attributions are dichotomous, a participant either learns explicitly or implicitly. Source attributions have not been used as a direct measure of awareness; rather they are used to support the interpretation of confidence rating data, which is sensible as relying on what participants believe they are doing unlikely reflects what they are actually doing. The desire to categorise type of learning dichotomously may be obfuscating the possibility that a target feature can be learnt explicitly and implicitly, and this chronological means of establishing type of learning likely oversimplifies what is actually occurring. Perhaps this explains why research has not investigated whether two types of learning can occur simultaneously.

Secondly, the assumption that post-attentional processes must be explicit may be underestimating the role of implicit processing mechanisms in all learning, which could explain

the superior results for explicit learners on posttests when compared to implicit learners. It is understandable to err on the side of caution by assuming explicit learning as opposed to implicit learning in research that is attempting to prove the existence of implicit learning. However, in moving beyond proving implicit learning, it may be that finer-grained analyses of awareness data are warranted to more accurately determine the type of learning that has occurred.

Thirdly, all awareness measures focus on the language system as conceptualised by the researcher as opposed to the language system that the participant creates. Research has demonstrated that second language learning is not solely input-driven as many other factors may correlate with frequency information and subsequently affect what is learnt (N.Ellis, 2005). Developmental sequence research has also clearly demonstrated that the acquisition of certain linguistic features may include stages where the use of the feature does not resemble how it can ever be used in the target language or in the learner's first language (e.g. the use of *your* at an initial stage of the acquisition of the English possessive determiners *his* and *her*, J.White, 1998). In this respect, a rule governing the language system used in implicit learning research may not be learnt by a participant. However, he/she may have understood something else about the language system that is unforeseeable *a priori*, but that may actually constitute initial learning of this rule. It is therefore important to include a measure of awareness that allows *all* structural knowledge created by participants to be taken into account (Hama & Leow, 2010).

The above discussion highlighted different means of measuring type of learning (awareness) and their advantages and disadvantages. It also highlighted that how the measures are interpreted may be responsible for the finding that explicit learning is superior to implicit learning. Furthermore, the dichotomous nature of the awareness measures may explain why research has not been conducted that allows participants to learn explicitly and implicitly.

1.4.5 Simultaneous explicit learning and implicit learning?

Understanding whether these two types of learning can occur at the same time and in what quantities is crucial if we are to explain how adults interact with language for form when they are focused on global comprehension. Should we expect adults to use both types of learning mechanism or does one adult favour explicit learning whilst another adult favours implicit learning? To my knowledge, this issue has not been investigated *a priori* despite its importance and the belief that these two types of learning can occur at the same time. For example, N.Ellis hypothesises that implicit learning is the standard learning used during comprehension and production, and explicit learning may occur when communication breaks down. In this conceptualisation, whilst completing one task, it would be possible for both types of learning to occur. Furthermore, research conducted by R.Ellis and colleagues (Ellis et al., 2009) that has investigated different types of treatments tested learners on whether they had created explicit knowledge or implicit knowledge. The assumption again was that during the treatment, it was possible for the learners to learn explicitly and implicitly. Finally, Rebuschat's (2008) experiments investigating the possibility of implicit syntax learning yielded results that suggested his participants had learnt both explicitly and implicitly.

The above discussion of the measures of awareness makes it clear that the lack of research information on whether adults learn language input explicitly and implicitly simultaneously may be due to the dichotomous classification employed by the awareness measures. A dichotomous measure can address the issue of whether there are more participants that learn explicitly or implicitly, but it cannot address within-participant dual learning despite some researchers believing that purely explicit or purely implicit learning is likely rare (e.g. Dienes & Perner, 1999). Therefore, to address the issue of co-occurrence, it is necessary to employ a continuous measure of awareness. In the present study, a dichotomous

measure, confidence ratings, and two continuous measures, source attributions and knowledge and test behaviour (detailed in Chapter Two) were used in order to address the following three research questions.

2. How much learning occurs explicitly and how much learning occurs implicitly?
3. Are there differences in the accuracy of explicit learning and the accuracy of implicit learning?
4. What are the differences between the two means of classifying awareness (one continuous and one dichotomous?

1.5 Explaining Learning Differences: Language Learning Aptitude

The above discussion and research questions respond to a need to further understanding of the quantity and type of learning of form that occurs when participants use language to comprehend only. Even though the use of tasks that require language use is novel, it is expected that there will be differences in terms of the type of learning and the quantity of learning that occurs due to past research results (Bell & Collins, 2009; Leow, 2000; Rebuschat, 2008; Williams, 2005). Therefore, an important research direction is to investigate why these differences arise, if indeed they do when language is used, between participants when they all receive the same input. Why are there differences between participants in how much they learn during incidental exposure? Why do some participants become aware of formal regularities in the input and others do not? And why are there differences between participants in how much they learn based on their type of learning? The importance of explaining the causes of these differences in relation to type and quantity of learning has important theoretical and pedagogical implications. From a theoretical perspective, understanding factors that may play a role in why a participant learns more or less explicitly (or implicitly) advances knowledge

of factors that affect learning. From a pedagogical perspective, identifying factors that contribute to differences can lead to suggestions on how languages should be taught.

Previous SLA research has explored a number of possible factors that can explain differences between people in terms of quantity of learning. In addition, some research has addressed this issue in relation to incidental learning, and explicit and implicit learning. The extant research has focused on explaining these types of learning in terms of language learning aptitude and, as the present study is also focusing on language learning aptitude's role in the quantity and type of learning, I will now discuss theoretical issues of importance in relation to explicit learning, implicit learning, incidental learning, and language learning aptitude. Secondly, I will discuss the extant research findings and highlight areas where further research is needed.

1.5.1 Language learning aptitude, and incidental, explicit and implicit learning: Theoretical issues

It has been suggested by a number of researchers (Krashen, 1982; Reber, 1993; Zobl, 1992) that language learning aptitude is only relevant to explicit learning as the cognitive abilities associated with language learning aptitude relate to consciousness. As implicit language learning is unconscious, these abilities should not play a role in the quantity of implicit learning. Reber's general theory of implicit learning (1989) suggested that implicit learning and memory are much less affected by individual differences than explicit learning and memory. Krashen discussed the irrelevance of aptitude for *acquisition* (implicit learning) as opposed to *learning* (explicit learning) as the tests that had been created to measure aptitude (Carroll & Sapon's MLAT IV Words in Sentences [Carroll, 1964] and Pimsleur's Language Analysis section

[Pimsleur, 1968]) focused on grammatical sensitivity and inductive language learning ability[7]. Zobl (1992) suggested that when focus is on meaning only, aptitude differences between learners may be nullified, a particularly important hypothesis in relation to the present study where participants are only focused on meaning.

More specific theoretical debates have also arisen in relation to working memory as an individual cognitive ability and its importance to implicit learning. Some researchers believe that it plays an important role (N.Ellis, 2002, 2005) whilst others claim it should play no role as implicit knowledge is inherently unconscious and as such, it cannot be held in working memory: a conscious store (Paradis, 2009). These theoretical positions have been partially supported by extant research.

1.5.2 Language learning aptitude, and incidental, explicit and implicit learning: Extant research

Despite the above-mentioned claims, research has found that working memory capacity and grammatical sensitivity may play a role in the type and quantity of learning. Robinson (1997a) trained participants in one of four learning conditions: instructed and rule-search (two explicit conditions), implicit (memorise the input) and incidental (comprehend the input). Regardless of condition, each participant's awareness was measured via a questionnaire administered after testing. Participants were coded as noticing or not noticing rules, looking or not looking for rules, and being able to verbalise or not being able to verbalise rules. Aptitude could predict awareness for three out of the four conditions (implicit, rule-search, instructed but not incidental [meaning-based]). In the implicit condition, grammatical sensitivity (as measured

[7] Krashen (1982) did not discuss the memory parts of the aptitude batteries except to say, "The other parts of the aptitude batteries, in both cases, deal with auditory factors (which are not discussed here)" (p. 21)

using the MLAT IV Words in Sentences) was significantly different between those learners that looked for or verbalised rules compared to those that did not. In the rule-search condition, grammatical sensitivity was significantly different between participants that noticed and did not notice rules. In the instructed condition, memory capacity was significantly different between participants that noticed and did not notice rules. In terms of aptitude and learning, significant correlations were found between aptitude scores and accuracy scores for participants in these three conditions. In the incidental condition, there was no relationship between aptitude and awareness, or quantity of learning and aptitude.

These results are difficult to interpret. The inclusion of an off-line measure of awareness was a methodological improvement as previous research had assumed type of learning based on treatment condition (e.g. DeGraaff, 1997; Doughty, 1991). However, the inclusion of three levels of awareness and the non-specific analyses of the responses to the three questions (e.g. what each participant noticed was not verified) means the results in relation to awareness need to be treated carefully, as Robinson strongly suggests. The fact that the interactions between awareness and aptitude, awareness and learning, and awareness and treatment condition were so varied speak to this issue.

Another issue with Robinson's (1997a) study is related to how learning was operationalised. Participants were placed in treatment conditions that may or may not encourage the presumed type of learning. Informing participants to memorise in order to operationalise implicit learning has been criticised in the cognitive psychology literature (Destrebecqz & Cleermans, 2001; Dienes & Scott, 2005; Kaufman et al., 2010; Reber & Allen, 1978) as not promoting maximally implicit learning, and memory research highlights the inefficiency of rehearsal when compared to other strategies for learning (learning here meaning immediate cued recall) such as creating a visual image (Bower & Winzenz, 1970). The task given

to the participants in Robinson's incidental treatment condition (to answer yes/no comprehension questions related to the comprehension of vocabulary) may be more akin to normal learning conditions, which could lead to explicit and/or implicit learning. The results of no relationship between aptitude and awareness, and aptitude and extent of learning in the incidental condition supports Krashen's (1982) and Reber's (1989) assumption that implicit learning is not affected by cognitive abilities.

The role of aptitude when participants learn incidentally (comprehension-based treatment) was further investigated by Robinson (2005). Robinson investigated the relationship between aptitude factors and the incidental learning of Samoan, implicit artificial-grammar (letter strings) learning (Reber, 1989), and explicit-artificial series-solution grammar learning (Reber). Three aptitude factors were measured: general intelligence (WAIS-R IQ), *Language Aptitude Battery for the Japanese* that consisted of three subtests that measured rote memory for paired associates, phonemic sensitivity (matching sounds and symbols), and grammatical sensitivity to grammatical patterns in a new language (inductive language learning ability in Carroll's terms, 1964) (Sasaki, 1996, as mentioned in Robinson), and a working memory reading-span test (Osaka & Osaka, 1992). The results showed that implicit artificial grammar learning was significantly negatively correlated with IQ, explicit artificial grammar learning was significantly positively correlated with the grammatical and phonological sensitivity measures from the language aptitude battery for the Japanese, and the incidental acquisition of Samoan was significantly positively correlated with the working memory measure on both an immediate and delayed (one week after exposure) listening grammaticality judgement test, but not on a written grammaticality judgement test. Scores on a guided production test of Samoan did not correlate at the immediate posttest, but after one week, the scores correlated with the working memory measure, and after six months, the scores correlated with both the working memory

and aptitude measures. Robinson predicted that aptitude would play a role in the incidental learning of Samoan, but not in the implicit learning of the artificial grammar. This hypothesis was only partially confirmed as working memory, but not aptitude (as measured) played a role in the incidental acquisition of Samoan.

Robinson's research (1997a, 2005) demonstrates that individual differences interact with learning in ways that are difficult to interpret. It seems that incidental acquisition, which may or may not lead to implicit learning, is less affected by individual difference measures than treatment conditions that ask learners to memorise items or search for rules, and conditions that instruct learners. In addition, even when an extremely controlled task that presented 450 sentences that highlighted 3 grammar rules of Samoan was used, participants that scored highly on a test of grammatical sensitivity were not advantaged in quantity of learning that occurred. This suggests that when participants are concentrating on comprehending language whilst incidentally acquiring grammar, individual cognitive differences that are traditionally discussed in SLA research may not be significantly important.

Nevertheless, as the type of learning that occurred was not well established in Robinson's 1997a study (as Robinson discusses) and was not established in his 2005 study as it was not an aim of the study, more research is needed. In addition, Robinson's tasks involved the processing of isolated sentences (with pictures) that were unrelated as opposed to global comprehension, which is required when using a language.

Bell (2009) addressed the relationship between different aptitude traits and the explicit and implicit learning of language. Thirty-six Anglophones with low French proficiency were asked to complete a crossword. The crossword focused on vocabulary (i.e. meaning) by providing clues that defined certain objects. The objects (answers) were provided to the participants in an answer key. This allowed for exposure to 8 masculine nouns ending in *–eau*

(e.g. *le couteau*) and 8 feminine nouns ending in *–elle* (e.g. *la gazelle*), and for the exploration of whether participants would become aware that these two endings accurately (above 99%) predict gender. Participants were asked to think-aloud whilst completing the crossword and they were also asked a probe question immediately after exposure and on completing the posttest (a methodology used by Leow and colleagues, 1997, 2000, 2004, 2010). These measures of awareness were used to allocate participants to one of two groups: aware or unaware. Another way of classifying these groups could be in terms of explicit learning and implicit learning as the awareness measures showed whether the participants had become conscious or not of the utility of noun endings to determining French gender[8]. Participants also completed a number of individual difference measures: attention control, grammatical sensitivity, inductive language learning ability, phonological short-term memory, and working memory. These measures were entered into a regression analysis based on the type of learning that had occurred (whether the participants were aware or not). Only inductive language learning ability was able to significantly predict whether a participant would become aware during exposure (accurately assign participants to the aware group at a rate of 77.78% and to the unaware group at 66.67%).

Outside SLA, the importance of individual cognitive differences to implicit and explicit learning has received some research attention. Kaufman et al. (2010) investigated the importance of individual differences to implicit learning (the automatic detection of complex and noisy regularities in the input) and explicit learning (associate learning) in order to understand whether implicit learning is an ability that can be affected by individual differences, contrary to Reber's (1993) claim that implicit learning is far less affected by individual differences than explicit learning. Kaufman et al. asked English-speaking teenagers (aged 16-17)

[8] It must be noted that it is unlikely that participants learnt French gender. Rather, they may have memorised (or learnt) individual nouns with the corresponding article.

to complete a probabilistic serial reaction-time task, the preferred task type for demonstrating implicit learning due to its allowing for more incidental acquisition than a task that requires participants to memorise (Shanks, 2005). The participants also completed a number of cognitive and personality variables. The cognitive variables investigated were psychometric intelligence (verbal reasoning, mental reasoning, and perception), working memory (an operation span task asking participants to recall words after having to solve a simple maths problem), and processing speed (verbal, numerical, and figural). Significant correlations were found between implicit learning, and processing speed and verbal reasoning (residual variance not attributable to psychometric intelligence). No correlations were found between implicit learning, and explicit associative learning, working memory, and psychometric intelligence (as a whole [verbal reasoning is one out of three measures making up intelligence]). Kaufman et al. interpret the significant correlation between implicit learning and verbal reasoning as highlighting a possible role for implicit learning in a specific language acquisition ability. In addition, they found significant associations between implicit learning and educational achievement, particularly the results for foreign languages (French and German) on the British General Certificate in Secondary Education. Based on other research findings in relation to implicit learning and first and second language acquisition, they suggest "that a more complete understanding of language acquisition and perhaps other aspects of cognition could be had by further investigating individual differences in implicit learning" (p. 335).

This discussion demonstrates that individual cognitive differences play a role in the type of knowledge that is created, but research in this area is still in its infancy. Research findings have led to discussions concerning individual differences (e.g. Rebuschat, 2008; Williams, 2009) and research that has been conducted to directly address this issue has either used measures of awareness that are considered fairly insensitive (Robinson, 1996), or no measures of awareness

(DeKeyser, 1995; Robinson, 2005). In addition, the type of tasks that have been used in extant research have not always required the focus to be on meaning, and they have never required participants to use language for global comprehension only, a time where it has been hypothesised that aptitude differences will be irrelevant (Zobl, 1992). To fill this research gap, the present study asked:

5. Do cognitive abilities play a role in the quantity of incidental learning?
6. Do cognitive abilities play a different role in explicit learning and implicit learning?
7. Do cognitive abilities play a role in the accuracy of explicit learning and the accuracy of implicit learning that occurs?

1.6 Research Questions and Hypotheses

Before moving on to the methodology section, I will reiterate my research questions and propose my hypotheses.

1. Does incidental acquisition of two unknown word-order rules occur when adult learners use language?
2. How much learning occurs explicitly and how much learning occurs implicitly?
3. Are there differences in the accuracy of explicit learning and the accuracy of implicit learning?
4. What are the differences between the results based on the three means of classifying awareness for learning and the two means of classifying awareness for the accuracy of type of learning (one continuous and one dichotomous)?
5. Do cognitive abilities play a role in the quantity of incidental learning?
6. Do cognitive abilities play a different role in explicit learning and implicit learning?
7. Do cognitive abilities play a role in the accuracy of explicit learning and the accuracy of implicit learning that occurs?

In relation to research question one, it is hypothesised that adult learners, during language use, will incidentally acquire some knowledge of how the semi-artificial grammatical system works in order to allow them to perform at above-chance accuracy on two syntactic rules on the test of learning (a grammaticality judgement test). Previous research has shown participants to be capable of incidentally acquiring certain aspects of language form when its processing is not required (Bell & Collins, 2009; Rebuschat, 2008; Robinson, 2005; Williams, 2005). However, based on Rebuschat's (2008) findings, it is hypothesised that the acquisition that occurs will not reflect the word-order rules, but other information that the two word-order rules highlight (e.g. a verb can go in final position). If participants have learnt rules (whether consciously or unconsciously), they should be close to categorical in their judgement of accurate and inaccurate items. The only participants in Rebuschat's (2008) work that were categorical at accurately classifying grammatical sentences (above 90%) and rejecting ungrammatical sentences (less than 10% accepted) were those learners that had been instructed on the rules. Even in a condition where participants were asked to label the sentence type (main clause; subordinate + main; main + subordinate) before judging the plausibility of the sentence, no participants could categorically classify sentences as being grammatical or ungrammatical in the testing.

In addition, it is hypothesised that all participants will be better able to accept grammatical utterances than reject ungrammatical utterances. Research that has employed grammaticality judgement tests has frequently found that participants are more accurate at accepting grammatical sentences than rejecting ungrammatical ones (Ellis et al., 2009; Rebuschat, 2008).

In relation to research question two, it is hypothesised that participants will learn some of the language input explicitly and some of the language input implicitly (i.e. without conscious

awareness of what is being processed). This hypothesis is based on previous research that has never found participants that believe themselves to have learnt only explicitly (by choosing all rule/memory when attributing the source of the knowledge used to answer the test of learning) or only implicitly (by choosing all intuition/guess when attributing source) (Dienes & Scott, 2005; Rebuschat, 2008).

In relation to research question three, it is hypothesised that explicit learning will lead to greater accuracy than implicit learning. Extant research has frequently found that participants that process language features explicitly are more accurate than participants that process language features implicitly (Leow, 2000; Robinson, 1997a; Rosa & O'Neill; Rosa & Leow, 2004 although see Bell & Collins, 2009).

There is no hypothesis concerning research question number four as only one language learning study (Rebuschat, 2008), to my knowledge, has employed a method of classifying awareness that permits learners to demonstrate both explicit and implicit learning. However, the data from this measure, source attributions, were used for interpretation of what had been learnt rather than as a means of dividing behaviour and learning, and analysing them statistically.

In relation to the cognitive ability measures and type and quantity of learning, hypotheses are entertained in relation to explicit and implicit learning and accuracy. No hypothesis is advanced in relation to incidental exposure as research results have been contradictory (Robinson, 1997a; Robinson, 2005). In relation to explicit learning and implicit learning, the only research that has investigated whether type of learning may be related to cognitive abilities is Robinson (1997a) and Bell (2009). The results from Robinson (1997a) for the group of participants that interacted with the language incidentally for comprehension found no relationship between aptitude scores (memory and grammatical sensitivity) and whether the participants had noticed rules, looked for rules, or verbalised rules. However, Bell

found significant differences between aware and no verbal report participants based on their inductive language learning ability. Aware participants had significantly higher scores than no verbal report participants. As the individual difference measure used in Bell and the present study is the same, it is predicted that inductive language learning ability scores will be higher for those participants that demonstrate more explicit learning than those participants that demonstrate more implicit learning using confidence ratings to classify type of learning (unrelated to accuracy). In addition, when within-participant explicit learning and implicit learning scores are calculated (which is possible using the measure of knowledge and test behaviour of awareness as an individual can learn the language explicitly and implicitly), it is hypothesised that there will be a positive relationship between explicit learning and inductive language learning ability, and a negative relationship between implicit learning and inductive ability.

In relation to the accuracy of explicit learning, it is expected that working memory and inductive language learning ability will play a significant role (Bell, 2009; Robinson, 1997a). In relation to the accuracy of implicit learning, it is hypothesised that processing speed and verbal reasoning will play a significant role (Kaufmann et al., 2010). Robinson (1997a) found grammatical sensitivity was correlated with implicit learning. However, his implicit condition differs from the present study as his participants were placed into an implicit condition prior to exposure. He then asked them to interact with the input in order to respond to memory-based questions concerning the co-occurrence of words within sentences.

To summarise, eight hypotheses were entertained:

H1: Incidental acquisition will occur.

H2: The contents of learning will reflect a sensitivity to verb phrase placement rather than the two word-order rules.

H3: Participants will be better able to accept grammatical items than reject ungrammatical items on the test of learning.

H4: Participants will demonstrate both types of learning.

H5: Explicit learning will be more accurate than implicit learning.

H6: Inductive language learning ability scores will be higher for those participants that demonstrate more explicit learning than those participants that demonstrate more implicit learning.

H7: Within-participants, there will be a positive relationship between explicit learning and inductive language learning ability, and a negative relationship between implicit learning and inductive language learning ability.

H8: Working memory and inductive language learning ability will predict the accuracy of explicit learning whereas processing speed and verbal reasoning will predict the accuracy of implicit learning.

Chapter Two: Methodology

In this section, I detail how the study was conducted. Information on the participants, the target language, and the tasks used for language exposure are presented. Then, the measures of learning, awareness, and cognitive abilities are discussed. Finally, the procedure that the participants followed is detailed. Information on the development of all aspects of the employed methodology based on pilot testing is included throughout this chapter.

2.1 Participants

The participants were 81 Anglophone adults with some knowledge of at least one other non-verb second (V2) language as the present study used a V2 language as discussed below (page 65). All participants signed a consent form (Appendix A) and completed an introductory questionnaire (Appendix B) to ensure they fit the requirements detailed below. Previous implicit learning research has either not required monolingual participants or it has used participants with different first languages (e.g. R.Ellis et al., 2009; Rebuschat, 2008; Robinson, 1997a). In this project, participants were required to have some knowledge of another language. Collins (personal communication, 2011) suggested that true adult monolinguals may not behave in a similar way to adults that have had some experience with language learning. In her research experience, complete monolinguals treat language learning tasks in an inflexible manner, reluctant, for example to entertain more than one possible "correct" response for a given context; in other words, they are prescriptive. To my knowledge, this view has not been directly supported by research. However, it has been demonstrated that explicit L2 instruction and level of education play a role in a person's ability to accept grammatical utterances in his/her first language (Dąbrowska, 2010; Dąbrowska & Street, 2006). If monolinguals are used,

presenting a semi-artificial grammar in English that adapts syntax (as in the present study) may only lead to the mental unscrambling of the sentences into correct English. Ideally, as Rebuschat's (2008) participants demonstrated, participants should interact with the language without unscrambling.

Experimental participants were recruited via personal contacts, university distribution lists, and advertisements posted on-line (Montreal Craigslist and Kijiji). They were tested in a research office at a Montreal university and they were paid $10 (Canadian) for their time. Eighty-eight participants completed the experimental procedure. However, 7 participants were removed; 5 because they had studied German, the language whose syntax underlay the present study's language; 1 because she compared the sentences in the test of learning to English rather than the artificial language on which she had received training, and 1 because he had learnt English at age 13 so he could not be considered a native-speaker of English (defined in the present study as being raised in English by at least one parent and/or attending all primary school in English in an English-speaking environment). Forty control participants were recruited via personal contacts. They were all Anglophone adults and they were tested on-line. They were not paid for their time.

Including a control group was important in order to establish that the semi-artificial language would indeed be perceived as inaccurate in standard English. As experimental participants were presented the language in English, but with non-English syntax (e.g. *Yesterday ate Sara noodles*), it is possible that participants would unscramble sentences automatically (without conscious effort to unscramble) in a similar vein to the *fluent restorations* evidenced by Marslen-Wilson and Welsh (1978) whereby participants corrected pronunciation errors made by a person they were shadowing in their L1 without any dysfluency (on 49% of mispronounced words). Furthermore, certain items that are considered to be ungrammatical in English by

myself, a trained applied linguist, may not be considered ungrammatical by naive Anglophones (Dąbrowska, 2010). The control participants were not exposed to the language; rather they were asked to complete a modified version of the test of learning that consisted of grammatical and ungrammatical sentences in English (see below for an explanation and justification of the modifications). The ungrammatical sentences in English were taken from the experimental participants' test of learning. Control group responses could therefore ensure that a.) unscrambling did not occur and b.) all items considered ungrammatical in standard English by the researcher were also considered ungrammatical by naive Anglophones.

It was unnecessary to test equal numbers of control and experimental participants as both sets of results were not being compared. Rather, one initial analysis was conducted on 16 items that appeared in both the control group and experimental group grammaticality judgement test. The expectation was that the control participants should reject these items whilst the experimental participants, after exposure to a semi-artificial language, should accept them (as they were incorrect in standard English, but correct in the semi-artificial language). After this analysis, experimental group learning was classified as being anything that differed from what control participants should score on the test of learning. In addition, the control participants did not complete the cognitive measures of aptitude. The number of experimental participants was chosen based on the expected type of statistical analyses. In order to address research questions 5, 6, and 7 with regards to individual differences and learning, regression analyses were to be conducted. Sample size should be dictated by the number of predictor variables entered into a regression analysis. In the present study, 4 individual difference measures, the predictor variables, were measured. Following Tabachnick and Fidell's (2001) formula $N \geq 50+8m$ (m = number of predictor variables) (p. 117), it was decided that

approximately 82 participants were needed. The reason this figure is approximative is due to there being disagreement on how to calculate necessary sample size (Larson-Hall, 2010).

The average age of the experimental participants was 28. There were 26 males and 55 females. In terms of occupation, 46 participants were students, 23 participants were in full-time employment, and 12 participants were either in part-time employment or were unemployed. All participants had experience with at least one other language with French being the most common other-known language. Thirty-three participants considered themselves to be highly bilingual (either graded their second language proficiency as *equal to English* or *am able to live/work, and/or study in this language, but I feel more comfortable in English*).

2.2 The Language (Target of Learning)

In order to investigate the type of grammar knowledge that learners create whilst interacting with language, the participants needed to be presented with language input. Previous research has used a number of different language stimuli to understand whether learners acquire certain aspects of grammar: miniature artificial language systems, which are usually created to largely follow the rules of a natural language (Alanen, 1995; DeGraaff, 1997; DeKeyser, 1995; Friederici, Steinhauer, & Pfeifer, 2002); artificial words or phrases (and underlying grammar) that are presented embedded in a natural language (Robinson, 1997a; Williams, 2005); natural languages (Leow, 2000; Robinson, 2005; Tockowicz & MacWhinney, 2005); and semi-artificial languages that follow the patterns of natural languages and are presented using another natural language (Rebuschat, 2008).

For the purposes of this research, a modified version of Rebushcat's (2008) semi-artificial language was used (English lexis and German syntax) as this language allows meaningful tasks to be presented whilst controlling vocabulary knowledge (i.e. no unknown

words or vocabulary proficiency differences amongst participants). As any person with knowledge of a V2 language was excluded, using this language also ensures that no participant has ever been exposed to the target language feature, which is a crucial issue when investigating explicit and implicit learning.

The language system followed two syntactic rules:

1. Verb2 – All verb phrases in main clauses, including in questions, must be placed in the second-phrasal position
    a. *Yesterday walked James the dog*
2. VerbF – All verb phrases in and subordinate clauses, including in questions, must be placed in final-phrasal position
    a. *As James chocolate doesn't like, often swaps he chocolate for chips with his friends*

These rules are more limited than German syntactic rules. For example, in German main clauses, a complex verb phrase can be divided in two with the auxiliary appearing in second position and the main verb appearing in final position. The simplifications above were made in order to have only two rules governing the language system. Rebuschat (2008) adapted his system throughout his experiments and subsequently used three instead of four rules, but learning remained consistently limited except for participants that were told the rules. During piloting for the present study, it was evident that including only two rules was sufficiently challenging as participants did not learn categorically (i.e. they were not able to behave with accuracy levels above 90%). In addition, if the system had been too simple, explicit learning over implicit learning may have been encouraged as the adult participants may have attempted to break the code. This in no way suggests that implicit learning occurs (or is superior to explicit learning) only when linguistic features are complex (Krashen, 1982; Robinson, 1996). Rather,

since adults (older learners) may naturally be more analytic than children and they may seek out patterns in language input (Harley & Hart, 1997; Paradis, 2009), a system that is too simple may lead to 'insight' (Williams, 2009 taken from the problem-solving literature) where participants that were learning implicitly suddenly become aware of the simple rules or patterns underlying the input. If this were to occur, the proposed research would not be able to analyse data in relation to implicit learning, a type of learning that has been shown to exist in language learning although never when input is presented to participants in a natural fashion.

To summarise, the language was a semi-artificial language that was presented to the participants in their L1 (English). The language consisted of two syntactic rules that partly followed two rules of German syntax.

A number of other decisions were also taken concerning the language in order to ensure that a.) the training tasks remained natural, but b.) the system remained tightly controlled so that only the two rules governing the language could explain the system[9]. Decisions were made concerning: the inclusion of correct English and consequently, the type of phrase in initial position in main clauses; the limiting of lexis; the controlling of phrase type, number, and placement within a clause; and punctuation. I will now discuss these in turn.

English is a subject, verb, object language (SVO) so the verb phrase frequently comes in second clausal position (e.g. Children <u>love</u> summer). As the training tasks were supposed to be authentic, English syntax was initially included, but later removed for two reasons. Firstly, each clause that used English syntax meant one fewer clause that used non-English syntax leading to less novel input of the verb2 rule where participants could notice a gap (explicit learners) or

[9] This was successfully done except in relation to adverbials heading the independent clauses (see below for an explanation and justification).

reach a critical frequency level (implicit learners)[10] between their language system and this new language system. It could be argued that including English syntax may allow learners to bootstrap their way into the system and thus would lead to greater learning, but this remains an empirical question. Certainly in piloting, removing English syntax boosted learning. Secondly, due to constraints on how many test items could be included in the measure of learning, it seemed more useful to test participants on what they had understood about clauses and verb placement as opposed to focusing on distinguishing between correct and incorrect English syntax based on the semi-artificial grammar. In addition, Rebuschat (experiment 3, 2008) found that experimental participants were able to correctly reject sentences that followed English syntax 77.1% of the time (verb in 3rd position, *some time ago John filled the bucket with apples*), which was the best rejection rate of incorrect syntax in his experiment. As no English syntax was used during training (i.e. all of the semi-artificial grammar would be considered incorrect in standard English), this high rejection rate could simply be due to participants hypothesising that all English syntax is incorrect in this system. Alternatively, it could be that adult English speakers are better able to distinguish between correct and incorrect English syntax within the new language system.

The decision to exclude English syntax created a further problem; all main clauses would not be able to begin with the subject as a noun phrase. They would need to begin with the object (or verb complement) (e.g. The presents gave John to Sarah) and/or an adverbial (an adverb phrase or a prepositional phrase) (e.g. Really loved Jimmy holidays). Including only objects in initial position would mean that there were two shifts from English syntax as opposed to one: object in initial position and verb phrase in second position. As learning was limited in Rebuschat's (2008) participants, I wanted to simplify the system rather than make it more

[10] These terms are based on the assumption that implicit learning is statistically driven whilst explicit learning requires conscious hypothesis testing.

complex so I decided against placing objects in initial position in main clauses. Including both objects and adverbials in initial position is attractive based on Reber's (1993) notion that to increase the likelihood (possibility?) of a rule being learnt, it needs to be presented in all variations; varying the initial phrase type whilst maintaining the second phrase type (verb phrase) should lead to greater verb2 rule learning. However, other research has contradicted this (e.g. Rebuschat, 2008). In addition, if two types of phrase are included in initial position during training, both of these phrase types need to be tested to understand learning. This adds test items to a test that is already long for participants to complete. It was decided to include adverbials only in initial position in main clauses. Even though participants could then create the erroneous rule that main clauses needed to begin with adverbials, this was not deemed problematic as this rule was identified *a priori* so test items also included some items with adverbial in first position in main clauses and some not in order to highlight what had been learnt. Furthermore, the measure of awareness, knowledge and test behaviour, analysed awareness in terms of learner verbalisation of all structural knowledge rather than only in relation to the two language rules.

In this language, lexis was not controlled in any way. The training tasks used language in a natural, meaningful manner (see below for information on the tasks) so controlling lexis was not desirable. In addition, after manipulating lexis in his first three experiments, Rebuschat (2008) continued his experiments with free lexis as it did not appear to affect learning.

As this language is governed by phrase placement within clauses, it was important to take into account the types and number of phrases, and their placement within a clause. As the training tasks consisted of meaningful, every-day tasks, the training materials were created and then the syntactic patterns were documented. However, for the test of learning, the syntactic

patterns were tightly controlled to ensure that conclusions could be drawn concerning what had been learnt (see below for information on included patterns alongside justification).

Decisions regarding punctuation also needed to be made. In English, it is common to use a comma after an adverb or prepositional phrase in sentence-initial position (*Lately, I have been working hard* or; *In the morning, the sun rises in the east*) (Ehrlich, 1992). However, it does not appear to be compulsory and certain phrases, particularly one word phrases, seem less likely to take a comma. As all the verb2 sentences begin with adverbials, it was decided that no commas would be used. This was to avoid a rule in relation to the use of punctuation.

In complex sentences, commas are usually used between clauses when the subordinate clause is in sentence-initial position, but not when the main clause is in sentence-initial position (Celce-Murcia & Larsen-Freeman, 1999). This rule was adhered to as it proved a useful means of delimiting the end of the subordinate clause and the beginning of the main clause, for example *Because Jenny cake likes really enjoys visiting she her grandmother* vs. *Because Jenny cake likes, really enjoys visiting she her grandmother*. The comma allows for parsing of the sentence more efficiently. A comma would not have the same effect when the subordinate clause is in second position as a subordinator delimits the first clause from the second clause.

Participants were exposed to this language via a number of meaningful tasks that will now be discussed.

2.3 Presentation of the Input: Training Phase

The training phase (treatment) consisted of presenting the participants with the target of learning/stimuli (input) for approximately 30 minutes (the amount of time varied amongst participants as number of examples of the target input was controlled rather than time interacting with the input). Four tasks were used during this phase. I have referred to the tasks

using a number of adjectives (meaningful, every-day, comprehension-based, real-life) and before introducing the tasks, I would like to clarify what I mean by these adjectives and justify this choice as its employment during an explicit/implicit learning training phase is, to my knowledge, unique to the present study, and ensures a key contribution to the extant L2 learning literature. A *meaningful task* is one that is processed only for meaning in the same way a person would read a newspaper article in his/her first language, and the target of reading is a non-linguistic meaningful target outcome (Samuda & Bygate, 2008), i.e. to find out the day's events. Implicit grammatical knowledge may be needed to comprehend certain aspects of the text, for example, grammatical knowledge that the *s* morpheme marks plurality is essential in the noun phrase *the penguins*, but it is not essential in the noun phrase *two penguins* as 'two' also marks plurality. However, the goal of reading is purely meaning-based to understand the overall message of the text (i.e. the use of implicit grammatical knowledge to comprehend *the penguins* as referring to more than one penguin is not the aim of reading).

In terms of justifying the choice of task type, I am not aware of literature detailing how much time L2 learners spend processing input for meaning as opposed to processing it for form, but it is well established that L2 learners process meaning before form (Doughty & Williams, 1998; VanPatten, 2004). In addition, if lexis and grammar encode the same meaning (e.g. *yesterday* [lexis marking past]*, I washed* [grammar marking past] *the dishes)*, the lexis will be attended to over the grammar (Collins, Trofimovich, & Bell, 2011). As such, the use of a task type that requires processing only for meaning likely best reflects how L2 learners interact with input the majority of the time, particularly in language classrooms that prioritise communicative goals.

I will now present the four exposure tasks by providing information on their creation and how they were presented to the participants, including information on important choices

relating to how the input was presented and the decision not to provide feedback. Finally, I will provide an analysis of the number and type of phrases included in the training phase.

2.3.1 The four tasks

The training phase required the participants to complete four tasks: two reading passages with comprehension questions, and two crosswords (see Appendix C). These tasks fit the requirement that language can be processed for meaning only because they have a meaningful target outcome (Samuda & Bygate, 2008), which means the processing of the linguistic content is done for an overall non-linguistic goal (i.e. completing the crossword clues or answering reading comprehension questions). Furthermore, all crossword clues and comprehension questions could be answered by processing lexis; no questions required a grammatical analysis for an accurate response.

No *a priori* decisions were taken as to the number of tasks. Instead, the number of examples for each rule of the language system to be included was established. A minimum of 40 examples was chosen based on Rebuschat's (2008) findings. In his experiments, he had either 32 or 40 examples for each rule. When 40 examples were included, it seemed that more learning had occurred. Due to other methodological changes, it was not possible to determine a direct link between increases in exposure and learning, but as the importance of frequency of exposure in learning has been well-established (e.g. Ellis & Collins, 2009), 40 examples was set as a minimum. Due to the importance of participant attention remaining focused on the passage they were reading and interpreting for comprehension, it was decided that the total number of tokens should be presented across more than one exposure task (a minimum of 80 sentences).

Task creation began with reading passages as they can be used for the processing of meaning and they are also frequently employed in second language classrooms. However, it quickly became apparent that simple sentences constituted the majority of sentence types. Since at least 40 complex sentences were needed to highlight the verbF rule, I decided also to include crosswords in which the target input was embedded in the clues, rather than attempting to manipulate the short stories to include more complex sentences than felt natural. In fact, crosswords are attractive for a number of reasons; it is easy to write crossword clues containing complex sentences, crosswords are also used in second language classrooms, making the results applicable to classroom settings, and crosswords have been successfully employed in SLA awareness studies (Bell & Collins, 2009; Leow, 1997, 2000). It is possible that task type may affect type and quantity of learning. However, as understanding the effects of task type on learning was not an aim of the present study, the four tasks were analysed as a whole.

Input modality was important to consider, and extant research has used both aural and textual input. Initially, input was to be provided visually only as this was much more natural than requiring the participants to listen to and read the same text. However, it became evident during piloting that extremely little learning was occurring. Pilot participants only needed to skim the input in order to answer the questions/crossword clues. Two methodological changes were made that successfully boosted learning. Since research has demonstrated that using both aural and visual input streams can result in greater learning than using just one stream (Moreno & Mayer, 2002), audio was presented prior to visual interaction with the text[11]. In order to ensure that the participants read every word as opposed to just skimming the text, they were also required to read the text aloud. It is not common to read aloud, or to read and listen to the

[11] The audio was presented prior to visual input so participants did not spend time analysing the language form visually whilst the audio finished, which would have meant the methodology favoured explicit learning over implicit learning (a normal reading-aloud rate is 120 words per minute compared to 250 words per minute for silent reading, Aldrich & Parkin, 1989).

same text (e.g. movies with subtitles) in uninstructed settings (L1 and L2), which poses a problem for the ecological validity of this study. However, these changes were made for a number of reasons. Firstly, L2 learners in instructed settings interact with texts in this way. Research conducted by Bell and Collins (2010) revealed that adult EFL course books often present texts aurally then visually and reading-aloud is also recommended for some text extracts (e.g. *American Headway* by Soars & Soars, 2008) despite reading-aloud as a pedagogical activity being controversial. Secondly, it was essential that the participants process the syntactic deviations for any learning to occur, which, when skimming, may not have happened. Requiring participants to listen and read aloud ensured that they processed the syntactic deviations. (This points towards an important issue for the effectiveness of incidental grammar acquisition through processing written texts for meaning; the provided grammatical input may not be read by learners as they simply search for the necessary lexis to build meaning). Finally, the alternative option of providing a great deal more input (either aurally or textually) was rejected due to time, budgetary, and attentional constraints; participants were already being tested for approximately 90 minutes and it was deemed undesirable to have them spend more time completing cognitively-demanding tasks.

The issue of whether to provide feedback also needed to be considered. It has been widely documented that providing feedback is an essential means of pushing learner language development (recently documented in a meta-analysis; Li, 2010). However, this line of research focuses on formal aspects (including the learning of vocabulary). In the present study, feedback could only focus on whether the participants had correctly answered the questions/clues for meaning. Even though this would allow for task closure, it was decided that no feedback would be provided. During piloting, the participants were confident in their responses to the reading passages. Challenging crossword clues were adapted (e.g. to the response *horse*, the clue was

changed twice, from *Strangely is eaten this animal in France*, then to *Strangely is used the head of this animal as a warning in the Godfather*, and finally to *Always is used this animal in cowboy movies*) with the result that most participants were able to finish the crosswords. Aside from this evidence suggesting that feedback was not necessary, the main reason for not providing feedback was a practical one. The tasks were presented on paper so including feedback would have required interaction between the researcher and participant in real time between tasks. This would have detracted from the participant's interaction with the artificial language and would also have resulted in potentially unequal amounts of exposure to target forms across participants. It was possible to present these tasks using a computer, but this would have required additional resources (financial and time) for the writing of the program, it could have created problems for participants that were not computer literate[12], and it would make the present study a computer-assisted language learning study, which was not an aim.

To summarise, each task required the participants to do three things: listen to the text, read the text aloud, and answer the questions/clues. Participants were informed that they were completing the tasks for research investigating reading comprehension in adults. In this way, the testing phase came as a surprise, which is essential if the findings are to be discussed in relation to incidental learning as opposed to intentional learning (Hulstijn, 2003). This also acted as justification for the unrecorded reading-aloud ("You need to read aloud as I am interested in reading comprehension and if you read in your head, you will not read every word, you will skip over lots of words"). In addition, participants were told to answer the comprehension questions and clues as quickly as possible so as to increase the likelihood that the tasks were completed for meaning only, and to reduce the likelihood of reflection and explicit learning except for

[12] As participants came from diverse backgrounds (i.e. not all university students), this was an issue. In hindsight, I believe that at least 6 of the tested participants may have found it challenging to interact further with the computer than was already necessary.

those participants that learn in this way in real time. Finally, just before beginning the tasks, the participants were informed that the language of the tasks was not English, but that they would understand it ("also, I'd like to let you know that the language used in the tasks is not English, but you will understand it."). The participants were provided with this information in order to create the same type of learning condition present in extant explicit/implicit learning research where participants are always aware that they are processing new stimuli regardless of whether this occurs in a first, second, or artificial language.

2.3.2 Analysis of the stimuli

Table 2.1 details the analysis of the stimuli. The information on phrasal patterns refers to the number and order of phrases within a sentence. For example, one verb2 rule example in an affirmative phrase pattern was adjective phrase + verb phrase + noun phrase (*really was Jimmy worried.*). Thirty different phrasal patterns were used and the frequency of each pattern ranged from one to nineteen. All the phrasal patterns are detailed in Appendix D.

Table 2.1

Characteristics of the Training Phase Stimuli

Rule and Example	Frequency	Number of Phrasal Patterns
V2: Quickly washed Hannah the dishes.	61 (in simple sentences) 41 (in complex sentences)	17 (simple sentences) 12 (complex sentences)
VF: As Hannah the dishes quickly washed, quietly prepared Jane the dinner.	41 (only complex sentences) 20 subordinate clause first 21 subordinate clause second	10

After completing the training phase, participants were passed a sheet of paper that stated:

"All of the activities used a new language. You will now complete a surprise test to see how much of this language you have learnt. Remember, this test has NOTHING to do with English. Good luck!"

I will now describe the test of learning.

2.4 What Had The Participants Learnt?: Testing Phase

Quantity of learning was measured using a timed grammaticality judgement test (GJT), the principal means of measuring explicit and implicit language (letter strings) learning in cognitive psychology (Dienes & Scott, 2005; Reber, 1967), and of measuring whether knowledge is held implicitly or explicitly in SLA (Bialystok, 1982; Ellis et al., 2009; Green & Hecht, 1993).

The GJT for the experimental group was created using strict parameters in order to understand exactly what the participants had and had not learnt (see appendix E for the three versions of the GJT). There were 72 test items that tested 9 sentence patterns (8 items for each pattern). There were 3 grammatical patterns and 6 ungrammatical ones to test the acquisition of the verb2 and verbF rules. Each grammatical sentence type was paired with two ungrammatical ones. Table 2.2 presents the 9 patterns. Note that * indicates ungrammatical patterns.

Table 2.2

Sentence Patterns Employed to Test Learning

Pattern	Example	Template
V2	*Badly failed Matthew the entrance exams*	AP+VP+NP+NP
*V1	*Failed badly Matthew the entrance exams*	VP+AP+NP+NP
*VF	*Badly Matthew the entrance exams failed*	AP+NP+NP+VP
V2(main)VF(sub)	*As kindly provided Sophie her help, she her worth suddenly realised*	Sub+AP+VP+NP+NP, NP+NP+AP+VP
*V2(sub)VF(main)	*Suddenly realised Sophie her worth as she her help kindly provided*	AP+VP+NP+NP+ Sub+NP+NP+AP+VP
*V2V2	*Suddenly realised Sophie her worth as kindly provided she her help*	AP+VP+NP+NP+ Sub+AP+VP+NP+NP
VF(sub)V2(main)	*As Emma her constituency frequently represented, often visited she her neighbours*	Sub+NP+NP+AP+VP, AP+VP+NP+NP
*VF(main)V2(sub)	*Emma her neighbours often visited as frequently represented she her constituency*	NP+NP+AP+VP+ Sub+AP+VP+NP+NP
*VFVF	*As Emma her constituency frequently represented, she her neighbours often visited*	Sub+NP+NP+AP+VP, NP+NP+AP+VP

More ungrammatical patterns than grammatical patterns were needed to understand more precisely what the participants had learnt about the language. If, for example, the verb2 rule is contrasted only with an incorrect verb-initial (V1) rule, learning of the verb2 rule may be exaggerated as participants may reject V1 as it did not appear in any clause type in the training phase. On the contrary, if V2 is contrasted with an incorrect verb-final (VF) rule only, learning may be under-estimated as participants may accept VF regardless of clause type as the training phase included subordinate clauses with the verb phrase in final position.

Despite it being possible to still create an equal balance between grammatical and ungrammatical items in the test, it was decided that the number of items for each pattern should remain constant for frequency purposes. If the correct V2 pattern generated more items than the incorrect *V1 and *VF patterns for an equal split, participants may accept and reject based on frequency[13].

As table 2.2 highlights, the templates used for each test pattern (i.e. the phrase structures generating the items) were restricted for a number of reasons. Firstly, by keeping the templates consistent within each pattern, it reduced the risk that participants would accept and reject based on number of phrases in the items. Secondly, items could be kept short by not using verbs that require two object noun phrases and items with two or three adverbials (APs and PPs). Keeping the items short was a concern due to the number of tasks the participants were completing throughout the experiment and the quantity of items they were being asked to judge during the GJT. Another measure taken to keep the items short was to favour short phrases over long phrases (e.g. one-word adverb phrases were used more than multi-word

[13] This is highly unlikely to occur as a frequency analysis would have to occur during the test. As such, judgements based on frequency could only begin after completion of some of the test. In addition, Rebuschat (2008) did not find his participants to be more or less accurate at any one of eight stages of his GJT.

phrases). Thirdly, by keeping the number of phrases as small as possible, there were fewer potential syntactic rules to test, for example, verb phrases in third and fourth positions.

A number of other measures were taken to ensure that the testing items were not biased in any way:

- Noun and verb phrases from the training phase were avoided
- Noun phrases consisting of proper nouns could be of 8 types: 4 masculine names (Daniel, Matthew, Thomas, William) and 4 feminine names (Emma, Hannah, Olivia, Sophie)
- *As* and *while* were the only subordinators employed

The decision to avoid nouns and verbs from the training in the testing phase was two-fold. Previous research has either only included new items akin to Reber's transfer phase (Rebuschat, 2008) or included both old and new items in order to investigate whether item or system learning has occurred (Bell & Collins, 2009; Rosa & Leow, 2004; Williams & Kuribara, 2008). Even though the issue of item versus system explicit and implicit learning is of interest for understanding how adults learn under incidental conditions, it was not possible to address this question in the present research for two reasons. Firstly, including old and new items would have required the GJT to be lengthened, but as explained above, this was undesirable due to the number of tasks the participants were already completing[14]. Secondly, the GJT scores collected from the participants were already being analysed a number of times in relation to learning and individual differences. Including another factor (item versus system learning) would have resulted in double the statistical analyses. These two reasons combined led to the decision not to investigate item versus system learning in the present study.

[14] Even at 72 items, the GJT was completed with sighs from a number of participants. Even though the issue of test length has not been discussed in relation to learning research, it is important to bear this in mind if results are to be reflective of true learning.

The 72 items included 120 clauses with 48 items being complex sentences and 24 items simple sentences. Each clause consisted of 2 noun phrases for a total of 240 noun phrases. There were 120 subject noun phrases that consisted of 96 proper nouns and 24 subject pronouns. The 96 proper nouns were divided equally between common men's and women's names with each name appearing 12 times. In the complex sentences with the subordinator *while*, two different people acted in the sentence. Within a sentence, either only male or only female subjects were used (e.g. *Carelessly pulled Daniel the dog while Matthew the buggy carefully pushed*). In the complex sentences with the subordinator *as*, one person was used alongside a subject pronoun in the second clause (e.g. *William his troops often encouraged as valiantly protected he his country*). Therefore, *he* and *she* appeared 12 times each. The 120 object noun phrases were not controlled; rather they were written based on the choice of verb.

The verb phrases consisted of 120 tokens and 98 types and they were all conjugated in the simple past tense. 21 verbs were used twice and 1 verb was used three times. Initially, a list of the 331 most common verbs in the English language was obtained from the Macmillan English Dictionary for Advanced Learners (Rundell & Fox, 2002). The verbs were analysed for their argument structure. Only verbs that could take one object were retained as this fit the strict templates (all clauses consisted of one adverbial, two noun phrases, and one verb phrase). Sentences were written with the remaining verbs. Twenty-two verbs were used more than once simply due to their being easily employed in second clauses after first clauses had been written. In addition, 2 verbs appeared in the same form in both the training and the testing (*bought* and *read*). Six verbs appeared in a different form in both the training and the testing (*discover*, *see*, *visit*, *believe, understand*, *call*)

In the complex sentences, two subordinators were employed; *as* and *while*. *As* was used as a synonym for *because*, which was employed in the training phase. Even though no

analyses are to be conducted in this respect, it was decided that as only new items were to be used in the test, it was also useful not to repeat subordinators. *While* was not employed during the training phase. Both subordinators were used 24 times and their use in sentence-initial and sentence-mid (beginning of second clause) positions was balanced. Only in sentence-initial position was a comma used between the two clauses. This reflects the use of punctuation in the training phase. Balancing the use of subordinators in these ways ensures that any hypotheses with regards to subordinator placement would be evident in the results.

Three versions of the GJT were created (appendix E). The first version was created based on the above parameters. Eight items were written for each pattern in the order *V1, *V2sVFm, *V2V2, *VF, *VFmV2s, *VFVF, V2, V2VF, VFV2. These 72 items were randomised using a number generator (Haahr, 2011) to finalise version 1 of the test. Versions 2 and 3 were then created by rewriting the items according to the two other possible patterns. Table 2.3 details how the patterns changed across the versions.

Table 2.3

Rotation of Patterns Across Versions of the GJTs

Version 1	Version 2	Version 3
*V1	*VF	V2
*V2sVFm	*V2V2	V2VF
*V2V2	V2VF	*V2sVFm
*VF	V2	*V1
*VFmV2s	*VFVF	VFV2
*VFVF	VFV2	*VFmV2s
V2	*V1	*VF
V2VF	*V2sVFm	*V2V2
VFV2	*VFmV2s	*VFVF

Rotating the items in this fashion ensures that lexis plays no role in learning as the same lexis appeared equally in the three patterns that were being compared. This was a precautionary measure as lexis used in the training phase was avoided in the testing phase.

The GJT was created and presented to the participants using PsychoPy, an open-source application for experiments (Peirce, 2009). The items were presented aurally and textually simultaneously. Participants were asked to listen and read an item in order to judge whether it was accurate or inaccurate according to the language system with which they had just interacted. After every item, the participants were prompted to press *Y* for accurate or *N* for inaccurate. They had 10 seconds to make their decision, which included the presentation of the item. A time limit was imposed because this was the test of learning rather than part of the training. Without a time limit, participants could have used previous test items to drive learning

and thus, behave differently across the test of learning. Ideally, judgements on the test of learning should be related to the training phase only. The limit of 10 seconds was chosen based on pilot testing, which reflected the average amount of time (rounded up) it took pilot participants to judge the longest complex sentence. It is widely accepted that explicit knowledge takes more time to access than implicit knowledge, but a time restriction of 10 seconds was thought to be sufficient for explicit knowledge to be used if it existed. Loewen (2009) used timed and untimed grammaticality judgement tests to investigate the validity of their use in eliciting implicit and explicit knowledge respectively. On the untimed GJT, he found that the mean response time for L1 participants was 5.58 and for the L2 participants, it was 7.47 seconds.

2.5 Control Participants' Grammaticality Judgement Test

The control group completed a modified version of the GJT (Appendix F). Rather than assessing the grammaticality of the same 72 items as the experimental group (all ungrammatical in English), control participants were presented with 48 items from the experimental group's GJT: 16 grammatical and 32 ungrammatical items according to the artificial language (but all ungrammatical in standard English); and 24 items that followed standard English word order. They were asked to judge the grammaticality of the items. These modifications were made as asking the control participants to complete a GJT where 100% of items are ungrammatical in English, the language they are using to judge grammaticality, seems a.) different to what the experimental participants are doing, and b.) frankly to be a strange task. Previous research has asked control participants to judge items in the testing phase based on whether they believe these types of item to be grammatical in a language they do not know (Williams, 2010) or whether they believe them to be grammatical or ungrammatical in a language system that they

have not been trained on (Rebuschat, 2008). It is unclear what these two types of control group demonstrate in relation to whether the experimental groups have acquired knowledge of the novel language system; the main reason for including a control group. To show learning in the experimental group, it needed to be established that they had learnt something during training as opposed to basing their judgements on past experiences (i.e. their knowledge of English and the effects of other previously acquired languages on their judgement of these sentences presented in English and following the syntax of unknown languages, and test-taking skills). Thus, the control group needed to demonstrate the effects of past experiences on the test. My belief is that the best means of doing this is to judge the grammaticality (word order) of the items by presenting grammatical and ungrammatical items in English. However, in order to control for other known languages, the participants were simply asked to judge the grammaticality of the items; they were not told explicitly to judge grammaticality based on English, but it was assumed that this is what they would do based on English being their mother tongue and the lexis of the artificial language.

Three control GJTs were created from the experimental GJTs (Appendix F). Out of the 72 experimental items, 24 needed to be unscrambled into correct English. In keeping with the ratio of accurate versus inaccurate in the experimental GJT, 8 grammatical items and 16 ungrammatical items were unscrambled. The remaining 48 items were all considered ungrammatical in English, but 16 would be considered grammatical in the novel system. In order to choose which items to unscramble, two random lists of numbers were generated using an integer sequence randomiser (Haahr, 2011). The number of each grammatical item from the experimental GJT (24 out of a possible 72 items) was entered into the randomiser. As there were three grammatical patterns (V2, VFV2, V2VF), the first 8 numbers that allowed for 3 examples of 2 patterns and 2 examples of the remaining pattern were unscrambled. The

remaining sixteen items were included as part of the ungrammatical items in English. The same procedure was done for the ungrammatical items (48 out of a possible 72). The first 16 items that provided 3 examples of 4 of the patterns, and 2 examples of the remaining 2 patterns were unscrambled and the remaining 32 were included as ungrammatical in English. The same procedure was followed for all three versions of the control GJTs.

Up to this point, I have discussed how (incidental) learning was measured, but this research is also investigating quantities of explicit and implicit learning (type). In order to investigate type of learning, measures were employed to understand what participants were learning consciously and unconsciously. I will now introduce these measures.

2.6 Measuring Type of Learning: Explicit and/or Implicit

Three awareness measures were collected: confidence ratings, source attributions, and an off-line questionnaire. In this section, I will detail how these measures were employed.

Confidence ratings and source attributions were both incorporated into the test of learning. After hearing and reading each item, and responding to whether they believed it was accurate or inaccurate according to the language system, participants were prompted to rate their confidence in the judgement they had just made (confidence ratings: confident vs. not confident), and the source of their judgement (source attributions: rule, memory, intuition, or guess).

I used a binary confidence rating scale that simply asked participants to press 1 if they were confident they were correct and press 2 if they were not confident they were correct. In implicit learning research, a variety of numerical and textual scales have been used to measure confidence with conflicting results. Tunney and Shanks (2003) and Tunney (2005) found that binary confidence scales were more sensitive than continuous ones. However, Tunney has since

employed a continuous confidence scale (2010). Dienes (2008) referred to a series of experiments he conducted using different types of confidence scale. He reported that all scales were equally sensitive. I chose to use a binary scale as participants were already being asked to do a number of tasks so asking them to choose between one of two options seemed easier than having them rate their confidence on a continuous scale, particularly when research findings have not categorically favoured one scale over another one.

The participants chose from four source attributions: rule, memory, intuition, guess. Each term was defined to the participants using the following explanations. Rule = A grammar rule that you have created to explain the language system; Memory = A memory based on when you completed the 4 activities; Intuition = "the sentence just feels right" or "the sentence just feels wrong"; Guess = "I really have no idea". No participant asked for further clarification before they began completing the test. Dienes and Scott (2005) introduced source attributions as a means of demonstrating structural knowledge (knowledge due to learning) as opposed to judgement knowledge (knowledge to respond to test items). Structural knowledge is assumed to be conscious (explicit learning) when participants believe they are using a rule or memory, and unconscious (implicit learning) when they believe they are using intuition or guessing.

The final awareness measure was a written questionnaire used after the testing phase. A questionnaire asking for specific information was used as opposed to free recall where participants are asked to report all information about the language system. This decision was taken due to research demonstrating that asking specific questions is a more effective means of eliciting knowledge held consciously (Schmidt & Dark, 1998). The participants were asked four questions:

1. Could you tell me everything that you understood about the language used in the reading passages and crossword? Did you notice any particular rule or regularity?

2. Did you realise this information when completing the crosswords/reading passages, when completing the test, or just now in answering the above question?
3. As mentioned in the experiment, the scrambling of the sentences was not random. Instead, the word order in the sentences was based on a complex system. Reflecting now specifically on the placement of words within the sentences, can you recall any specific rule (pattern) or regularity?
4. If you had to tell another person about the system of this language, what would you tell them (i.e. how would you teach them what you know about this language)?

These questions were all aimed at eliciting as much information as possible from the participants.

These three measures collected data concerning the conscious knowledge that participants had created during exposure to the language (training and testing). These measures were analysed in three different ways to understand whether participants were using more conscious or unconscious knowledge. The three analysis techniques are described in Chapter Three.

2.7 Individual Cognitive Ability Measures

The documented research aimed to further understanding of whether cognitive differences between participants can explain the type and quantity (accuracy) of learning that occurs when participants complete meaning-based tasks in a novel language under incidental learning conditions. Building on research that had been carried out in this area (Bell, 2009; Robinson, 1997a, 2005), I investigated individual difference abilities that had received prior attention in the SLA literature and other abilities that had been shown to play a role in implicit learning in cognitive psychology (Kaufman et al., 2010; Salthouse et al., 1999). To my knowledge,

this is the first study asking participants to process language for global meaning whilst establishing their type of learning in order to further understanding of exactly how one may expect adult cognitive differences to play a role in type and quantity of adult L2 learning.

The investigation of cognitive abilities in relation to type of learning was justified in Chapter One. In this section, I will define each of the cognitive abilities measured and describe the tests used and, where necessary, justify the specific tests. However, when more than one choice of test exists, my choices were driven by test availability and test length.

2.7.1 Inductive language learning ability

Inductive language learning ability refers to the ability to infer or induce the rules present in a set of language materials. It was tested using part IV of the PLAB (Pimsleur, Reed, & Stansfield, 2004 edition): Language Analysis. This test measures the ability to understand a language system from essential translations. It is divided into two sections. The first section presents a key that implicitly presents three language rules via translation of short sentences (sentence order; accusative case; past morphology). The second section includes two more rules (negation; pronoun contraction [minus accusative case]). Participants have 10 minutes to complete the test. This time limit is the same imposed in my previous research (Bell, 2009). The original decision was motivated by the 40 minute time limit for the completion of four sections of the PLAB in the original testing instrument. This was divided by four. It was also felt that the inclusion of a time limit was essential as all participants may be able to work out the system if no time limit is imposed. Interestingly, in my experience administering this test, it has been possible to observe clear differences between participants in the ease with which they completed the test. In addition, confidence in performance has not always correlated with

success with some high-performing participants expressing doubts and some low-performing participants expressing confidence in their answers.

This test was chosen for its ability to significantly predict awareness level in previous research (Bell, 2009). In addition, this is the only widely available inductive language learning ability test. Other tests used in SLA research could not be obtained (e.g. Alderson, Clapham, & Steel, 1996).

2.7.2 Working memory

Working memory is assumed to be a limited capacity system that supports human thought processes. It supports processes by providing an interface between perception, long-term memory, and action by temporarily maintaining and storing information (Baddeley, 2003, p. 829). Working memory was tested using the Letter-Number Sequencing subtest from the Weschler Adult Intelligence Scale – WAIS III (Psychological Corporation, 1997). Participants are read sequences of numbers and letters starting with two digits and ending at a maximum of eight digits. They are asked to report the sequence verbally in a rearranged order; numbers first in numerical order and letters second in alphabetical order. This on-line manipulation of the input requires storage and processing, the two requirements for a test of working memory (Gathercole & Baddeley, 1993). There are a number of working memory measures and originally, *The Operation Span Task* (Ospan) (Turner & Engle, 1989) was to be used due to its inclusion in implicit learning research (Kaufman et al., 2010). However, the Letter-Number Sequencing measure is quick and easy to administer, an important point when participants are completing a battery of tests.

2.7.3 Processing speed

Processing speed (psychomotor speed) refers to the speed at which very simple operations can be achieved. It was measured using the first part of the Trail Making Test, which forms part of the US Army Individual Test Battery (1944). Participants are required to connect numbers in order from one to twenty-three as quickly as they can. This measure was used instead of other measures of processing speed as it was readily available to me, it has been widely used and validated, and it is quick to administer.

2.7.4 Verbal reasoning

Verbal reasoning can be defined as a person's ability to link ideas together in order to arrive at a rational conclusion. It was assessed using the verbal reasoning section of the Canadian Test of Cognitive Skills Test 4 Verbal Reasoning. This test requires participants to complete three types of multiple-choice exercises that all focus on a person's ability to understand relationships between words/clauses/sentences. This test was chosen as it was available to me, and it has been widely-used in Canadian testing. The test consists of 20 items and is administered with a 12 minute time limit.

2.8 Procedure

The procedure of the study is detailed in Table 2.4 below. The control participants completed the consent form, the introductory questionnaire, and an adapted version of the GJT.

Table 2.4

Experimental Participants' Data Collection Procedure

Order of Activities	Tests (names, explanation and appendix letter if necessary)	Time Needed (in minutes)
Consent Form and Introductory Questionnaire	See Appendices A and B	10
Training Tasks (appendix C)	1. Reading passage 1 (The Visitor) 2. Crossword 1 (Vacations!) 3. Reading passage 2 (The Nasty Parrot) 4. Crossword 2 (Animals)	20-30
Testing	Grammaticality Judgement Test (including confidence ratings and source attributions)	10-15
Debriefing Questionnaire	See Appendix G	5-10
Working Memory	Wechsler Number-Letter	4
Processing Speed	Trail Making Test	3
Inductive Language Learning Ability	PLAB IV Language Analysis	10
Verbal Reasoning	Verbal Reasoning Sub-Test of the Canadian Test of Cognitive Skills	12
Payment		1

To sum up, the above discussion introduced the methodology employed in the present research. A number of measures were used to address the research questions, which are detailed in table 2.5.

Table 2.5

Research Questions and Corresponding Measures

Research Question (RQ)	Measures Employed to Address RQ
1. Does incidental acquisition of two unknown word-order rules occur when adult learners use language?	Test of learning (timed GJT)
2. How much learning occurs explicitly and how much learning occurs implicitly?	Measures of awareness (confidence ratings, source attributions, and knowledge and test behaviour) Test of learning scores divided into explicit learning and implicit learning (based on awareness measures)
3. Are there differences in the accuracy of explicit learning and the accuracy of implicit learning?	Test of learning scores divided into explicit learning and implicit learning (based on awareness measures)
4. What are the differences between the results based on the three means of classifying awareness for learning and the two means of classifying awareness for the accuracy of type of learning (one continuous and one dichotomous)?	Test of learning scores divided into type of learning Test of learning scores divided into accuracy of explicit and implicit learning

5. Do cognitive abilities play a role in quantity of incidental learning?	Four individual difference measures Test of learning
6. Do cognitive abilities play a different role in explicit learning and implicit learning?	Four individual difference measures Test of learning divided based on type of learning
7. Do cognitive abilities play a role in the accuracy of explicit learning and the accuracy of implicit learning that occurs?	Four individual difference measures Test of learning divided based on the accuracy of explicit and implicit learning

Chapter Three: Analysis and Results

Before presenting the analyses, it is necessary to discuss a number of decisions that were taken in order to address the research questions. In this section, I will explain the scoring of the test of learning, the division of test scores based on the two rules governing the language, the establishment of a baseline for learning, and the establishment of the level of significance. I will then discuss the analyses used to establish type of learning (explicit and implicit) before presenting the analyses and results used to address each research question and the hypotheses. I will end this section with a summary of the findings before moving on to Chapter Four, where I will interpret the results. As some of the research questions are referred to in the initial discussion, I have included table 3.1 to remind the reader of the questions and hypotheses.

Table 3.1

Research Questions and Hypotheses

Research Question	Hypotheses
1. Does incidental acquisition of two unknown word-order rules occur when adult learners use language?	H1: Incidental acquisition will occur. H2: The contents of learning will reflect a sensitivity to verb phrase placement rather than the two word-order rules. H3: Participants will be better able to accept grammatical items than reject ungrammatical items on the GJT.
2. How much learning occurs explicitly and how much learning occurs implicitly?	H4: Participants will demonstrate both types of learning.

3. Are there differences in the accuracy of explicit learning and the accuracy of implicit learning?	H5: Explicit learning will be more accurate than implicit learning.
4. What are the differences between the results based on the three means of classifying awareness for learning and the two means of classifying awareness for the accuracy of type of learning (one continuous and one dichotomous)?	No hypotheses were entertained.
5. Do cognitive abilities play a role in quantity of incidental learning?	No hypotheses were entertained.
6. Do cognitive abilities play a different role in explicit learning and implicit learning?	H6: Inductive language learning ability scores will be higher for those participants that demonstrate more explicit learning than those participants that demonstrate more implicit learning. H7: Within-participants, there will be a positive relationship between explicit learning and inductive language learning ability, and a negative relationship between implicit learning and inductive language learning ability.
7. Do cognitive abilities play a role in the accuracy of explicit learning	H8: Working memory and inductive language learning ability will predict the accuracy of explicit learning

and the accuracy of implicit learning that occurs?	whereas processing speed and verbal reasoning will predict the accuracy of implicit learning.

3.1 Scoring the Test of Learning

In order to investigate whether learning occurred in the present study, scores on the test of learning (the grammaticality judgement test [GJT]) needed to be calculated. Research employing GJTs to measure learning (knowledge, competence, performance [see Loewen, 2009, for a discussion on what GJTs measure]) normally calculate accuracy scores (e.g. Bialystok, 1979, Ellis, 1991, Han & Ellis, 1999). However, accuracy scores alone are problematic as they only show what a person accurately accepts and rejects as opposed to a participant's ability to discriminate grammatical (in the present study, patterns V2, V2VF, VFV2) from ungrammatical items (patterns *V1, *VF, *V2V2, *V2sVFm, *VFVF, *VFmV2s). Ability to discriminate is important because research in SLA that has employed GJTs demonstrates that participants are better able to notice something that is correct than reject something that is incorrect (e.g. Loewen, 2009) and over-endorsement (or under-rejection) of all items can occur (Rebuschat, 2008; Williams, 2010), i.e. a propensity to accept as opposed to reject. This behaviour may be related to response bias and/or it could be explained by the fact that second language forms that are subsets of first language forms (e.g. English permits a greater number of motion verbs [*run*] to occur with prepositional phrases than Japanese, Inagaki, 2001) continue to be affected by transfer from the first language, and negative evidence may be necessary for these forms to be learnt (Inagaki; White, 1987, 1989, 1991). This may also be true for language forms that differ in subtle ways (e.g. adverb placement in English and French, L.White, 1991). In other words, a person may have learnt that something is possible (leading to correct acceptance), but have not learnt that something is not possible (leading to incorrect acceptance). Understanding

a participant's ability to discriminate can thus provide information that accuracy scores alone cannot, which is important in the present study for understanding what aspects of the language system have been learnt.

Therefore, accuracy scores and endorsement rates for the nine tested patterns were calculated. Endorsement rates are tallies of the number of items that were accepted as being correct for each pattern regardless of grammaticality. Accuracy scores were used to address all research questions. Endorsement rates were used to understand what participants had learnt about the language, the contents of learning, in order to address research question one and hypothesis two.

3.2 Analysis of Learning Based on the Two Rules

As discussed in the methodology section, the novel language was governed by two rules relating to main clauses (verb in second position [verb2]: *quickly washed Sarah the dishes*) and dependent clauses (verb in final position [verbF]: *while Jane the table vigorously wiped, quickly washed Sarah the dishes*). The test of learning, created to test these two rules using nine different sentence patterns, is presented in table 3.2.

Table 3.2

Sentence Patterns Employed in the Test of Learning

Pattern	Example
V2	*Badly failed Matthew the entrance exams*
*V1	*Failed badly Matthew the entrance exams*
*VF	*Badly Matthew the entrance exams failed*
V2(main)VF(sub)	*As kindly provided Sophie her help, she her worth suddenly realised*
*V2(sub)VF(main)	*Suddenly realised Sophie her worth as she her help kindly provided*
*V2V2	*Suddenly realised Sophie her worth as kindly provided she her help*
VF(sub)V2(main)	*As Emma her constituency frequently represented, often visited she her neighbours*
*VF(main)V2(sub)	*Emma her neighbours often visited as frequently represented she her constituency*
*VFVF	*As Emma her constituency frequently represented, she her neighbours often visited*

The main-clause verb2 rule was tested using one grammatical pattern (V2) and two ungrammatical patterns (*V1 and *VF). The dependent-clause verbF rule was tested using two grammatical patterns (V2VF and VFV2) and four ungrammatical patterns (*V2V2, *V2subordinateVFmain, *VFVF, *VFmainV2subordinate). Six patterns were employed to test the dependent-clause rule in order to understand whether participants had understood the

importance of clause type in the language. The creation of the test of learning was based on one grammatical pattern being tested alongside two ungrammatical patterns:

V2 vs. *V1 and *VF

V2VF vs. *V2V2 and *V2sVFm

VFV2 vs. *VFVF and *VFmV2s

The second two sets of patterns were thought to be testing the same underlying information (whether the participants had understood that clause type plays a role in verb placement). However, a correlational analysis between these two sets of patterns demonstrated that participants had not responded in the same way to these patterns (r = .28). Therefore, analyses were conducted for the entire test (the language system – 72 items), and, when specific analyses were done, they were conducted on each of the three sets of three patterns (V2 [simple sentences], V2VF [complex sentences with verb in second position in the initial clause], and VFV2 [complex sentences with verb in final position in the initial clause]).

3.3 Establishing a Baseline for Learning

The data collected from the control group (n = 40) on the test of learning differed from the experimental group data as discussed in Chapter Two. The control group GJT consisted of 72 items, but 24 of these items are correct in standard English. Out of the 48 remaining ungrammatical items in standard English, 16 are grammatical in the novel language and 32 are ungrammatical in the novel language. These 48 items were analysed for the control participants to demonstrate how English-speakers that had not been trained on the novel language would react. If control participants did not unscramble the sentences automatically into grammatical English, they should reject all 48 items (all = 32; V2 = 10; V2VF = 10; VFV2 = 10) and

endorsement rates should be zero. Indeed, as detailed in table 3.3, the control participants' accuracy scores and endorsement rates were as expected.

Table 3.3
Accuracy Scores and Endorsement Rates for Control Participants (n = 39)

	Mean	*SD*
All Accuracy	32.13	0.34
V2 Accuracy	10.15	0.43
V2VF Accuracy	9.97	0.16
VFV2 Accuracy	10.00	0.00
All Accurately Endorsed	0.15	0.43
All Inaccurately Endorsed	0.03	0.16
V2 Accurately Endorsed	0.13	0.41
V2 Inaccurately Endorsed	0.00	0.00
V2VF Accurately Endorsed	0.00	0.00
V2VF Inaccurately Endorsed	0.03	0.16
VFV2 Accurately Endorsed	0.00	0.00
VFV2 Inaccurately Endorsed	0.00	0.00

For three reasons, control participant scores were not statistically analysed with experimental participant scores to investigate quantity (accuracy) of learning. Firstly, the two groups had completed different tests. Secondly, the control participants demonstrated no variance so statistical procedures that rely on variance for analyses could not be used (the assumption of homogeneity of variance could not be met). Finally, the aim of including a

control group was to ensure that native-speakers of English do not automatically rearrange the deviant syntax into acceptable English in order to demonstrate that experimental participants were actually learning the syntax. As such, establishing that non-trained native-speakers rejected the items is sufficient to discuss experimental group learning.

To investigate whether incidental learning occurred, the experimental participants' GJT accuracy scores were compared to the expected scores of non-trained participants based on the control group's reactions to the language. For the accuracy scores on the whole test, the test value was set at 48 as a non-trained English-speaker would have an accuracy score of 48/72 on the experimental GJT. For the three sets of three patterns, the test value was set at 16 as a non-trained English-speaker would have an accuracy score of 16/24.

3.4 Establishing the Level of Significance: Setting p

In social science research, the level of significance tends to be set at 0.05, which means that there is a 5% probability that any documented differences are due to chance. However, in situations that require a number of statistical analyses to be conducted on the same data, the probability of documenting differences that are actually due to chance increases; the chance of finding a false-positive increases (known as a type I error). Statistical programs can automatically adjust *p* values when a number of tests are being conducted on the same data within one analysis. However, the *p* value needs to be adjusted by the researcher when different analyses are being conducted (as the statistical program cannot know beforehand the number of analyses that will be done). One means of adjusting *p* is to use the Bonferroni adjustment, which limits the familywise type I error rate. It requires the standard *p* value to be divided by the number of tests that are being conducted. However, it has been argued that this adjustment is too conservative as it increases the risk of making a Type II error (finding no

difference when one exists) (Herrington, 2002; Williams, Jones, & Tukey, 1999). In other words, the trade-off between ensuring no Type I error and ensuring no Type II error does not seem equitable. Another means of controlling the likelihood of finding a false positive is to control for the false detection (discovery) rate (Benjamini & Hochberg, 1995). In second language research, the false discovery rate has also been advocated over the Bonferroni adjustment (Larson-Hall, 2010). The false discovery rate controls for "the expected proportion of falsely rejected hypotheses" (Benjamini & Hochberg, 1995, p. 289) and it refers to "the average fraction of erroneous assertions among all confident directions asserted" (Williams, Jones, & Tukey, p. 44). In other words, after all significant tests have been conducted, what is the proportion of these tests that should be rejected if one maintains an error rate of .05? When calculated, the false discovery rate is the new significance level at which hypotheses should be rejected/accepted. In the present study, the false discovery rate as opposed to an *a priori* Bonferroni adjustment was employed. The actual calculation of the false discovery rate is presented at the end of this chapter, after all the *p* values have been calculated. However, in order to ensure the reader understands which results are significant and non-significant in this chapter, I have included the false discovery rate here: the calculation called for *p* to be set at .011 in order to maintain a type I error rate of 5%.

3.5 Analysis of Awareness Data

In the present research, quantitative differences between explicit learning and accuracy, and implicit learning and accuracy were investigated. In addition, the role that individual cognitive abilities may have on a.) a person's preferred type of learning, and b.) the accuracy of explicit learning and implicit learning were investigated. In order to discuss type of learning, three awareness measures were collected; confidence ratings, source attributions, and post-

exposure verbal reports. These measures can be analysed in a number of different ways to investigate explicit learning and implicit learning: confidence ratings can be used to calculate the *guessing criterion*, the *zero correlation criterion*, the *binary confidence technique*; confidence ratings and source attributions can be pooled; and off-line verbal reports can be analysed for the rules of the language, or for all conscious structural knowledge that participants stated they employed in the learning that could affect behaviour on the test of learning regardless of its accuracy in relation to the language (measure of knowledge and test behaviour). These methods of analysis differ in terms of whether researcher interpretation is required (analysis of verbal reports) or not (all other methods; although it is important to bear in mind that these methods are all based on assumptions concerning the relationship between confidence and conscious knowledge, and attribution of source of knowledge and conscious knowledge). In addition, some of these methods classify participants as being either explicit learners OR implicit learners (*guessing criterion, zero-correlation criterion, binary confidence technique, on- and off-line verbal reports*) whilst the other two methods allow for participants to be coded as having learnt explicitly AND implicitly (*source attributions,* and *knowledge and test behaviour*). Since it is assumed that languages are processed explicitly and implicitly simultaneously (Stadler & Frensch, 1998), methods that allow for a continuum are preferable. In addition, as one of the aims of the present study was to investigate the possibility of the input being processed explicitly and implicitly simultaneously, a continuous measure of awareness was needed. Source attributions are a continuous measure of awareness. When a participant believes he/she is employing a rule or a memory to respond to the GJT, the behaviour is explicit. When a participant believes he/she is using intuition or guess to respond to the GJT, the behaviour is implicit. However, to my knowledge, this information has never been used independently to classify participant behaviour and to calculate explicit and implicit learning scores (accuracy

scores). Rather, source attributions have either been discussed without statistical analyses or have been used to provide a more fine-grained analysis of type of learning based on confidence rating scores (Dienes & Scott, 2005; Rebuschat, 2008). Therefore, in addition to collecting source attributions to document quantity of explicit and implicit behaviour (i.e. according to the participants, had they learnt explicitly or implicitly), I created a continuous measure of awareness. An extant dichotomous measure, confidence ratings, was also employed to investigate whether the measures resulted in similar findings to answer research question four (RQ4: What are the differences between the results based on the three means of classifying awareness for learning and the two means of classifying awareness for the accuracy of the two types of learning). To summarise, one dichotomous measure was used: confidence ratings. Two continuous measures were used: source attributions, and the measure of knowledge and test behaviour (requiring an analysis of data from probe questions and the test of learning).

3.5.1 Scoring the dichotomous measure: Confidence ratings

The scores from the confidence ratings were calculated as *d'* (dee-prime) scores using the *binary confidence technique* (Kunimoto, Miller, & Pashler, 2001). *d'* is a measure of sensitivity created to objectively measure performance according to (Signal) Detection Theory (Green & Swets, 1966; Macmillan & Creelman, 2005). Its use as a measure of awareness in implicit learning research was proposed by Kunimoto and colleagues and it has subsequently been used in research investigating the implicit learning of letter strings (artificial grammars) (Tunney & Shanks, 2003) and the second language learning of a semi-artificial language (Rebuschat, 2008). However, it is important to bear in mind that the use of *d'* in relation to consciousness has been criticised as the theory behind *d'* is unrelated to consciousness (Macmillan & Creelman). Conceptually, *d'* measures the relationship between accuracy and

confidence, and it removes response bias (a participant's willingness to say 'yes' or 'no'). It measures a subject's awareness of his/her own performance, and hence is a subjective measure of awareness without bias. To calculate *d'*, a participant's correct and incorrect responses are tabulated alongside his/her confidence ratings as documented in table 3.4.

Table 3.4

Treatment of Participant Responses for Calculating *d'* for Type of Learning

	Confident	Not Confident
Response	Yes	No
Accurate (X)	Hit	False Alarm
Inaccurate (X)	Miss	Correct Rejection

The number of hits and misses are translated into a hit rate, the proportion of accurate responses that the participant was confident in, and a miss rate, the proportion of inaccurate responses that the participant was confident in. Data on false alarms and correct rejections can be ignored as they are dependent on hits and misses: the number of false alarms is the number of accurate responses when not confident minus the number of hits.

The hit rate and miss rate are then converted into *z* scores (standard deviation units) with a proportion of 0.5 being converted to a *z* score of 0. A proportion above 0.5 is always positive and below 0.5 is always negative, i.e. for the hit rate, a number above 0.5 means that when the participant was accurate, he/she was confident more times than not confident.

In order to remove response bias, the miss rate needs to be factored out from the hit rate. Imagine a participant that responds highly confident very frequently whether accurate or inaccurate. This person is clearly a highly confident individual regardless of his/her actual accuracy. By factoring out the miss rate, the score that remains (*d'*), reflects the relationship

between accuracy and confidence objectively, i.e. two participants with a different conceptualisation of what it means to be confident can be compared.

Participants that have a negative *d'* score are implicit learners because there is no relationship between accuracy and confidence; the participants randomly assigned confidence as (it is assumed) the information driving their decision is unconscious. Participants that have a positive *d'* score are explicit learners as there is a relationship between accuracy and confidence. Participants that have a *d'* score of 0 are unclassifiable as they have either only used one of the confidence ratings to respond or have equal numbers of items answered correctly and incorrectly and an identical number of high confidence responses for these items. The confidence rating *d'* scores for the participants ranged from -2.096 to 1.339. Using this measure, 4 participants were unclassifiable and thus were not included in analyses that used data from the confidence ratings, 29 participants were classified as explicit learners, and 48 participants were classified as implicit learners.

3.5.2 Scoring the continuous measure: Source attributions

Data collected from the source attributions were only used in determining quantities of explicit learning and implicit learning based on the participants' categorising each judgement on the test of learning as being due to rule or memory (explicit), or intuition or guess (implicit). Therefore, the source attribution data addressed research question two concerning how the input was processed.

3.5.3 Scoring the continuous measure: Knowledge and test behaviour

The knowledge and test behaviour analysis is subjective as it requires the verbal reports to be examined for evidence of conscious knowledge in order to determine a.) the quantity of

explicit and implicit learning, and b.) the accuracy of explicit and implicit learning i.e. when learning is explicit, how accurate is the participant; when learning is implicit, how accurate is the participant?). Two raters each analysed the reports twice and inter-rater reliability was 100% for the first analysis and 95.06% for the second analysis. In real terms, this meant that for four participants, there were differing opinions on the second analysis. Through discussion, these four participants were classified. All verbal report data can be found in appendix H.

The first analysis categorised participants depending on whether they had conscious knowledge of word-order rules or not. This analysis found 63 participants with some conscious knowledge and 18 participants with no conscious knowledge. The 18 participants with no conscious knowledge were labelled as implicit learners. An example of a participant that would be considered to have no conscious knowledge is someone who reported: "Everything made sense, but I couldn't identify any rules or patterns without more time to study it."

It is important to note that the conscious knowledge verbalised by the participants varied in terms of the use of, and the accuracy of, metalinguistic terms. As can be seen in appendix H, many participants used incorrect terminology (e.g. *adjective* for *adverb*). However, the inter-rater reliability figures reported above demonstrate that the two raters interpreted the data in a very similar fashion. This is perhaps due to probe question one and three being extremely similar with both asking for any noticed rules or regularities. Many participants responded with a rule/regularity to only one of these questions or responded with a rule/regularity to one and an example to the other. These examples helped the raters understand incorrect terminological use (e.g. whether the term 'action' referred to the verb phrase). Based on this research, it seems that in-built redundancy in post-exposure questions may help participants to express their knowledge more thoroughly.

The verbal reports from the 63 participants were then reanalysed to determine how the knowledge they had stated would affect their acceptance and rejection of items on the test of learning. This was possible due to the test of learning being tightly controlled with the use of 9 sentence patterns. For example, participant 18 stated "the subject pronoun after the verb before the object". The raters thus predicted this participant should accept any sentence where the verb comes before the subject: V2, *V1, *V2V2. All other templates should be rejected as they included a verb after the subject. Predictions were made for the 63 participants and these predictions were then used alongside the results on the GJT to categorise test behaviour in two ways:

1. Test behaviour is explicable from reported conscious knowledge
2. Test behaviour is inexplicable from or contradicts reported conscious knowledge

All explicable behaviour is assumed to have been driven by explicit learning. All inexplicable and contradictory behaviour is assumed to have been driven by implicit learning. In other words, verbalisable knowledge, regardless of whether it reflects the language system, is considered to have been created by explicit learning processes. No verbalisable knowledge is assumed to reflect implicit learning processes. Despite concerns with the assumption that explicit knowledge has to be verbalisable (Shanks & St. John, 1994), it has also been argued that verbal reports are the best means of measuring explicit learning (Rünger & Frensch, 2010). In addition, as the measure used in the present study focused on verbalisation in terms of all knowledge the learner had created about the language system rather than the rules of the language, quantity of explicit learning should not be under-estimated.

This classification means the 63 participants could have learnt (processed the language input) explicitly and implicitly. With respect to data from participant 18 mentioned above, any accepted *V1 items would be coded as 1 (explicit learning), and any rejected *V1 items would

be coded as 2 (implicit learning). For the 63 participants that had written information concerning the structure of the language, their test items could be coded using both categories. This classification allows each participant to have a unique profile of the proportion of use of his/her implicit and explicit learning processes. Figure 2 shows 10 randomly-chosen participants' explicit and implicit learning profiles (see Appendix I for all participants' profiles). No participant learnt solely explicitly.

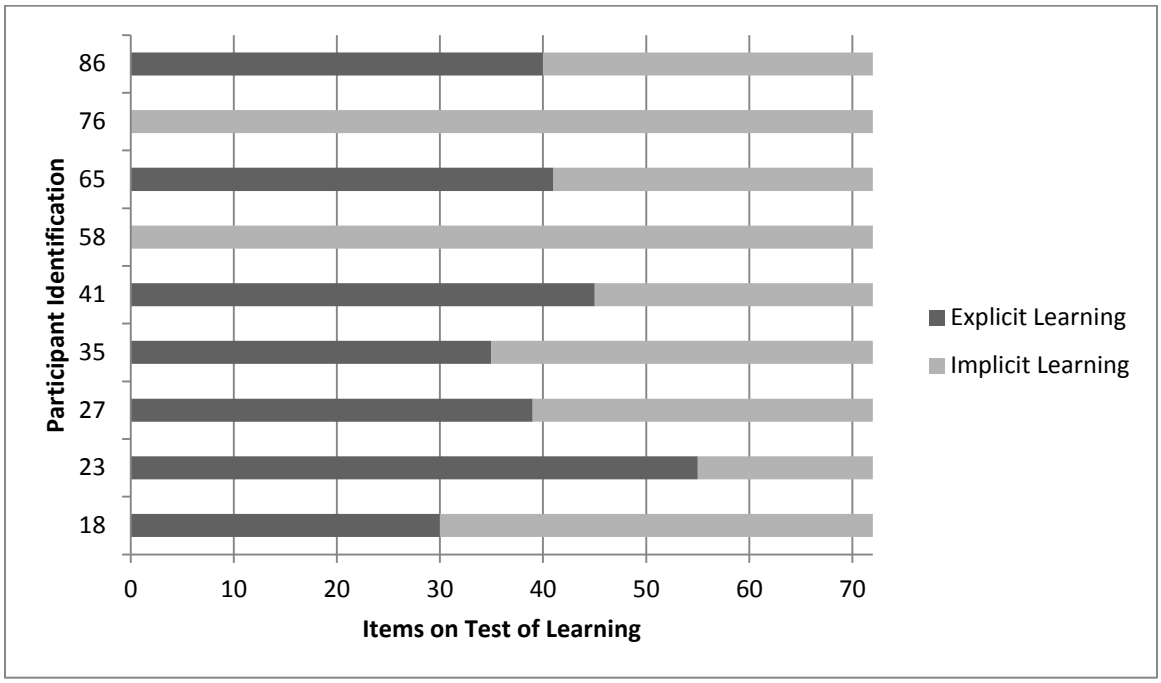

Figure 2

Participant learning profiles

It is important to note that a participant whose conscious knowledge could explain learning is not *prima facie* an accurate participant as if the conscious knowledge is inaccurate according to the language system, the participant's explicit responses may be incorrect. In addition, even when conscious knowledge is accurate, the participant may not have always used this knowledge on the test of learning and thus this test behaviour would be categorised as being due to implicit learning.

After participants' test items were coded as being due to explicit learning and/or implicit learning, accuracy scores were calculated for each participant in each category. The number of accuracy scores a participant received depended on how many types of learning they had demonstrated (either one [only explicit learning or implicit learning] or two [both explicit and implicit learning). The accuracy scores were converted into percentages as the number of data points entered into each score was participant-dependent. It is important to bear in mind that as the number of items entered into each participant's percentage was different, the items constituting the percentage were weighted differently across participants.

The measure of knowledge and test behaviour avoids the real problem of assuming a participant has learnt implicitly when his/her contents of knowledge do not fit the rules of the language (Hama & Leow, 2010). When participants interact with language incidentally (particularly without feedback), they may learn something that is only partially correct or that is entirely incorrect. However, if the contents of this learning can explain their performance on the GJT, it is incorrect to classify these participants as implicit learners.

Equally importantly, this technique also avoids the classification of a participant as an explicit learner at any mention of treating the targeted linguistic feature objectively. As has been discussed (Robinson, 2003; Schmidt, 2010; Williams, 2009), there is no reason to believe that implicit learning cannot occur after noticing has taken place. This investigation of participant verbal reports and test behaviour allows participants to be classified as having learnt explicitly only when verbal report matches test behaviour.

In order to address research questions three and seven concerning the accuracy of learning, one means of analysing the data using the measure of knowledge and test behaviour is to compare more explicit learners with more implicit learners to see if there are differences in terms of accuracy. To this end, participants were coded as more explicit learners if 40 or more

responses out of 72 could be explained (for the individual patterns out of 24, participants were coded as more explicit if 14 or more responses were explained by explicit learning). Participants were coded as more implicit learners if 40 or more responses were inexplicable (14 or more for the individual patterns out of 24). Participants that responded to 33 to 39 items implicitly and explicitly were coded as equally explicit/implicit (11-13 for the individual patterns out of 24). These cut-offs were chosen as it seemed reasonable to suggest that over 55% of one type of learning was sufficient to categorise a participant as exhibiting more of this type of learning.

3.6 Quantitative Analyses: Answering the Research Questions and Hypotheses

I will now reiterate each research question alongside any proposed hypotheses, and present the analyses and results pertaining to each question. For the analyses conducted, the assumptions relevant to each test were verified and no violations were documented based on Field (2005) and Larson-Hall (2010). I have divided this section in two based on analyses relating to type and quantity of learning (research questions one, two, three, and four), and analyses relating to learning and the individual difference measures (research questions five, six, and seven).

3.6.1 Type and quantity of learning

1. Does incidental acquisition of two word-order rules occur when adult learners use language?

H1: Incidental acquisition will occur.

H2: The contents of learning will reflect a sensitivity to verb phrase placement rather than the two word-order rules.

H3: Participants will be better able to accept grammatical items than reject ungrammatical items on the GJT.

To address this question, 1 one-sample *t*-test was conducted on the accuracy scores. The test value was set at 48 as this is the expected mean value that a group of non-trained subjects would obtain based on the control participants' behaviour (i.e. all 72 items would be classified as ungrammatical in English and as 48 of the items were ungrammatical in the novel language, an untrained subject would score 48/72). In addition, 3 one-sample *t*-tests were run on the accuracy scores for the three sets of patterns (V2, *V1, *VF; V2VF, *V2V2, *V2sVFm; VFV2, *VFVF, *VFmV2s). The test values were set at 16 as non-trained subjects would classify all 24 items as ungrammatical and thus score 16/24. Table 3.5 documents the results from the *t*-tests. All of the tests were significant. The effect sizes calculated using Cohen's *d* (1992) for these differences are 2.04, 1.60, 1.71, and 1.27. According to Cohen, effect sizes of 0.20 are small, 0.50 are moderate, and 0.80 are large so all four effect sizes were large.

Table 3.5

T-Test Results for Incidental Acquisition (N = 81)

Test of Learning	Mean	*SD*	Test Value	*t*(80)	*d*
Accuracy Scores	33.42	7.15	48	-18.34*	2.04
V2 Accuracy Scores	10.84	3.23	16	-14.36*	1.60
V2VF Accuracy Scores	10.65	3.12	16	-15.42*	1.71
VFV2 Accuracy Scores	11.89	3.24	16	11.41*	1.27

*p > .001

To address the issue of the contents of their learning (did they learn the two word-order rules?), endorsement rates for the three sets of patterns were calculated (V2; V2VF; VFV2). Figure 3 shows that participants were more likely to endorse than reject all patterns. They were also more likely to accept simple sentences (V2 patterns) than complex sentences (V2VF and VFV2 patterns). In the complex sentences, the patterns that began with VF were less likely to be

endorsed than the patterns that began with V2. In other words, it seems as though sentences beginning with a V2 clause were more acceptable to the participants than sentences beginning with a VF clause.

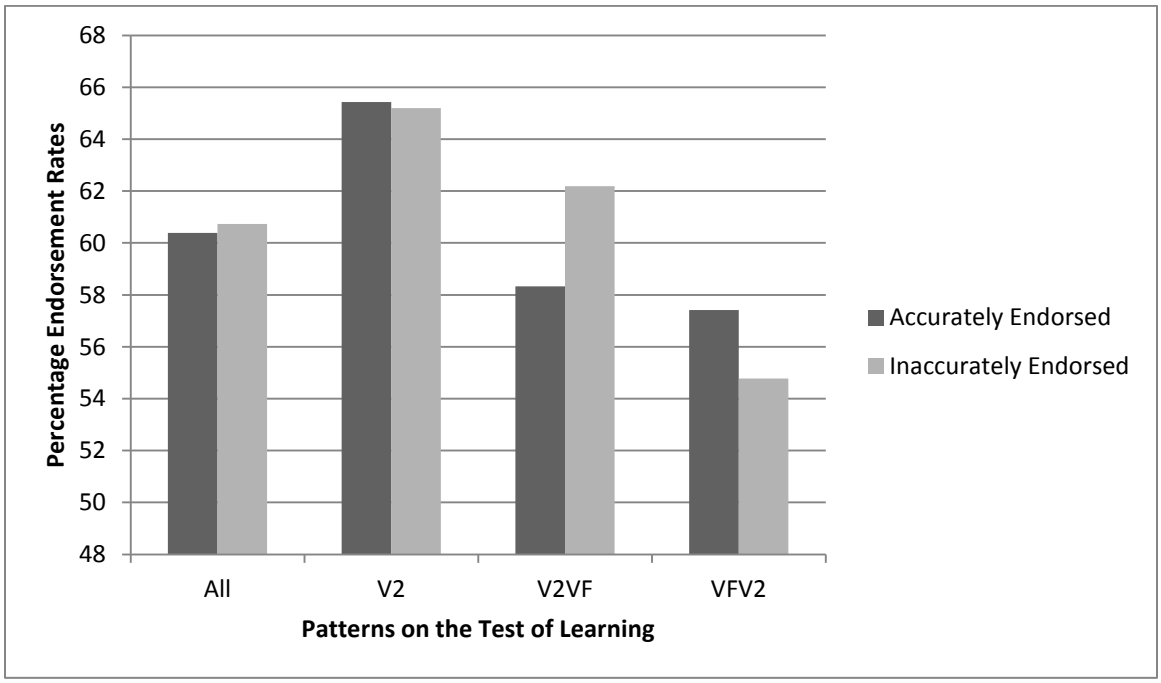

Figure 3.

Endorsement rates across the three sets of patterns (%).

By further breaking down the endorsement rates into individual patterns, it is possible to see which patterns the participants correctly endorsed and incorrectly endorsed (Figure 4). *VF (simple sentence) was incorrectly endorsed 70.52% of the time whereas *V1 was incorrectly endorsed 59.11% of the time, which is not surprising as clauses with verb in final position had been present in the input (although only in subordinate clauses). The differences between endorsement of *VF and *V1 were significant ($t[80] = 2.61$, $p < .011$), but not between V2 and *V1 ($t[80] = 2.01$, $p = .05$). Participants were significantly more likely to incorrectly accept *V2V2 than correctly accept V2VF ($t[80] = 2.12$, $p < .011$). The difference between the endorsement rates of *V2V2 and VFV2 was not statistically significant ($t[80] = 2.19$, $p = .38$).

This suggests that in complex sentences, participants had not learnt that the verb phrases needed to be placed in different positions in each clause (regardless of what those positions are in relation to clause type). Furthermore, *V2sVFm and *VFmV2s were incorrectly endorsed equal amounts of the time, which demonstrates that the importance of clause had not been learnt. The percentage acceptance rates for *V2V2 (65.43%) and *VFVF (54.78%) demonstrate that participants were more willing to accept items with verbs in second position in both clauses than items with verbs in final position in both clauses, but this difference was not significant ($t[80] = 2.88$, $p = .032$). Based on the input they received that included 102 examples of the verb2 rule and only 41 examples of the verbF rule, this pattern of acceptance is to be expected even though it did not reach significance. This pattern demonstrates that the participants seemed to be becoming sensitive to the importance of the verb being in second position in the novel language. Overall, it is also clear that participants, as a group, were over-endorsing all patterns.

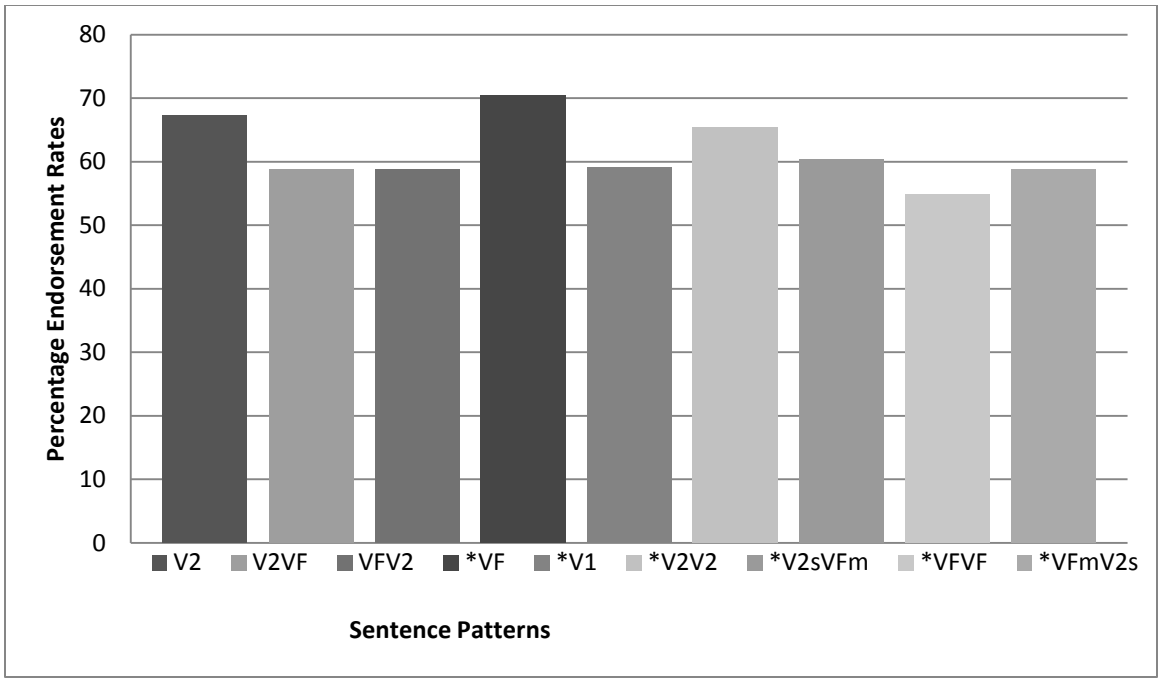

Figure 4.

Endorsement rates for individual patterns (%).

The results in relation to research question 1 support the three hypotheses that were advanced. Firstly, incidental acquisition did occur. Secondly, there was no evidence that the two word-order rules had been fully acquired. Rather, the participants had become sensitive to the fact that verb phrases could appear in second and final phrasal positions. Thirdly, based on the endorsement rates, it is evident that the participants were better able to accept grammatical items than reject ungrammatical items.

The second research question required the contents of incidental learning to be further divided to understand whether the learners were using explicit learning mechanisms or implicit learning mechanisms.

2. How much learning occurs explicitly and how much learning occurs implicitly?

H4: Participants will demonstrate both types of learning.

To address this question, the three measures of type of learning were used (confidence ratings, source attributions, and knowledge and test behaviour). It is important to bear in mind that research question 2 is not addressing accuracy, but learning processes. Therefore, all figures relate to quantity of explicit and/or implicit learning regardless of whether this learning led to accurate responses on the test of learning. A summary of the results is detailed in table 3.6. Note that as confidence ratings divides participants as either having learnt explicitly or implicitly, the explicit learning figure represents all responses by the 29 explicit learners, and the implicit learning figure represents all responses by the 48 implicit learners. The other two measures classify within participant.

Table 3.6.

Percentages of Use of Explicit Learning and Implicit Learning for each Awareness Measure

Awareness Measure	Explicit Learning	Implicit Learning
Confidence Ratings (n = 78)	2,088/5,544 = 35.8%	3,456/5,544 = 59.26%
Source Attributions (n = 82)	3,296/5,832 = 56.51%	2,536/5,832 = 43.49%
Knowledge and Test Behaviour (n = 82)	2,266/5,832 = 38.85%	3,566/5,832 = 61.15%

Based on the confidence ratings, a dichotomous measure of awareness, 4 participants could not be classified as being either explicit learners or implicit learners. Two of the participants only used one of the confidence ratings' options (confident). Two of the participants had identical numbers of correct and incorrect items alongside identical numbers of confident judgements, which leads to a *d'* score of zero. Twenty-nine participants were explicit learners as their accuracy scores and their confidence were related; when they believed they were confident, they were more likely to be accurate. Explicit learning processes were used to make 35.8% of all judgements. Forty-eight participants were implicit learners as their confidence ratings and accuracy scores were unrelated; there was no relationship between

confidence and accuracy. Implicit learning processes were used to make 59.26% of all judgements.

In relation to source attributions, all 82 participants believed their judgements were driven by rule and memory (explicit learning) 3,296 times on the test of learning (out of 5,832 judgements). In other words, knowledge attributed to explicit learning constituted 56.51% of behaviour (rule = 36.15% and memory = 20.36%). Participants believed their judgements were driven by intuition and guess (implicit learning) 2,536 times on the test of learning: 43.49% of the time (intuition = 30.93% and guess = 12.56%).

In relation to the measure of knowledge and test behaviour, participants used structural knowledge to respond to 2,266 items on the test of learning (out of 5,832). In other words, knowledge attributed to explicit learning constituted 38.85% of behaviour. Therefore, 3,566 items on the test were made based on implicit learning constituting 61.15% of behaviour.

The two continuous measures demonstrated that participants had processed the syntax explicitly and implicitly during language use. However, participants believed they had processed information explicitly more than they had processed information implicitly, but the knowledge and test behaviour measure found the opposite. The dichotomous measure of confidence ratings divided participants based on whether they were explicit learners or implicit learners. An aim of the present study was to understand whether explicit learning and implicit learning could occur simultaneously and thus, a continuous awareness measure was needed. However, a dichotomous measure was also employed to understand whether dichotomous and continuous measures lead to similar results (research question four), and thus understand the importance of interpreting explicit and implicit learning research based on how type of learning is established.

Despite different interpretations of participant learning across the three measures, the number of judgements made using knowledge created by explicit learning processes were similar (35.8% or 38.85%) and created by implicit learning processes (59.26% and 61.15%) for confidence ratings and the measure of knowledge and test behaviour, the two measures that are to be used to address research question 3.

When participants used language to incidentally pick up language form, they learnt explicitly and implicitly, which supports hypothesis three. However, this does not provide information on whether participants' explicit and/or implicit learning were accurate. Research question 3 addresses explicit learning and implicit learning in terms of accuracy.

3. Are there differences in the accuracy of explicit learning and the accuracy of implicit learning?

H5: Explicit learning will be more accurate than implicit learning.

To address this question, explicit learning accuracy scores and implicit learning accuracy scores were calculated for the participants based on two measures of awareness: confidence ratings, and knowledge and test behaviour. For the dichotomous measure of awareness, confidence ratings, participants were grouped by whether they were coded as explicit learners (n=29) or implicit learners (n=48). The 4 participants that could not be classified were removed from the analyses as there were insufficient people to constitute a non-classifiable group. Four accuracy scores for the explicit learners and the implicit learners were compared using a factorial analysis of variance (ANOVA). The four accuracy scores referred to the test as a whole (/72), the simple sentences (/24), the complex sentences beginning with verb in second position (/24), and the complex sentences beginning with verb in final position (/24). The descriptive statistics are reported in Table 3.7. The factorial ANOVA found no significant differences between the two groups on the four accuracy scores.

Table 3.7.

Descriptive Statistics: Explicit Learning vs. Implicit Learning for all Scores and the Three Sets of Patterns (Confidence Ratings).

Accuracy Scores	Type of Learner	Mean	*SD*
All	Explicit	33.34	8.56
	Implicit	33.27	6.16
V2	Explicit	11.52	3.90
	Implicit	10.38	2.71
V2VF	Explicit	10.52	3.76
	Implicit	10.65	2.67
VFV2	Explicit	11.31	3.74
	Implicit	12.19	2.91

Using the dichotomous measure based on confidence ratings to classify type of learning resulted in the accuracy of explicit learning and implicit learning to be the same. No significant differences were found between participant accuracy based on type of learning.

For the continuous measure of awareness, knowledge and test behaviour, participant accuracy scores were calculated based on what each participant had learnt explicitly and implicitly. Sixty-three participants demonstrated both types of learning, and thus had an explicit accuracy score and an implicit accuracy score. Eighteen participants demonstrated only implicit

learning and thus, only had an implicit accuracy score. Two different analyses were conducted based on the measure of knowledge and test behaviour: one that classified the participants as being more explicit, explicit/implicit, and more implicit; and one that classified within-participants for the 63 participants that had learnt explicitly and implicitly.

The first analysis divided the 81 participants into one of three groups: predominantly explicit (judged more than 39 items explicitly on whole test/judged more than 13 items explicitly on the individual patterns), equally explicit/implicit (judged items explicitly and implicitly between 33 and 39 times on whole test/judged items explicitly and implicitly between 11 and 13 times on the individual patterns), and predominantly implicit (judged more than 39 items implicitly on whole test/judged more than 13 items explicitly on the individual patterns), and their accuracy scores were compared using paired-samples *t*-tests. It was not possible to use one factorial ANOVA as one participant could be more explicit overall, but be more implicit with regards to one of the three sets of patterns.

The one-way ANOVA for all accuracy scores showed that there were significant differences between the three groups of learners (more explicit [n = 22], explicit/implicit [n = 15], more implicit [n = 44]), F (2, 78) = 7.56, $p < .01$. An LSD post-hoc test demonstrated that the more explicit learners (M = 37.95) had learnt significantly more than the implicit learners (M=31.23) ($p < .011$). The effect size was calculated for this difference using Cohen's *d* (1992); it was 1.00. This demonstrates that the difference between the more explicit learners and the more implicit learners is one standard deviation. The magnitude of the independent variable (group) on the dependent variable (accuracy scores) is large for the explicit learners versus implicit learners.

In relation to the simple sentences that highlighted the V2 rules, the one-way ANOVA was not significant, F (2, 78) = 1.45, p = .24. Scores for the explicit learners (n = 30), explicit/implicit learners (n = 16), and the implicit learners (n = 35) were not different statistically.

In relation to complex sentences beginning with V2, the one-way ANOVA was not significant, F (2, 78) = 1.82, p = .17. Scores for the explicit learners (n = 21), explicit/implicit learners (14), and the implicit learners (n = 46) were not different statistically.

In relation to the complex sentences beginning with VF, the one-way ANOVA was not significant, F (2, 78) = 2.53, p = .09. Scores for the explicit learners (n = 20), explicit/implicit learners (14), and the implicit learners (n = 47) were not different statistically.

Overall, the more explicit participants were more successful than the more implicit participants. However, these differences were not significant when the test items were divided into separate patterns. Furthermore, the explicit/implicit participants were not significantly different from either group.

The second analysis compared within-participant explicit and implicit accuracy scores for the 63 participants that demonstrated both types of learning using paired-samples t-tests. Four different accuracy scores were compared (all, V2, V2VF, and VFV2) so the number of participants entered into each analysis differed as some participants did not demonstrate implicit learning, or explicit learning for one of the three individual sets of patterns. The results are documented in Table 3.8.

Table 3.8

Paired Comparisons for all Scores and the Three Sets of Patterns Based on Knowledge and Test Behaviour (%)

Comparisons		Mean	*SD*	*t(df)*
Pair 1	All Explicit	49.05	17.41	2.01(62)
	All Implicit	43.33	15.57	
Pair 2	V2 Explicit	52.31	30.59	2.09(59)
	V2 Implicit	38.49	30.37	
Pair 3	V2VF Explicit	38.98	23.01	2.46(58)
	V2VF Implicit	50.48	25.08	
Pair 4	VFV2 Explicit	60.53	25.07	3.76(57)*
	VFV2 Implicit	40.58	25.72	

*p > .011

Participants that demonstrated both explicit and implicit learning were not significantly more accurate when using one type of learning on the test as a whole. Furthermore, on the individual patterns, they were equally as accurate using both types of learning for V2 and V2VF. However, they were more accurate when they had learnt explicitly on the VFV2 pattern (*d* = 0.79).

To answer research question 3, when participants were divided as having learnt explicitly or implicitly based on confidence ratings, there were no differences in accuracy between those participants that had learnt explicitly and those participants that had learnt implicitly. When the participants that had demonstrated both types of learning were classified as learning more explicitly, both explicitly/implicitly, and more implicitly based on the measure of knowledge and test behaviour, it was found that on the whole test, those learners that had

demonstrated more explicit learning outperformed the implicit learners. However, there were no significant differences between the groups on the three sets of patterns. When participants that had demonstrated both explicit and implicit learning (n = 63) had their accuracy scores for each type of learning compared, it was shown that they were not significantly more accurate due to one type of learning on the whole test, the V2 items, and the V2VF items. However, they were more accurate when using information they had learnt explicitly on the VFV2 items. These results partially support the fourth hypothesis. Explicit learning was found to lead to greater accuracy when compared to implicit learning, but only when type of learning was classified using the measure of knowledge and test behaviour. Furthermore, when participants were grouped (more explicit, implicit/explicit, more implicit), explicit learning was only superior for the test as a whole. When within-participant accuracy scores were used, explicitly-learnt information was only more accurate than implicitly-learnt information for one of the three sets of patterns (VFV2).

4. What are the differences between the results based on the three means of classifying awareness for learning and the two means of classifying awareness for the accuracy of the two types of learning (one continuous and one dichotomous)?

From the three different types of analyses conducted to understand whether learning occurred more explicitly or implicitly (i.e. quantity of information processed explicitly or implicitly, unrelated to the accuracy resulting from this processing), the results were similar. Source attributions suggested that there was more explicit learning than implicit learning whilst knowledge and test behaviour suggested the contrary. The measure used to classify individuals as being explicit learners or implicit learners actually found a similar percentage of explicit learning and implicit learning as the measure of knowledge and test behaviour. Despite these two measures being different (confidence ratings divide participants; knowledge and test

behaviour divides within-participants), the use of explicit learning processes and implicit learning processes were similar.

In relation to explicit accuracy and implicit accuracy, the awareness measures led to different results insofar as analyses based on confidence ratings did not find significant differences between learners, but analyses based on knowledge and test behaviour did. However, for both measures, the patterns of the scores were similar with explicit learning being slightly more accurate than implicit learning.

3.6.2 Learning and its predictors (individual difference measures)

The remaining three research questions address the role of cognitive individual differences on incidental learning, explicit learning, and implicit learning. Four cognitive abilities were measured: inductive language learning ability, working memory, processing speed, and verbal reasoning. Before addressing the research questions, it is important to understand whether there is collinearity. If two variables are strongly correlated, this information needs to be borne in mind when conducting the analyses to answer the remaining research questions as collinearity can increase the probability of a good predictor of the outcome being found non-significant (Field, 2005). Table 3.9 reports Pearson correlations for the four aptitude measures. Despite a significant and fairly strong relationship between working memory and verbal reasoning, as none of them were above .80, this was not deemed problematic (Field).

Table 3.9.

Pearson Correlations of the Four Aptitude Measures (Predictor Variables).

Pearson Correlation	Inductive	Working Memory	Processing Speed	Verbal Reasoning
Inductive		.20	-.17	.24*
Working Memory			-.07	.51**
Processing Speed				-.10
Verbal Reasoning				

*p = .03, **p = .001

5. Do cognitive abilities play a role in quantity of incidental learning?

No hypotheses were entertained for this research question as extant research has been contradictory (Robinson, 1997a, 2005).

To investigate whether cognitive abilities can predict the quantity of incidental learning that occurs, a multiple regression analysis was run. The results from the four cognitive measures were entered as the predictor variables and the accuracy scores for the entire test were entered as the outcome variable. The accuracy scores were not divided based on the 9 patterns, as above, as there was no reason to believe that aptitude should play different roles in learning based on the 9 patterns (it may play a different role in the learning of the two rules, but this was not possible to tease apart in the present study as any pattern testing the verbF rule also tested the verb2 rule). The cognitive abilities were entered simultaneously as no hypotheses had been advanced with regards to the relationship between cognitive abilities and incidental acquisition.

The results from the regression analysis were not significant; the cognitive abilities measured could not account for a significant amount of variance in the incidental acquisition

scores. Table 3.10 details the total R^2 for the model, the unstandardised regression coefficients (*B*) and their 95% confidence intervals. As all of the confidence intervals include zero in their range, the cognitive measures do not explain a statistically significant proportion of the variance.

Table 3.10.

Total R^2 and the Individual (Non-)Contributions of the Aptitude Factors to Incidental Learning.

Aptitude factors	[15]*B*	95% CI
Inductive ability	.38	[-.05, .81]
Working memory	-.39	[-1.28, .51]
Processing speed	-.15	[-.35, .05]
Verbal reasoning	.10	[-.49, .69]
R^2	.08	

Note. CI = confidence interval.

The regression analysis demonstrated that when adults use language for comprehension, the quantity of form that is incidentally acquired is not dependent on cognitive abilities. Cognitive abilities did not predict incidental acquisition in this experiment.

6. Do cognitive abilities play a different role in explicit learning and implicit learning?

H6: Inductive language learning ability scores will be higher for those participants that demonstrate more explicit learning than those participants that demonstrate more implicit learning.

H7: Within-participants, there will be a positive relationship between explicit learning and inductive language learning ability, and a negative relationship between implicit learning and inductive ability.

[15] Unstandardised coefficients have been provided so readers can write a predictive equation (Larson-Hall, 2010)

The different awareness measures allow this question to be addressed in two different ways as explicit learning and implicit learning can be analysed using a participant-grouping variable (participants that process the input more explicitly vs. participants that process the input more implicitly [using confidence ratings, and the measure of knowledge and test behaviour]), which addresses the relationship between cognitive abilities and a person's preferred means of processing the input. Alternatively, learning can be analysed using a within-grouping variable (participants that process the input explicitly and implicitly [using the measure of knowledge and test behaviour), which addresses the role of cognitive abilities on the proportion of explicit learning that occurred and the proportion of implicit learning that occurred. Firstly, I will answer question six in relation to group membership. Secondly, I will answer question six in relation to predicting quantity of explicit learning processes, and quantity of implicit learning processes.

The first two analyses conducted attempted to understand whether the classification (division) of participants could be explained by their cognitive abilities. The first analysis used the data from confidence ratings to classify learning and therefore included 77 participants. The second analysis used the data from the measure of knowledge and test behaviour to classify learning and therefore included 81 participants (the measure was changed from being continuous to trichotomous by assigning participants to one of three groups: mainly explicit, explicit/implicit, and implicit). Two one-way ANOVAs were conducted with group as the dependent variable and scores on the aptitude measures as the independent variables. If there is a relationship between aptitude and group membership, significant differences should be found between the two groups on their aptitude scores. Even though binary logistic regression allows the prediction of the probability of membership to each category, Field (2005) discusses that this type of analysis is rarely used and in Larson-Hall's book (2010) that is dedicated to

analysing data from second language acquisition research, it is only briefly touched upon and not in relationship to the type of data in the present study (p. 214). In addition, if differences are found on the ANOVA, post-hoc analyses can determine what these differences are. The results from the one-way ANOVA that classified participants according to confidence ratings showed that there were no significant effects of group membership on the aptitude scores (inductive F [1,75] = .93, p = .34; working memory F [1,75] = .001, p = 1.00; processing speed F [1,75] = .81, p = .37; verbal reasoning F [1,75] = .34, p = .56).

The results from the ANOVA that used knowledge and test behaviour to classify type of learning demonstrated that there was a significant difference between the groups on inductive language learning ability, F [2,78] = 5.276, p = .007. LSD post-hoc analyses showed that the more explicit participants had significantly higher scores on the measure than the more implicit participants (p > .011). The participants that were classified as having processed the input explicitly and implicitly to equal degrees were not significantly different from either group.

To address whether the quantity of explicit learning or the quantity of implicit learning (regardless of accuracy) could be predicted by participant aptitude scores, two linear regression analyses were run. Linear regressions as opposed to sequential regressions were conducted as previous research has not investigated whether quantity of explicit learning, or quantity of implicit learning, can be predicted (as learning has not been measured in a continuous fashion) and, as such, there was no reason to enter certain variables ahead of others. The first analysis investigated whether the quantity of explicit learning could be predicted by the aptitude measures. Sixty-three participants were entered into this analysis. The results demonstrated that the regression model could not significantly predict the quantity of explicit learning (R^2 = .065).

The second regression analysis was conducted to understand whether implicit learning could be explained by the four cognitive abilities. All 81 participants were entered into this analysis. The results demonstrated that the regression model was significant and that inductive language learning ability could explain a significant amount of the variance in the quantity of implicit learning, but the relationship was negative. In other words, the lower the inductive language learning ability score, the greater quantity of implicit learning. To understand the unique contribution of inductive language learning ability, it is possible to state that if the other cognitive abilities are held constant, every one point increase on the inductive measure is associated with a reduction of 1.98 points out of a possible 72 on the quantity of implicit learning demonstrated. In addition, the confidence intervals demonstrate that if the study were replicated 100 times, the quantity of variance that could be explained would vary from 3 points to 0.95 points. Total R^2 for the model, and unstandardised regression coefficients (*B*) and their 95% confidence intervals are found in table 3.11.

Table 3.11.

Regression Model for Implicit Learning (Knowledge and Test Behaviour) and Aptitude.

Aptitude Factors	*B*	95% CI
Inductive ability	-1.98	[-3.00, -.95]
Working memory	.24	[-1.89, 2.37]
Processing speed	.20	[-.28, .67]
Verbal reasoning	.37	[-1.03, 1.78]
R^2	.18*	

Note. CI = confidence interval.

*$p < .01$.

In terms of whether type of learning was related to cognitive abilities, it was found that when participants were classified based on the measure of knowledge and test behaviour, inductive language learning ability scores were significantly higher for explicit learners than implicit learners. More explicit learners were significantly more likely to have a higher inductive language learning ability score than more implicit learners. This supports hypothesis five. However, when type of learner was classified using confidence ratings, there were no differences between the two groups of learners. Therefore, hypothesis five is only partially supported.

In terms of whether the quantity of explicit learning or the quantity of implicit learning could be predicted by aptitude measures, it was found that inductive language learning ability negatively predicted quantity of implicit learning. For the participants that demonstrated implicit learning, those participants that had lower inductive language learning ability scores had demonstrated more use of implicit learning processes. This partially supports hypothesis six as inductive language learning ability had a negative relationship with implicit learning. However, a relationship was not found between explicit learning and inductive language learning ability.

7. Do cognitive abilities play a role in the accuracy of explicit learning and the accuracy of implicit learning that occurs?

H8: Working memory and inductive language learning ability will predict the accuracy of explicit learning whereas processing speed and verbal reasoning will predict the accuracy of implicit learning.

As with the above analyses, as type of learning was measured in two different ways, there are two different explicit accuracy scores and implicit accuracy scores, which also group participants in different ways. Scores based on confidence ratings assign each participant to a group, but the scores based on knowledge and test behaviour provide an explicit accuracy score

and an implicit accuracy score for each participant. Below I will report the results from the different sequential regressions that were conducted. Sequential regression analyses were run rather than standard multiple regressions as prior research would predict certain variables to play a greater role in explicit accuracy (inductive language learning ability and working memory [Bell, 2009, Robinson, 1996]) and others in implicit accuracy (verbal reasoning and processing speed [Kaufman et al., 2010]). For all analyses related to explicit accuracy, inductive language learning ability and working memory were entered last. For all analyses related to implicit accuracy, verbal reasoning and processing speed were entered last. It is important to enter the variables that are expected to explain the relationship after the other variables in order to investigate whether the non-predicted variables are making a unique contribution to quantity of learning (Larson-Hall, 2010).

To address this question using the scores based on confidence ratings, two separate sequential regression analyses were conducted. The first analysis investigated whether the accuracy of explicit learning could be predicted by the aptitude measures for the 29 participants that had confidence rating d' scores above 0. Verbal reasoning and processing speed were entered prior to inductive language learning ability and working memory as the latter two variables were expected to account for a greater amount of the variance. If inductive ability and working memory are entered first, any effect that verbal reasoning and processing speed may have on the accuracy of explicit learning could be masked by the hypothesised effects that inductive ability and working memory may have on learning (Larson-Hall, 2010). Neither regression model was significant (model 1, $R^2 = .08$; model 2, $R^2 = .15$, $\Delta R^2 = .074$).

The second analysis investigated whether the accuracy of implicit learning could be predicted by the aptitude measures for the 48 implicit participants. Inductive language learning ability and working memory were entered first, and processing speed and verbal reasoning were

entered last (for the same reasons as mentioned above with respect to the accuracy of explicit learning, but in the opposite direction). Neither regression model was significant (model 1, R^2 = .02; model 2, R^2 = .07, ΔR^2 = .048).

Two regression analyses were conducted for the accuracy scores calculated using the knowledge and test behaviour measure of awareness. The first sequential regression investigated whether explicit accuracy scores (n=63) could be predicted by the cognitive measures. As above, processing speed and verbal reasoning were entered first. The regression analysis was not significant (model 1, R^2 = .11; model 2, R^2 = .20, ΔR^2 = .09).

The final sequential regression analysis was conducted on the implicit accuracy scores and the cognitive abilities. All 81 participants were entered into this analysis. Inductive language learning ability and working memory were entered first. Neither regression model was significant (model 1, R^2 = .02; model 2, R^2 = .03, ΔR^2 = .002).

The relationships between accuracy of explicit learning and accuracy of implicit learning, and the cognitive abilities were not significant when the accuracy scores were calculated using data from participant confidence ratings and the measure of knowledge and test behaviour. The results do not support hypothesis seven.

3.7 Calculating the False Discovery Rate

Out of the 56 *p* values calculated in the present research, 23 were below .05, the normal level of significance in social science research. However, as multiple comparisons were conducted on the same data, it was necessary to adjust the significance value in order to avoid incorrectly claiming a significant difference when one does not exist. In the present study, the false discovery rate was calculated to ensure that all significant findings should be interpreted as such. The free, downloadable R program was used to calculate the rate (R Development Core

Team, 2011). Appendix J details the input for and output from R used based on the 53 values obtained from the statistical tests. In controlling for the proportion of differences that may have been incorrectly found whilst maintaining the overall number of decision errors at the 5% alpha level, the program found that any *p* value below .011 could be interpreted as being significant. Out of the 23 *p* values below .05, 13 were significant.

3.8 Summary of Results

Table 3.12 summarises the results in relation to each research question and hypothesis.

Table 3.12.

Research Questions, Hypotheses, and Results.

Research Question	Hypotheses Supported?
1. Does incidental acquisition of two word-order rules occur when adult learners use language?	H1: Incidental acquisition will occur. - **Supported** H2: The contents of learning will reflect a sensitivity to verb phrase placement rather than the two word-order rules. - **Supported** H3: Participants will be better able to accept grammatical items than reject ungrammatical items on the GJT. - **Supported**
2. How much learning occurs explicitly and how much learning occurs implicitly?	H4: Participants will demonstrate both types of learning. - **Supported**
3. Are there differences in the accuracy of explicit learning and the accuracy of implicit	H5: Explicit learning will be more accurate than implicit learning. – **Partially supported**

learning?	
4. What are the differences between the results based on the three means of classifying awareness for learning and the two means of classifying awareness for the accuracy of type of learning (one continuous and one dichotomous)?	No hypotheses were entertained. The results demonstrated that there were differences between the measures in both quantity of learning and accuracy of both types of learning.
5. Do cognitive abilities play a role in quantity of incidental learning?	No hypotheses were entertained. The results demonstrated that cognitive abilities do not play a role in quantity of incidental learning.
6. Do cognitive abilities play a different role in explicit learning and implicit learning?	H6: Inductive language learning ability scores will be higher for those participants that demonstrate more explicit learning than those participants that demonstrate more implicit learning. – **Partially supported** H7: Within-participants, there will be a positive relationship between explicit learning and inductive language learning ability, and a negative relationship between implicit learning and inductive language learning ability. – **Partially supported**
7. Do cognitive abilities play a role in the accuracy of explicit	H8: Working memory and inductive language learning ability will predict the accuracy of explicit learning whereas

learning and the accuracy of implicit learning that occurs?	processing speed and verbal reasoning will predict the accuracy of implicit learning. – **Not supported**

After using a novel language for comprehension, participants were able to incidentally acquire some information about the language syntax. They seemed to have become sensitive to verb phrases in second and final position, with a preference for second position in complex sentences. However, they had not learnt the importance of clause. The majority of the participants appeared to have learnt the language input both explicitly and implicitly based on source attribution responses and the measure of knowledge and test behaviour. Based on confidence rating data, participants ranged in how explicitly or implicitly they learnt the language.

When participants were divided based on confidence ratings, there were no differences between the accuracy of explicit learning and implicit learning (both types of participant were equally accurate). However, when participants were divided based on the measure of knowledge and test behaviour, the more explicit learners outperformed the more implicit learners on the test as a whole, but not when the test was divided into the three sets of patterns. The implicit/explicit learners performed similarly to both explicit learners and implicit learners. When participants that had learnt the input explicitly and implicitly had their explicit and implicit accuracy scores compared, they were equally accurate when using information they had learnt explicitly and implicitly on the whole test and on the V2 and V2VF patterns. However, they were more accurate due to explicit learning for the VFV2 pattern.

No relationship was found between cognitive abilities and incidental acquisition; the cognitive abilities of the participants did not affect the quantity of incidental acquisition that occurred during language use for comprehension.

In terms of explicit learning and implicit learning, and cognitive abilities, the analyses point towards a role for inductive language learning ability. When participants were categorised as more explicit, explicit/implicit, and more implicit using the measure of knowledge and test behaviour, the more explicit learners had significantly higher scores on the inductive language learning ability measure than the other two types of learner.

When the cognitive ability measures were used to try to predict the quantity of explicit learning and the quantity of implicit learning a participant demonstrated, it was found that inductive language learning ability had a negative relationship with implicit learning; participants that had higher inductive scores demonstrated less implicit learning.

When the cognitive ability measures were used to investigate accuracy, it was found that none of the aptitude measures could predict the accuracy of explicit learning or the accuracy of implicit learning. In this study, explicit accuracy and implicit accuracy were not affected by the individual difference measures.

Chapter Four: Discussion

The discussion section is divided to reflect the areas of SLA to which the results are most relevant and as such, the research questions will be addressed in the following order: incidental acquisition (RQ1), explicit and implicit learning (RQ2), and explicit and implicit accuracy (RQ3), cognitive abilities and learning/accuracy (RQ5, RQ6, and RQ7), and the measurement of explicit and implicit learning (RQ4).

4.1 RQ1: Incidental Acquisition

In the present study and in-line with hypothesis one, incidental acquisition of syntax was documented after aural and visual exposure consisting of 102 example items of one word-order rule (verb2), and 41 examples of the other word-order rule (verbF); on the test of learning, the participants reacted differently from the way untrained participants would have acted (based on scores from an adapted version of the test of learning given to a control group). However, as predicted by hypothesis two, there was no evidence that the participants had learnt the two word-order rules that were driven by clause type as they did not accept V2VF and VFV2 significantly more times than *V2sVFm and *VFmV2s. Rather, it seems the participants were in the initial stages of learning that the verb phrase could come in second and final position, but not in first position. This finding can be partially explained by frequency as *V1 was not present in any of the input. However, as it was still accepted 59.11% of the time, other variables appear to be at play.

Why would *V1 be accepted over 50% of the time if it was never in the input and this type of structure in English affirmative sentences does not exist (in the indicative mood)? One interpretation of these results relates to differences between acceptance of well-formed items

and rejection of ill-formed items on GJTs (Hedgcock, 1993); as hypothesised in the present study (hypothesis three), participants were better able to accept grammatical items than reject ungrammatical items. It has been previously noted that participants respond differently to grammatical and ungrammatical items on GJTs (Hedgcock; R.Ellis et al., 2009). Discussion has posited that scores on ungrammatical items, particularly on untimed GJTs, demonstrate explicit knowledge (i.e. explicit knowledge is used to accept or reject ungrammatical items on untimed GJTs: if explicit knowledge is accurate, these items will be rejected). Indeed, research conducted by R.Ellis and colleagues (R.Ellis et al.) used scores from ungrammatical items on an untimed GJT as a score of explicit knowledge whilst scores on both grammatical and ungrammatical items on a timed GJT were interpreted as scores of implicit knowledge. This assumes that participants have both explicit knowledge and implicit knowledge, and it is the type of test and the type of item (grammatical vs. ungrammatical) that determines which type of knowledge is deployed. However, in the present study, it is difficult to envisage the grammatical items and ungrammatical items being treated differently based on type of learning when the participants only had approximately 30 minutes experience with the language and all of the items would be considered ungrammatical in English.

In fact, a more plausible explanation for the supported hypothesis that acceptance of grammatical items would be higher than rejection for ungrammatical items, and an explanation for the over-endorsement of ungrammatical *V1 items in the present study, relates to a difference between knowing that something is right and knowing that something is wrong. The over-endorsement found in the present study has been well-documented, that is, participants behave more accurately with grammatical items partially due to over-endorsement of all items (Bialystok, 1987; R.Ellis, 1991; Loewen, 2009; Rebuschat, 2008). This occurs despite the belief that certain errors are more salient than others (Bley-Vroman, Felix, & Ioup, 1987). As has been

documented elsewhere (L.White, 1991), it is more challenging to notice (whether explicitly or implicitly) that something is not in the input (i.e. something is ungrammatical, e.g. a particular word-order rule does not occur in the L2) than to notice that something is in the input (i.e. something is grammatical, e.g. a particular word-order rule does occur). In the present study, participants likely understood that no standard English was possible, and positive evidence had been provided for the accurate grammatical items. However, the non-evidence of verb in initial position was insufficient for participants to accurately reject the *V1 items. It remains an empirical question whether explicit instruction of some sort (e.g. negative evidence) would be needed for the participants to be able to accurately reject categorically the ungrammatical items in this novel language.

The finding that the incorrect *V1 items were accepted at levels over 50% despite no verb phrases in initial position in the training phase could also be interpreted based on their developmental stage in acquiring the language system. It could be that the participants became sensitive to the fact that the word order varied from standard English, but they were only beginning to learn in what ways. As such, if the test of learning had included verbs in other phrasal positions, they may also have been over-endorsed. However, the L1 also likely plays a role in incidental development of phrase placement as Rebuschat (2008) found that participants only endorsed 22.9% of items with the verb phrase in third position (*V3) despite these items being accurate in English, the mother tongue of his participants (e.g. *Yesterday John inspected the homework with increased rigour*, Rebuschat, p. 176). When the language was replaced by nonsense syllables, the participants were significantly more likely to endorse *V3 (45.3%). The acceptance of *V3 with nonsense syllables may reflect the success of data-driven, bottom-up processing for the quantity of input provided. The higher rejection of *V3 with natural language may reflect the interaction of data-driven, bottom-up processing (input is the only source of

information) and conceptually-driven, top-down processing (input leads to activation of other sources of information). The data provide the information that *V3 is unacceptable in the novel language as it is not in the input, but this takes time to learn. The top-down processing may speed up the acquisition that *V3 is unacceptable as its non-use in the input (demonstrating its unacceptability) and then its use in the test of learning can be compared to existing information that this type of sentence is possible in English, and thus, it may help participants to realise, consciously and/or unconsciously, that this form is incorrect in the novel language. When the phrasal positions are incorrect in both standard English and the novel language as in the current research (and the phrasal positions do not have to be understood to process meaning), during incidental acquisition, data-driven processing similar to that observed when Rebuschat's participants processed nonsense syllables may be the standard type of processing used as information in long-term memory would only help participants to notice that no standard English is acceptable, but it would not lead them to notice what is unacceptable in both English and the novel language.

In the present study, there was also a tendency for participants to prefer *V2V2 to *VFVF; it was more acceptable for both verb phrases in complex sentences to be in second phrasal position than in final phrasal position. This could be explained by input frequency at the clausal level due to their having received more exposure to verbs in second position than in final position following a usage-based account of language acquisition (e.g. Goldberg, 2006; N.Ellis, 2002; N.Ellis & Robinson, 2008; Roehr, 2008). It would seem that the participants had better acquired the construction [Adverbial+Verb+Subject+Object] than the construction [Subject+Object+Adverbial+Verb] regardless of clause type. Perhaps with more input, they would have rejected *VFVF and accepted *V2V2 at higher rates, or rejected both these patterns whilst accepting any pattern that had one verb phrase in final position and one in second

position regardless of clause type. These different suggestions do not reflect the rules that govern the language system, but as they had not become sensitive to the importance of clause type for verb placement, it remains an empirical question as to whether (Anglophone) adults can become sensitive to its importance without receiving feedback, explicit information, or actively engaging in understanding the importance of clause via explicit learning.

In addition, the syntactic rules governing this language are formal in nature; the syntactic deviations have no evident form-meaning pairing. Even though it has been argued that constructions are all symbolic at some level (Langacker, 1991), these syntactic deviations are governed by another formal aspect of language, clause type. Therefore, it also remains an empirical question as to whether adults are able to incidentally system learn highly formal aspects of language without feedback, explicit information, or the use of explicit learning, as opposed to formal aspects that carry obvious meaning (e.g. standard question formation when asking for information).

Even forms that do encode some meaning may require some form of instruction or effortful learning. Loewen et al. (2009) found no evidence for the acquisition of third person *–s* during incidental exposure. Meaning, in this sense, refers to the fact that the *–s* morpheme is used in English to convey plurality, possessive, and third person singular present simple. One of the explanations for this finding was that exposure involved explicit information on another grammatical aspect of language (the indefinite article) so it would appear that it is difficult to learn one (or more) form(s) incidentally if the learning task is geared towards the learning of another form explicitly. Even though this explanation is justified based on the present research (as the participants incidentally learnt syntax when focused on meaning), it is also possible that the type of form plays a role in what can and cannot be acquired incidentally. It may be that for formal aspects of language that carry little or no meaning (i.e. forms that would never or rarely

cause a communication breakdown), adults need to either explicitly identify regularities ("by abducing conscious metalinguistic hypotheses about language", N.Ellis, 2009, p. 142) or have their attention drawn to the form and its use if complete acquisition is to occur. Without this attention, adults' learning may prematurely stabilise, reflecting knowledge skewed towards the higher frequency patterns. To use the present language feature as an example, this would result in a 'system' that incorrectly assumes that verbs can come in second position at any time, but verbs can only come in final position in complex sentences when the verb is in second position in the other clause. Alternatively, it could be that acquisition of the system can occur, but it may take longer for forms that carry little or no meaning. Documenting longitudinally how adults' interlanguages develop based solely on language use could further understanding of whether language use alone could be sufficient for the whole system to be accurately learnt or not. In addition, it could shed light on whether the longitudinal development would differentially recruit explicit and/or implicit learning processes.

During incidental acquisition that focused on language use, where comparisons are possible, participants followed similar patterns of behaviour to the participants in Rebuschat's experiments (2008). Rebuschat's participants processed language incidentally for meaning at the sentential level. The present participants processed language incidentally for meaning at the sentential and textual level whilst also having a target outcome that was non-linguistic in nature (comprehending reading passages and solving crossword clues) (defined as a meaningful target outcome, Samuda & Bygate, 2008). The addition of a (non-linguistic) meaningful target outcome and the difference between checking comprehension after every sentence (Rebuschat) or after whole-text comprehension did not seem to affect the pattern of what the participants had learnt about the language. In both studies, participants were significantly more likely to incorrectly accept *VF than *V1, and to accept *VF and V2 at similar rates. In Rebuschat's

experiment 3, participants incorrectly endorsed *V1 38.6% of the time even though verb in initial position was permitted in his language (for main clauses in second clausal position). In the present study, *V1 was accepted 59.11% of the time despite there being no input with the verb phrase in initial position. The fact that the participants in the present study accepted *V1 much more than Rebushcat's participants suggests that when using language (no vocabulary difficulties and processing language for a meaningful target outcome), adults need more time than when processing individual sentences to incidentally acquire the same quantities of form (or to realise what is possible and what is not possible in the language).

During incidental exposure that required language use (defined here as completion of tasks for a non-linguistic goal and without vocabulary difficulties), participants were able to learn something about the language system. This is an extremely positive finding when it is taken into consideration that they were exposed to only 102 sentences (two times; listening and reading aloud) over a period of approximately 30 minutes. It seems that with little exposure, incidental learning can occur. However, there are a number of caveats that need to be borne in mind.

Firstly, the participants did not incidentally learn the entire system; rather they appeared to become sensitive to acceptable possibilities (verbs in second and final position), and this possibly driven by frequency (due to their accepting *V2V2 [65.43%] more than *VFVF [54.78%], although this difference was not significant). It remains an empirical question as to whether the whole system can be correctly acquired during incidental exposure.

Secondly, despite relatively short exposure, there were a substantial number of examples for both rules. In normal language use, over one hundred incidental exposures to one (or two if we treat each rule separately) linguistic feature(s) could involve many hours of exposure over weeks, months, or years. In addition, in the case of the two syntactic rules, if

some of the verb phrases include or are surrounded by unknown words, it could be that the syntax is not processed at all as the learner does not realise which words constitute which phrases; in other words, exposure to a linguistic feature may only count as exposure if it is perceived in the input (Collins, Trofimovich, & Bell, 2011; N.Ellis, 2006).

Thirdly, the use of an artificial language that eliminated any vocabulary challenges for the participants could also have led to increased incidental learning during language use. In the present study, the participants were language users not language learners insofar as they only had to comprehend the language to achieve the meaningful target outcome. Language learners, on the other hand, in achieving the meaningful target outcome, may also encounter problems with vocabulary or phonology. It has been estimated that for successful text comprehension in reading, 98% of the words in a text need to be understood (Laufer & Ravenhorst-Kalovski, 2010). For listening comprehension, the figure may be slightly lower (95%) (VanZeeland & Schmitt, 2012). Without these levels of comprehension, it may be that incidental acquisition of formal aspects of language is limited.

The above discussion focused on the findings in relation to incidental acquisition, but the type of learning that occurred was also investigated in the present study. I will now turn to a discussion of the findings in relation to explicit and implicit learning, and explicit and implicit accuracy.

4.2 RQ2: Explicit and Implicit Learning

An important contribution of the present study was to investigate whether adults learn language input both explicitly and implicitly during language use. Previous research has divided participants as being explicit learners or implicit learners (i.e. having processed language explicitly or implicitly) (Bell & Collins, 2009; Leow, 2000; Rebuschat, 2008 [although the

participants' knowledge was also discussed in relation to both types of learning], Williams, 2005). However, there is no reason to suggest that one type of process excludes the other (N.Ellis, 2005; Paradis, 2009; Roehr, 2008) and extant research has assumed that learners can construct both types of knowledge and deploy them differentially based on test demands (R.Ellis et al., 2009). A real-life example to which readers will likely be able to relate is when one is reading the newspaper and suddenly comes across an unknown word or unknown structure that impedes comprehension in some way (the communication breakdown N.Ellis discussed). Up to this point, implicit comprehension processes have been at work. However, on meeting the unknown word/structure, some type of explicit analysis takes place that may or may not be successful at comprehending the unknown word/structure.

It was hypothesised that participants would demonstrate both types of learning. The findings from the present study support this hypothesis. Based on the measure of knowledge and test behaviour, the majority of adults processed the syntactic deviations explicitly and implicitly. However, out of the 81 participants, 18 did not provide evidence of explicit learning when evidence was operationalised as any information contained in post-verbal reports that could affect behaviour on the test of learning. Based on participant judgement of source of knowledge, the responses provided by the participants after each test item in relation to how they had judged the item (rule, memory, intuition, guess) showed that 78 participants believed they had processed the input explicitly (rule or memory) and implicitly (intuition or guess). Two participants believed they had processed the input only explicitly and one participant believed she had only processed the input implicitly. Finally, the confidence rating *d'* scores ranged from -2.10 to 1.34. Even though these scores divide implicit participants and explicit participants based on whether they fall below or above zero, the fact that there is a continuum suggests that some participants are learning more explicitly than others, and vice-versa. A positive

relationship between accuracy and confidence is interpreted as demonstrating that the learning occurred explicitly, but the strength of the relationship may determine whether implicit processes were also employed or not.

The finding that both explicit learning and implicit learning occurred, and this based on the three awareness measures, supports theory and research that favours a dynamic constructivist approach to L2 acquisition (Dörnyei, 2009; N.Ellis & Larsen-Freeman, 2006; N.Ellis & Robinson, 2008; R.Ellis et al., 2009) as it suggests language learning proceeds using domain-general learning mechanisms and it occurs in a fashion that may employ more or less explicit and implicit processes based on a number of factors (e.g. type of linguistic feature, similarity between feature in L1s and L2, cognitive abilities etc.). It also supports dissociable human learning systems; one explicit and one implicit (Shanks & St. John, 1994). Even though the finding could be a factor of the measures used, it helps further understanding of how adults can process language for comprehension and suggests it may be preferable for future research to analyse type of learning within participants as opposed to between participants.

If it is accepted that the majority of language learning and language use relies on implicit processing (learning), and this seems to be the case with many different explanations of how acquisition occurs (Goldberg, 2006; VanPatten & Williams, 2007; Paradis, 2009), the issue of importance is to understand when and for what features explicit learning can be helpful or indeed necessary. Extant research has favoured an approach whereby participants are implicit learners until a certain point in time when some form of attention is paid to the target feature. After this time, all learning is assumed to be explicit and they are labelled as explicit (or aware [noticing or understanding]) learners (Bell & Collins, 2009; Leow, 2000; Williams, 2005). However, this is problematic for two reasons. Firstly, it ignores the potential importance and influence of the implicit learning that occurred prior to explicit learning, and secondly, this

defines explicit learning as any and all learning that occurs following attention to the input of interest as a grammatical form in the input. However, even though there is considerable debate concerning these matters, it appears that attention at some level is necessary for learning (Robinson, 2003; Roehr, 2008; Williams, 2009).

The present study cannot shed light on the necessary level of attention as participants' understanding of the language system was elicited after training, and this was not an aim of the study. However, the findings do suggest that when participants use language for global comprehension, some form of attention was used (as it would be incorrect to claim that any participant did not realise the word order deviated from English, and this in the very initial seconds of hearing the language), but after this, the learning could occur explicitly and implicitly with there being both within-subject and between-subject differences in the quantity of explicit and implicit learning demonstrated (and the accuracy of learning, discussed below).

If participants learn language implicitly and explicitly during language use, and this to differing degrees, it suggests that there are two routes to language development that can occur simultaneously. This does not presuppose that the relationship between these two types of learning is separated and that they do not directly affect each other (the weak or no interface positions, R.Ellis, 2009) as the present research cannot shed light on whether these two routes can pass or not. What is important for future research is to understand whether, as seems to have been assumed in previous awareness research, explicit learning will occur at some point: Williams' (2009) discussion of 'insight'. Alternatively, it could be that different people use different learning processes to differing degrees with differing degrees of success (accuracy of learning) over time (probably also dependent on the target linguistic feature). Understanding these issues can help to explain when instructional intervention is useful.

4.3 RQ3: Explicit and Implicit Accuracy

In relation to the accuracy of explicit learning and the accuracy of implicit learning, hypothesis five stated that explicit learning would be more accurate than implicit learning. As participants could be divided in two different ways depending on the measure of awareness, it was possible to look at explicit and implicit accuracy within-subjects and between-subjects. Dividing participants based on confidence ratings as learning explicitly or implicitly did not result in between-participant differences; explicit learning and implicit learning were equally successful and thus, hypothesis five was not supported. This needs to be borne in mind when discussing the remaining findings.

When participants were divided as learning the language in one of three ways (more explicitly, explicitly and implicitly, and more implicitly) using the measure of knowledge and test behaviour, the explicit participants significantly outperformed the implicit participants on the overall test and the effect size was large (d = 1.00), which demonstrates that the difference between these two groups is one standard deviation apart. This finding supports hypothesis five. However, those participants that had learnt explicitly and implicitly equally did not differ from either the more explicit participants or the more implicit participants. Furthermore, there were no significant differences between the groups based on the three sets of patterns used on the test of learning. This suggests that when participants use more explicit processes to learn form when using language for meaning, the accurate learning of form, in general, may occur slightly more quickly (or with fewer examples). This adds evidence for the utility of explicit learning of language when language is being used to complete a meaningful target outcome. Extant research that has found differences between explicit learners and implicit learners has either focused on meaning at the sentential level (Rebuschat, 2008), or another grammatical feature (Leow, 2000). However, despite the effect size being large, which demonstrates an important

difference between the accuracy scores between the more explicit participants and the more implicit participants, it is unknown how development would have proceeded if more input had been provided. The fact that the equally explicit/implicit participants did not have accuracy scores that differed from the explicit participants, or the implicit participants also highlights that the differences between the accuracy of explicitly-learnt information and the accuracy of implicitly-learnt information may be smaller than is currently believed. In addition, this discussion has to be interpreted alongside the knowledge that the more explicit participants were also likely processing implicitly as well, and the more implicit participants were also likely processing explicitly.

The finding of accuracy differences between the more explicit participants and the more implicit participants contradicts the finding by Bell and Collins (2009) that there were no differences between implicit learners and explicit learners in accurately assigning French grammatical gender after exposure to French nouns ending in *–eau* and *–elle* through a meaningful crossword. This contradiction is important as, to my knowledge, these are the only two studies that have employed tasks that focus on comprehension and include a meaningful target outcome. However, despite both training phases requiring participants to focus on comprehension for a meaningful target outcome, the participants in Bell and Collins were low-level learners of French and thus, they also had to effortfully comprehend individual words in the input (language learners). In the present study, the participants could automatically process the meaning of individual words (language users). When adults are incidentally exposed to language as language learners, the differences in accuracy between explicit learning and implicit learning may be reduced. However, as language users, explicit learning may be facilitative in the acquisition of form. Note that in both these interpretations, explicit learning is not deemed necessary. This difference in findings highlights a potentially important difference between the

efficiency of explicit learning during language learning and during language use when learners are focused on completing a task for a non-linguistic goal. If further research demonstrates that when completing tasks for a non-linguistic goal (as is deemed necessary in task-based language teaching, Samuda & Bygate, 2008), language learners can process the input explicitly and implicitly with no difference in accuracy whilst language users learn more when processing explicitly, the pedagogical implication would be to ensure that tasks are sufficiently challenging for learners to remain language learners. In other words, if our tasks do not employ, for example, some challenging vocabulary, those learners that learn more explicitly may be advantaged. Of course, this recommendation would need to be interpreted based on how much learning occurs. It could be that despite the differences in accuracy of explicit learning and implicit learning during language use, the amount of both types of learning may be greater than during language learning.

It is evident future research is needed that increases the quantity of exposure to allow for higher levels of accuracy in order to determine whether explicit learning of the input is needed (leading to explicit accuracy), and if it is not necessary, how effective it is. Furthermore, manipulating the content to force participants to be either language learners or language users can shed light on how challenging meaningful activities should be during incidental exposure to grammatical forms.

In the present study, participants were also classified as processing the input using explicit and implicit learning. Sixty-three participants appeared to have learnt in both ways. When the scores on the test of learning for these 63 participants were divided based on type of learning, it was demonstrated that participants were only significantly more accurate due to explicit learning than implicit learning when judging one of the three sets of patterns. This finding only partially supports hypothesis five (explicit accuracy would be greater than implicit

accuracy). The fact that a significant difference was not found on the test as a whole demonstrates that participants that learn explicitly and implicitly will be equally as accurate with both types of learning overall. What needs to be further understood is whether the equality documented between these two types of learning remains as participants become more and more accurate with the language system.

The finding that within-participant explicit accuracy and implicit accuracy are the same contradicts the belief that implicitly-learnt information is more systematic than explicitly-learnt information. Paradis (2009) suggests that variation is a characteristic of controlled processing of explicit knowledge even in highly fluent speech. He argues that if one is to claim that something has been internalised (learnt implicitly), there should be no variation. However, this begs the question of how the information was internalised in the first place, especially as he assumes no interface between the two systems. We cannot go from novice to mastery in one fell swoop (discussed further below).

R.Ellis (2008) suggests that implicit knowledge is systematically variable as can be seen from documented developmental sequences. This variability may become smaller as implicit learning continues. Explicitly-learnt information, however, may not, as it is hypothesised to be "anomalous and inconsistent" (p. 418, R.Ellis). At the early stages of learning documented in the present study, both explicitly-learnt information and implicitly-learnt information were used with similar levels of accuracy within-participants. When participants were divided based on their being more explicit, explicit/implicit, and more implicit, the more explicit participants were significantly more accurate than the more implicit participants. Even though there was a tendency for explicit learning to lead to greater accuracy than implicit learning, future research could document both types of learning as they occur over longer exposure to further understanding of variability and systematicity of both explicit knowledge and implicit knowledge.

The above two paragraphs highlight an important difference between explicit learning and implicit learning, and how they relate to explicit knowledge and implicit knowledge. As explicitly-learnt information should be verbalisable, it is possible to discuss this in terms of knowledge. The participants that had learnt explicitly mentioned facts that they believed explained the language (regardless of whether they were accurate or inaccurate). However, the same is not true for implicitly-learnt information. It would be premature to suggest that the participants had implicit knowledge of the language system. Rather, at these initial stages, they were knowledge-building. This may not appear to be an important distinction, but if one accepts that implicit knowledge should be systematic (which it is in first language use), and that it may consist of condition-action rules that reflect procedural knowledge (R.Ellis, 2009) in the ACT-R cognitive architecture (Anderson, Matessa, & Lebiere, 1997), it may be necessary to avoid the term implicit knowledge in comparison to explicit knowledge at early stages of acquisition. This difference between explicit and implicit learning/knowledge is highlighted by the belief that implicit learning takes longer to occur than explicit learning. What is clear is that the participants in the present study were only at the initial stages of learning. It remains to be seen whether any initial explicit knowledge (the facts the participants verbalised) or initial implicit learning would develop until it accurately reflected the language system.

The results in relation to accuracy based on explicit learning and implicit learning warrant further research attention. Recognising that participants may learn explicitly and implicitly (as opposed to rigidly classifying them as one or the other type of learner) seems to better reflect real language learning. The pattern of explicit learning being superior to implicit learning supports the utility of doing this as past research has also found this to be the case (e.g. Leow, 2000; Robinson, 1997b; Rosa & O'Neill, 1999). However, many questions remain in order to further understanding of how these two processes work simultaneously, and the differences

in outcomes of these two processes. These two issues are fundamental in understanding how languages are acquired and supporting or rejecting current hypotheses in relation to the interface issue (N.Ellis, 2005; R.Ellis, 2009; Paradis, 2009).

4.4 RQ5: Cognitive Abilities and Learning: Incidental Acquisition

Four different cognitive abilities were measured in the present study: inductive language learning ability, working memory, processing speed, and verbal reasoning. None of them were found to play a role in the quantity of incidental acquisition that occurred. When participants use language for global meaning, cognitive ability differences do not appear to affect the acquisition of form. Using language for meaning (incidental exposure) may permit all learners to benefit equally regardless of aptitude. This position has been hypothesised (Krashen, 1982; Zobl, 1992), and research has been conducted to understand whether incidental acquisition is open to individual cognitive differences (Harley & Hart, 1997, 2002; Ranta, 2002; Robinson, 1997a, 2005). Research by Harley and Hart, and Ranta demonstrated that the proficiency of learners from French immersion (content-based language instruction) and intensive English (meaning-focused ESL instruction) was dependent on individual differences. However, they investigated general language proficiency as opposed to targeting a specific linguistic feature. Furthermore, their research was conducted over a longer period of time where the quantity of language learning is incomparable to the present study. On the other hand, Robinson (1997a) found no relationship between his incidental participants (who read individual sentences for meaning) and aptitude (short-term memory and grammatical sensitivity) on the acquisition of two syntactic linguistic features. In both Robinson and the present study, participants received intensive input on the linguistic features; it could be that the sheer quantity of examples in such a short period of time levelled the playing field. In normal

circumstances, where input on specific features is distributed, aptitude may play a role. Alternatively, aptitude may have an insignificant role in terms of individual linguistic features, but a significant role with respect to language proficiency as a whole. Nevertheless, Robinson (2005) found a significant positive correlation between working memory and scores on a listening grammaticality judgement test in the incidental acquisition of Samoan. The listening test focused on three grammatical features of Samoan. This relationship held on the immediate posttest after one week, but not after six months. However, working memory was significantly correlated with a measure of guided sentence production after one week and after six months. Furthermore, at the six-month posttest, aptitude, as measured by three sub-tests (grammatical sensitivity, phonological sensitivity, and paired-associate rote memory), also correlated significantly with a measure of guided sentence production. This suggests that cognitive abilities may play a role with specific linguistic features after all during incidental acquisition. However, the complexity of Robinson's results and two contradictory findings point towards a need for further research as understanding the relationship between incidental learning and aptitude is important for pedagogical practices, especially in language learning contexts where meaning is prioritised over form (as is the case in Quebec).

A final important point to consider in relation to incidental learning and aptitude is that the participants in the present study were language users as opposed to language learners. It could be that all participants had sufficient attentional resources to focus (explicitly and implicitly) on language form so that differences in aptitude were not as relevant. When adult learners also have to focus on non-grammatical features to comprehend and execute a task, cognitive abilities may play a role in the incidental acquisition of grammatical forms that do not need to be understood for comprehension of meaning. Further research is needed to

understand this potentially important difference between acquisition during language use and language learning.

4.5 RQ6: Cognitive Abilities and Learning: Explicit and Implicit Learning

The cognitive ability measures were also investigated alongside measures of explicit and implicit learning. It was hypothesised that participants that demonstrated more explicit learning processes would have higher inductive language learning ability scores than participants that demonstrated more implicit learning processes (hypothesis six). It was also hypothesised that there would be a positive relationship between inductive language learning ability and explicit learning, but a negative relationship between inductive language learning ability and implicit learning (hypothesis seven). The hypotheses were partially supported. In classifying type of learning using the awareness measure of knowledge and test behaviour, it was demonstrated that participants that processed the language more explicitly had higher inductive language learning ability scores than the more implicit participants, which replicates Bell's findings with regards to the difference between aware learners and no verbal report learners (2009), and supports hypothesis six. These results are also supported by Robinson's (1997a) finding that learners in an implicit condition were more likely to look for rules and verbalise rules if they had high scores on a measure of grammatical sensitivity. However, it needs to be borne in mind that grammatical sensitivity (tested in Robinson) and inductive language learning ability (tested in the present study and Bell, 2009) may be testing two different abilities. Skehan (1998) proposed that these two abilities constituted analytic ability. However, Bell found that tests of the two measures did not correlate significantly, and were not both able to predict whether learners paid attention to form or not.

In the present study, it was also possible to identify whether there were differences in explicit learning and implicit learning within participants based on aptitude scores to observe whether hypothesis seven could be supported. Contrary to hypothesis seven, a positive relationship between explicit learning and inductive language learning ability was not found, which suggests that participants do not process the language explicitly based on their being able to successfully induce patterns in the input.

However, it was demonstrated that implicit learning was negatively related to inductive language learning ability, which supports hypothesis seven. This suggests that learners with low inductive language learning ability scores may be more prone to process the input implicitly (to learn implicitly). It is not possible to say whether this will make language learning less efficient as this is unrelated to the accuracy of what has been learnt implicitly (discussed below). It could be that a person's ability to induce patterns in language affects how learning occurs, but it does not have any effect on the outcome of learning.

The analyses conducted to address the relationship between explicit and implicit learning, and the aptitude measures divided the participants based on the types of learning they had demonstrated. This led to the classification of participants as follows: 63 participants demonstrated explicit learning, 81 participants demonstrated implicit learning. The responses on the test of learning for the 63 participants that demonstrated both types of learning were divided based on the measure of knowledge and test behaviour. Therefore, explicit learning scores and implicit learning scores for these participants equalled 100; they were mirror images, and any positive relationships found between explicit learning and cognitive abilities automatically engender identical negative relationships between implicit learning and aptitude. Therefore, the significant relationship between implicit learning and inductive ability was driven by the 18 participants that only learnt implicitly.

It is not clear why inductive language learning ability predicted implicit learning, but not explicit learning, particularly as previous research has demonstrated a relationship between grammatical sensitivity and the likelihood of explicit learning (Robinson, 1997a), and it has long been thought that aptitude plays a greater role in explicit learning than implicit learning (Carroll, 1962; Cook, 1996; Reber, 1993). It could be that adults that have difficulty inducing patterns in input are more likely to process language implicitly as, when they learn explicitly, they take longer to become accurate. Even though no significant relationship was found between inductive ability and explicit accuracy, these two variables were positively related; participants with low inductive ability scores were less accurate than participants with high inductive ability scores when learning explicitly. As no similar relationship was found between inductive ability and implicit learning, adults that learn implicitly may not have their implicit accuracy affected by low inductive ability. This suggests that participants may process language based on their cognitive profiles, playing to their strengths and weaknesses. However, due to the exploratory nature of this study, it is clear that more research is needed to understand the relationship between cognitive profiles and the explicit and implicit learning (processing) of language. Furthermore, the above discussion refers only to initial explicit learning and implicit learning and their relationship to cognitive profiles.

4.6 RQ7: Cognitive Abilities and Learning: Explicit and Implicit Accuracy

If inductive language learning ability plays a role in whether participants learn language implicitly, does it also play a role in terms of accuracy? It was hypothesised that explicit accuracy would be related to inductive language learning ability and working memory, but implicit accuracy would be related to processing speed and verbal reasoning. The hypotheses

were not supported. With both awareness measures (confidence ratings, and knowledge and test behaviour) no relationships were found.

The finding that explicit accuracy was unrelated to processing speed and verbal reasoning was expected. However, the finding that explicit accuracy was unrelated to inductive language learning ability and working memory contradicts previous research. Robinson (1997a) found a positive relationship between participant accuracy, and grammatical sensitivity and short-term memory for participants in rule-search and instructed conditions. These differences could be explained by the fact that Robinson's participants were placed into one of four learning conditions and thus, did not choose the learning processes that they would normally use. When adults use language without instructions on how to learn, we may naturally choose the most efficient means of learning to lead to higher levels of accuracy so some differences in cognitive abilities (i.e. memory) are decreased.

It could also be that as the participants in the current study were language users as opposed to language learners, the role that cognitive abilities may have on explicit accuracy were downplayed. When learners have to focus on multiple cues in the input to comprehend individual words, grammatical structures, and global meaning, differences in cognitive abilities may have a more pronounced effect on the accuracy of explicit learning. This remains an empirical question.

The finding that none of the cognitive abilities could predict explicit accuracy in the present study is extremely positive. In many classrooms, even when meaning is prioritised over form, language is often treated as an object. If learners are able to choose how to learn (process explicitly and/or implicitly), subsequent accuracy may not be affected by individual differences. The important factor here may be the issue of choice; when learners are encouraged to learn explicitly or implicitly (due to teaching beliefs, activity types etc.), the

accuracy of explicitly-learnt information may be open to the effects of certain individual differences (as found in Robinson, 1997a). However, if learners are able to process input in a manner that they naturally choose, explicitly-learnt information may be less affected by individual differences.

The finding that implicit accuracy was not affected by inductive language learning ability and processing speed was expected based on previous research. However, it is interesting that there was a negative relationship between inductive ability and implicit learning, but this does not hold when discussing the learning in terms of accuracy. Participants that have low inductive scores may be more likely to learn implicitly, but this does not affect the accuracy of implicit learning. This positive finding points towards adults knowing how best to process for their cognitive profiles. Furthermore, as there were no differences in explicit accuracy based on individual differences, there does not appear to be a reason to suggest that one type of learning be encouraged over the other in order to reach higher levels of accuracy. Of course, further research is necessary in order to understand exactly how individual differences affect explicit learning and subsequent accuracy, and implicit learning and subsequent accuracy as this information has direct pedagogical implications.

Outside of language research, a relationship has been found between implicit learning and verbal reasoning (Kaufman et al., 2010) and processing speed (Kaufman et al.; Salthouse, McGuthry, & Hambrick, 1999), which led to the formulation of hypothesis eight with regards to a relationship between implicit accuracy, and processing speed and verbal reasoning. This relationship was not replicated in the present study. When adults use language for comprehension, implicit accuracy was not affected by these cognitive abilities. However, as this is the first study to investigate whether cognitive abilities that are known to affect implicit learning also affect implicit learning of languages, it would be useful for further research to also

include these measures. It could be that the ease of the tasks, and the fact that the participants were more akin to users than learners negated some of the relationships between learning and individual differences.

No relationship between implicit learning and cognitive abilities supports claims by Krashen (1982) and Zobl (1992) that acquired knowledge is more uniform than learned knowledge. It also supports Reber's (1993) notion that implicit learning should not be affected by individual differences. Future research in cognitive psychology and SLA that attempts to investigate whether implicit learning can be classified as an ability, and hence open to individual differences, is warranted. The results in the present study contradict findings from studies of general language proficiency in content-based and communicative classrooms, which have found that individual differences still play a role when focus on meaning is prioritised over focus on form (Harley & Hart, 1997; Ranta, 2002). However, this is the first study that set out to measure type of learning at the level of verbalisation after incidental exposure to approximately 30 minutes of meaningful input. Two interpretations are entertained here. Firstly, as exposure in studies of general language proficiency occurs over a much longer period of time than in the present study (e.g. Ranta's study was conducted over an academic year), it may be that the importance of aptitude factors to implicit learning takes time to develop. When initial implicit learning occurs, individual differences may not be important. However, over time, their influence on the accuracy of implicit learning may become evident.

An alternative interpretation is that previous research has found differences because explicit and implicit learners have not been divided. When learners process language implicitly, regardless of whether they also process language explicitly, individual differences in cognitive abilities may not affect accuracy of information learnt implicitly.

The above discussion has focused on interpreting the results of the study. However, it is also necessary to discuss the different results obtained based on the different measures of type of learning (awareness).

4.7 RQ4: The Measurement of Explicit and Implicit Learning

The divide between explicit learning and implicit learning in the present study, and hence explicit accuracy and implicit accuracy, was established using three measures of awareness: source attributions, confidence ratings, and knowledge and test behaviour. The results differed based on these measures. In terms of learning, source attributions demonstrated more explicit learning, but confidence ratings and knowledge and test behaviour demonstrated more implicit learning.

Source attributions are given by each participant for each judgement on the test of learning so they are controlled by the participant. In addition, what the participants understand by the different categories (rule, memory, intuition, guess) is not measured. Indeed, the control participants in the present study also provided source attributions. Even though intuition would be the expected source the majority of the time due to the test being conducted in their L1, some control participants claimed they were using rules. When they were prompted to provide any rules they may have used, the majority of responses demonstrated that the participants did not actually have specific rules. Rather, they believed they were using rules because English is their mother tongue ("the rule is my knowledge of the language"; "...I believe, therefore, that I was taught English according to rules which still govern my understanding of correct English usage."), or because the word order was 'right' or 'wrong', or other unrelated comments ("the rules are English semantics"). It would not be correct to classify these control participants as having responded to the test items using explicit knowledge. In addition, many control

participants believed they were using 'memory', but 'memory' in source attributions is supposed to refer to the training phase, which the control participants did not complete. Thus, it is difficult to know the reliability of the source attributions in terms of explicit and implicit language learning. Based on the above information, it would seem unjustified to claim that when participants believe they are using intuition or guess, they are using knowledge that has been learnt implicitly, and when they believe they are using rule or memory, they are using knowledge that has been learnt explicitly.

Nevertheless, research that has investigated the utility of source attributions has found divisions between how participants react based on whether they believe they are using rule/memory or intuition/guess (Dienes & Scott, 2005). For example, asking participants to complete a secondary task affects accuracy on judgements made using rule/memory, but not intuition/guess. This suggests that the divide reflects two different types of learning; one that is affected by reduced attention (explicit learning) and the other that is not (implicit learning). Therefore, source attributions provide important information on what the participants believe they are doing, but it may not be sufficiently sensitive to be included as an independent measure of consciousness. There has been a lot of discussion focusing on the importance of ensuring all conscious information has been elicited if one is to discuss learning in terms of its being explicit and implicit (Leow & Bowles, 2003; Schmidt, 2001; Shanks & St.John, 1994). Even though source attributions were a useful means of eliciting information concerning the simultaneity of implicit and explicit learning, it is important to include other measures that more precisely measure the contents of consciousness.

The two other measures were used to classify both learning and accuracy, but one was dichotomous (confidence ratings) and one was continuous (knowledge and test behaviour). The subsequent results differed, with confidence ratings finding no differences between explicit

learners and implicit learners (in terms of learning processes and accuracy), but the measure of knowledge and test behaviour finding that explicit learning was slightly more accurate than implicit learning. Which results better reflect the reality? Of course, it is not possible to answer this question with certainty, but it seems that the measure of knowledge and test behaviour was superior for a number of reasons. In order to justify this comment, I will first discuss confidence ratings and then the measure of knowledge and test behaviour.

The use of confidence ratings to define learning is difficult to fit into previous SLA theory. The assumption underlying the use of confidence ratings is that accuracy and confidence are related when learning has occurred explicitly. However, it is acknowledged that findings from first language learning contradict this assumption. Rebuschat's (2008) use of confidence ratings and his conclusion that they could be used in SLA research as they successfully captured low levels of awareness does not situate the measure within extant SLA theory. Is it feasible to have confidence in confidence ratings for measuring awareness of linguistic features in the acquisition of a second language? Why would no relationship between confidence and accuracy demonstrate that a participant did not process the linguistic feature explicitly? Based on the verbal reports in the present study, 63 participants had some structural knowledge of the language system. However, the confidence ratings classified 49 participants as implicit learners. Having verbalisable knowledge about the language that could affect test behaviour seems to be a more rigorous means of establishing type of learning (if type of learning is not treated dichotomously as a verbal report should not be interpreted to mean that a. all learning occurred explicitly, and b. all items on the test of learning were answered based on explicit knowledge). Due to the discrepancy between verbalisable knowledge and classification based on confidence ratings, the utility of confidence ratings is unclear. They certainly are an easy measure to administer and they allow participants to be divided into having learnt explicitly or implicitly (if

one desires to do this, which I have argued against). However, in discussing explicit learning and implicit learning of languages, verbalised structural knowledge surely trumps confidence ratings when they conflict: one participant wrote "Order of words: adjective, verb, noun. Example: quietly walked Emma", but was classified as an implicit learner based on confidence ratings. Even though the participant may not have used this knowledge in responding to all items on the test of learning, this information certainly suggests that he/she processed some of the input explicitly.

The underlying assumption of confidence ratings is that confidence and accuracy should be related when knowledge is conscious. However, this assumption was not advanced in relation to language, but subliminal perception (e.g. Pierce & Jastrow, 1885). Indeed, the idea that a relationship between accuracy and confidence automatically demonstrates learner consciousness has been criticised with reference to natural languages. Dienes and Scott (2005) stated, "if shown a sentence we can know it is grammatical and consciously know that it is grammatical, but not know at all why it is grammatical" (p. 339). With natural language, the relationship between confidence and accuracy may not reflect conscious versus unconscious knowledge. We can know that we are right (conscious awareness of being right [judgement knowledge, Dienes & Scott]), but not know why we are right because the information that is driving our decision is unconscious (structural knowledge, Dienes & Scott).

Another important point with regards to confidence ratings is that they are one of a number of dichotomous awareness measures. It is not evident to me that confidence ratings are more useful than extant SLA dichotomous awareness measures, noticeably think-aloud protocols and probe questions. Furthermore, in the present research, I have argued that a more realistic point of departure for awareness research may be to use a measure that is continuous, and indeed one was successfully employed in the present research.

The measure of knowledge and test behaviour is a continuous awareness measure that attempts to account for all structural knowledge that may affect test behaviour whilst also controlling for the possibility that the structural knowledge may not always be used. This is a valid assumption as research has demonstrated contradictions between performance and explicit knowledge. Correct explicit knowledge does not also ensure correct performance, and incorrect explicit knowledge does not also ensure incorrect performance (Green & Hecht, 1992; Sanz & Morgan-Short, 2004). Therefore, a measure that attempts to classify participants based on how they have actually behaved is promising. In addition, in the present study, the measure successfully divided participants, and the majority of the findings could be supported by extant research. If the results had been a factor of the measure used, they would be less likely to complement extant research.

However, it is important to mention a caveat with the measure; it divides the processing of the input based on verbalisation alone. A participant that verbalised any information that could affect test performance was classified as having processed at least some of the input explicitly (n = 63). Relying on verbalisation, particularly post-exposure, has been criticised (Hama & Leow, 2010) and it is widely accepted that knowledge does not need to be verbalisable for it to have been learnt explicitly (Schmidt, 2001; Shanks & St. John, 1994). However, even if ability to verbalise is not the point at which explicit learning and implicit learning differ, it seems that at our current state of knowledge, a division at this point can provide useful information. More specifically, it tells us what participants have consciously learnt and what participants appear to have unconsciously learnt.

The debate concerning how to determine whether explicit learning or implicit learning has occurred continues in cognitive psychology and SLA (Bowles, 2008; Dienes & Seth, 2010; Hama & Leow, 2010; Shanks, 2003). The present study employed an innovative measure in

order to capture all structural knowledge whilst also permitting both types of learning to co-occur. Its employment in future studies could advance knowledge of our learning processes especially if the post-exposure questions are carefully written to permit objectivity when classifying participant behaviour.

Furthermore, more research is needed to understand the validity of all of the awareness measures that are employed in learning research. If, as suggested above based on control participant behaviour, source attributions are not understood by participants in the same way as the researchers, it needs to be understood how they are a useful method for learning research. In relation to confidence ratings, it would seem appropriate to conduct research that asks participants on-line about their judgements every time there is a relationship between accuracy and confidence (accurate + confidence, and inaccurate – confidence). Participant reflections on-line could shed light on how accurate the assumption is that a relationship between confidence and accuracy signals conscious language learning. Finally, in relation to the measure of knowledge and test behaviour, it would be extremely insightful to ask participants to classify some test items during the post-exposure questionnaire. Consistency between test behaviour and these responses would allow inferences concerning the stability of what has been learnt.

In this chapter, the findings have been interpreted in relation to the research questions and hypotheses. In the present study, some hypotheses were supported, some were partially supported and one was rejected. Reasons for these findings were advanced. In the final chapter, I shall discuss the limitations of the study, the contributions, and future research directions.

Chapter Five: Conclusion

In this final chapter, I will first present the limitations of the present study before concluding with the contributions of the findings and directions for future research.

5.1 Limitations

There are a number of factors that need to be borne in mind with regards to the present study.

First, an artificial language that consisted of English lexis with syntactic deviations adapted from German was employed. There were a number of important reasons for choosing this language explained in Chapter Two (experimental control over past exposure, and vocabulary proficiency; and it permitted the use of meaningful tasks with a non-linguistic purpose). However, it is now necessary to see whether these results are replicable with a natural language. In order to understand how natural languages are processed and learnt, it is necessary to conduct research with natural languages. As Robinson (2005) demonstrated, the incidental acquisition of an artificial letter-string grammar and incidental acquisition of the natural language Samoan were not identical. Clearly, the present study used a language that is more akin to a natural language than strings of letters. However, it remains an empirical question whether participants would interact with the input in the same fashion if it consisted of a natural language that they were attempting to learn.

A second important point to raise is the issue of quantity of exposure in terms of duration and number of examples of the targeted feature. As in the majority of explicit/implicit learning/knowledge research (Leow, 2000; Rebuschat, 2008; Robinson, 1997a, 1997b; Williams, 2005), exposure lasted for a short amount of time (approximately 30 minutes), but with many

examples of the target feature (102 examples). This brief but intense exposure is not how language forms are believed to be learnt as the acquisition of a form occurs over a period of time and may pass through developmental stages that involve such language-related phenomena as backsliding, first language transfer, incorrect hypotheses, and overgeneralisation. However, it is important to note that much learning research and grammar activities in classrooms have conceptualised learning based on brief but intense exposure where learners complete activities that highlight an aspect of a targeted feature in input (comprehension) or demand controlled production, which entails the comprehension or production of many more examples than would be found in natural language use (in Norris & Ortega's meta-analysis, 15 studies had treatments of less than one hour, 14 studies had treatments of between one to two hours, 10 studies had treatments of between three to seven hours, and nine studies had treatments of longer than seven hours; see Bell & Collins, 2010 for an analysis of grammar activities contained in language course books). This issue has been frequently raised in discussions on the relevance of SLA research to real language learning (e.g. Doughty, 2004). However, it is particularly important with respect to explicit/implicit learning research if one assumes that implicit learning entails an analysis of statistical cues in the input (Rebuschat, 2008) and explicit learning entails conscious hypothesis testing and intention to learn. It seems reasonable to suggest that implicit learning may require greater quantities of examples of the target feature than explicit learning. Indeed, in accounts of language learning that assume a transition from declarative to procedural knowledge or from controlled processing to automatic processing, explicit learning should precede and affect implicit learning (although the learning may never become implicit as it could remain as highly automatised explicit procedures), and even output that may appear to be implicit (e.g. Skill Acquisition Theory, DeKeyser, 2007). It is therefore necessary for explicit/implicit learning research to investigate these two types of

learning over time in order to see whether the results found during brief, intense exposure can be replicated.

Related to the above, a third limitation of the present study is that participant learning was only tested immediately after exposure. It is unknown whether the learning (explicit and/or implicit) would have been retained in long-term memory after 24 hours or longer. In addition, with time to reflect between a posttest and a delayed posttest, participants may have created more conscious knowledge (possibly inaccurate) to explain the system and thus, explicit learning may have increased (although this may not have led to similar explicit accuracy increases). This is not to suggest that under normal language learning conditions, time to reflect will automatically engender more explicit learning. Rather, as the participants were language users and the language only differed from their mother tongue following two syntactic rules, it may have been possible for them to work out the system (or to believe they had worked out the system). The inclusion of a delayed posttest could provide important information on the retention of learning, which coupled with longer exposure, would more accurately reflect how second languages are learnt.

A final limitation that I would like to raise relates to the test of learning. In the present study, a timed grammaticality judgement test (GJT) was used to measure learning. A GJT was used as it permits a wide range of syntactic patterns to be tested in a short period of time. In addition, a comprehension-based as opposed to production-based test was needed as the participants had not practised producing the language (DeKeyser & Sokalski, 1996). However, it has been argued that GJTs favour the use of explicit knowledge over implicit knowledge and that the rejection of ungrammatical items may be associated with explicit knowledge (R.Ellis, 2005). This is clearly problematic if the test is supposed to be measuring both explicit learning and implicit learning and, as such, a time limit was included in the present study as it has been

argued that timed GJTs allow implicit knowledge to be used (Loewen, 2009). Furthermore, Dienes & Scott (2005) argued that responses on GJTs do not require the use of explicit structural knowledge (knowledge of the language system), but explicit judgement knowledge (knowledge that the item in the GJT is the same or different from items in the training phase). In other words, consciously rejecting an item on the GJT does not mean the knowledge used to reject the item has to be explicit. In my opinion, the use of a GJT was warranted in the present study, but it is important to interpret the results with this information in mind.

5.2 Contributions and Future Directions

In this final section, I will present the contributions of this study in order to clarify our present state of knowledge and look towards future research directions.

In terms of incidental acquisition, this study demonstrated that whilst language is being used for comprehension to achieve a meaningful target outcome, adult participants were able to incidentally acquire some information concerning language syntax. Despite clear evidence that incidental acquisition occurs when learners interact with language for non-language related goals (e.g. content-based classrooms), this is the first study to document its occurrence with adults for an individual linguistic feature based on short, intense exposure requiring a non-linguistic, meaningful outcome. It is now important to document this type of incidental acquisition with a natural language, with different linguistic features, and with different quantities of exposure that are distributed over time as opposed to massed as in the present study. Understanding these issues can provide information on how effective incidental acquisition can be, and whether its effectiveness depends on individual linguistic features. It can also shed light on the necessary/optimum quantity of input for the acquisition of grammatical features.

This study also furthers knowledge on how languages are learnt and what the consequences of these learning processes are. Documenting simultaneous explicit and implicit learning helps to clarify how adult language learners interact with input, and it lends support to dual-system accounts of language acquisition. It also helps to move awareness research away from treating learning as dichotomous, and in doing so, inadvertently favouring explicit learning over implicit learning (as a learner is implicit only up to the point of demonstrating any conscious processing). Again, as the present study used an artificial language that meant the participants were language users as opposed to language learners, it would be useful to employ this measure when exposure involves a natural language to see whether it can also successfully document simultaneous explicit and implicit learning.

The differences observed between participants in terms of explicit and implicit learning demonstrate that adults do not all process information explicitly and implicitly to the same degree. Of course, extant research has shown differences, but never within-participants. It is now important to understand whether these within-participant differences are the same when processing the grammar of natural second languages, which entails greater effort and attention to be paid to understanding individual words than in the present study.

The findings from the present study regarding the accuracy of explicit and implicit learning lend further support to the effectiveness of explicit learning, but they also demonstrate that the divide between the accuracy of these two types of learning may not be as large as presently thought. Implicit learning was still an effective means of acquiring the language system. Future research should increase the quantity and type of exposure to understand whether our learning processes change over time and whether one type of learning is differentially effective at different stages of acquisition; the slight advantage for the accuracy of

explicit learning documented at the early stages of acquisition in the present study may not remain if acquisition is pushed to its limits.

The present study also makes important contributions in terms of the effects of cognitive abilities on different types of learning. Firstly, an important finding was that initial incidental learning does not appear to be affected by cognitive abilities. Even though it has been hypothesised that individual differences are less important when the focus is on meaning, and this has been demonstrated in meaning-focused classrooms (e.g. Ranta, 2002), this is the first study to demonstrate that during brief exposure that required language use, participant cognitive abilities did not affect the quantity of learning. Again, understanding whether this can be replicated with a natural language is vital. As participants in the present study did not have to focus on individual word meaning to achieve global comprehension, cognitive ability differences may not have played a role. Can the positive finding that initial incidental learning levels the playing field be replicated with a natural language?

In terms of explicit learning and implicit learning, the findings provide initial information on how simultaneous explicit and implicit processing may be affected by cognitive abilities. Knowing that inductive language learning ability may make participants more likely to learn explicitly, or learn less implicitly is a novel finding that warrants further investigation. If our ability to induce patterns in input partially determines the proportion of explicit and implicit processing of language input, it is important to understand whether adults automatically choose the best method of learning dependent on their cognitive abilities. Furthermore, in classrooms where grammar is taught in an explicit fashion, training learners to induce patterns may help learners that naturally process information more implicitly.

In terms of cognitive abilities, and explicit and implicit accuracy, the study contributes to our understanding of how cognitive abilities may not be of great importance for the accuracy of

explicitly-learnt and implicitly-learnt information at initial stages of learning when the learner decides how to process language. Future research with natural languages should investigate whether this finding can be replicated as if explicit accuracy and implicit accuracy are not affected by cognitive abilities, it would seem to be useful to encourage learners to process input according to their own preferences (or to include a variety of activities that encourage explicit processing and implicit processing so all learners can benefit).

Two final contributions of this study to the literature are methodological in nature. First, this study successfully included a continuous measure of awareness (knowledge and test behaviour). It is now necessary to understand the validity of this measure. Future research that includes more in-depth, post-exposure questions can help researchers to understand what knowledge is held explicitly and implicitly. In addition, based on post-exposure question responses, researchers could conduct quick analyses of learner awareness and then ask further questions (i.e. if it is predicted the participant has an explicit rule that all sentences need to begin with an adverb, the researcher could verify with the participant what he/she understands by adverb by showing examples of different words). Based on my experience, I believe a quick analysis and further questions would be easy to implement as initial coding of the participants can be done very quickly. A further important point to raise is that the measure of knowledge and test behaviour could also be employed using on-line verbal reports as well as or as opposed to off-line verbal reports, which can address the potential issue of concurrent conscious processing that is not reported off-line.

The second methodological contribution of the present study was the employment of the false discovery rate to adjust the significance value for multiple tests. The false discovery rate has been recommended for SLA research by Larson-Hall (2010) as it is less conservative than the Bonferroni adjustment so it decreases the likelihood of making a type II error; rejecting

a difference when one actually exists. As the rate is calculated to keep the significance value at 0.05 after all *p* values have been calculated (at the 0.05 level), the likelihood of finding a difference when one does not exist is still 5%. As this is the level of significance that is accepted in social science research, I would recommend the use of this rate.

To conclude, this study contributed to the literature on incidental, explicit, and implicit learning. It is clear that more research is needed to understand how learners process information, to what end, and why. As has been discussed before in relation to these types of learning, research is in its infancy (Hama & Leow, 2010; Shintani & Ellis, 2010). The present study has added some pieces to the puzzle, but many questions still remain with the first one being to investigate whether these findings can be replicated with learners of a natural language.

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APPENDIX A – CONSENT FORM

This is to state that I agree to participate in a program of research being conducted by Philippa Bell, supervised by Dr. Laura Collins of the Department of Education (Applied Linguistics) at Concordia University.

Contact Information :
E-mail : p_bell@education.concordia.ca/philippakbell@yahoo.ca
Phone : 514 845 6491

A. PURPOSE
I have been informed that the purpose of the research is to study how adults comprehend language.

B. PROCEDURES
I have been informed that (1) this study will take place at Concordia University or at my home university/college; (2) that I will be asked to complete 2 reading tasks and 2 crosswords; (3) that I will also complete 4 measures of my cognitive abilities; and (4) the total session will last no more than two hours.

C. CONDITIONS OF PARTICIPATION

- I understand that I am free to withdraw my consent and discontinue my participation at any time without negative consequences by e-mail, phone, or in person.
- I understand that my participation in this study is CONFIDENTIAL (i.e. the researcher will know, but will not disclose my identity).
- I understand that the data from this study may be published or presented at a scientific conference; data will be reported in a way that protects each participant's identity.
- I understand that I will receive a monetary compensation of $10.00 for participating in this study.
- I understand that if I request a copy of the final research report, one will be sent to me. I can make this request to Philippa Bell during this interview or later in writing.

I HAVE CAREFULLY STUDIED THE ABOVE AND UNDERSTAND THIS AGREEMENT. I FREELY CONSENT AND VOLUNTARILY AGREE TO PARTICIPATE IN THIS STUDY.

NAME (please print) _____

SIGNATURE _____

RESEARCHER'S/S' SIGNATURE

DATE

Would you like to be sent a copy of this consent form? _____ Yes _____ No

If at any time you have questions about your rights as a research participant, please contact the Research Ethics and Compliance Advisor, Concordia University, 514.848.2424 ex. 7481 ethics@alcor.concordia.ca

APPENDIX B – INTRODUCTORY QUESTIONNAIRE

Please provide the following information:

1. Name:_____
2. Age:_____
3. Gender (please circle): M F

4. Where did you grow up (i.e. in which town did you attend primary school)?

5. Occupation (if a student, what is your major?):
   _____

6. What is your first language? _____

7. If your parents are not English-speakers, please explain how English is your mother tongue (i.e. when did you start to hear/speak it and with whom)?

8. Have you done any of your education (primary, secondary, collegial/university) in a language other than English? If yes, which language?

9. What other languages do you know (including the language from question 6 if appropriate) (if you know more than 2 other languages, please continue on the underside of this sheet of paper)?

a. Language =
b. How did you learn this language?
c. At what age did you start learning this language?
d. Please rate your proficiency level:

i. Equal to English
ii. Am able to live, work, and/or study in this language, but I feel more comfortable in English
iii. Can converse in this language and watch TV, but I make errors. There are lots of words that I don't know how to say (e.g. grumpy/enamel/skunk) and ideas that I can't express clearly
iv. Can converse in this language, but the other person has to slow down their speech and may ask me to repeat what I say. If I need to do something, I do (or should) prepare what I want to say (e.g. if phoning HydroQuebec or going to the beautician, car services etc.)
v. Can do some basic things in the language (e.g. reserve a table, buy metro tickets), but I know enough about the language that I could, if necessary, look up more information to do something specific (e.g. buy a specific item, order a special meal, greet an acquaintance, visit the beautician or hairdressers)
vi. Can do a few things in the language (e.g. tourist information)
vii. Know a few words and a bit about the language from school education

PLEASE TURN OVER IF YOU KNOW MORE THAN ONE FOREIGN LANGUAGE
THANK YOU FOR PROVIDING THIS INFORMATION

APPENDIX C – THE 4 TRAINING TASKS

Task 1: The Visitor

Once visited a businesswoman Washington D.C. Unfortunately arrived she at 9am even though her meeting until 3pm didn't start. Because she Washington D.C. before hadn't visited, quickly decided to see she the Capitol building. Unfortunately didn't know she the directions. Really needed to ask she someone because she the directions didn't know. Soon saw she a policeman. Hurriedly was leaving the policeman a coffee shop. Quickly asked the businesswoman the policeman for directions because the policeman fast was walking. Uncharacteristically didn't take the policeman the woman because he to an emergency had been called. Instead gave he her the correct bus number. Number 54. Profusely thanked she the policeman. Swiftly left to patrol the policeman the city streets. Because the businesswoman very cold felt, first bought she gloves and a hat. Afterwards walked she to the bus stop.

After 3 hours returned the policeman for more coffee. Strangely saw he the businesswoman. Smiling waved the businesswoman to the policeman. Because the policeman for 3 hours had been gone, really couldn't understand he. Efficiently parked he his car. Patiently waited to cross he the road. When there a break in the traffic was, finally crossed he the street to the bus stop. "Why are waiting you still? There are no 54 buses?". Immediately replied she: 2 minutes ago passed the 45th bus. Not long now!

Comprehension Questions (one-word/short answers)

1. Where visited the businesswoman?_____
2. This was her first time in Washington DC? _____
3. The businesswoman knew the directions?_____

4. Who asked the businesswoman?_____

5. The weather was nice? _____

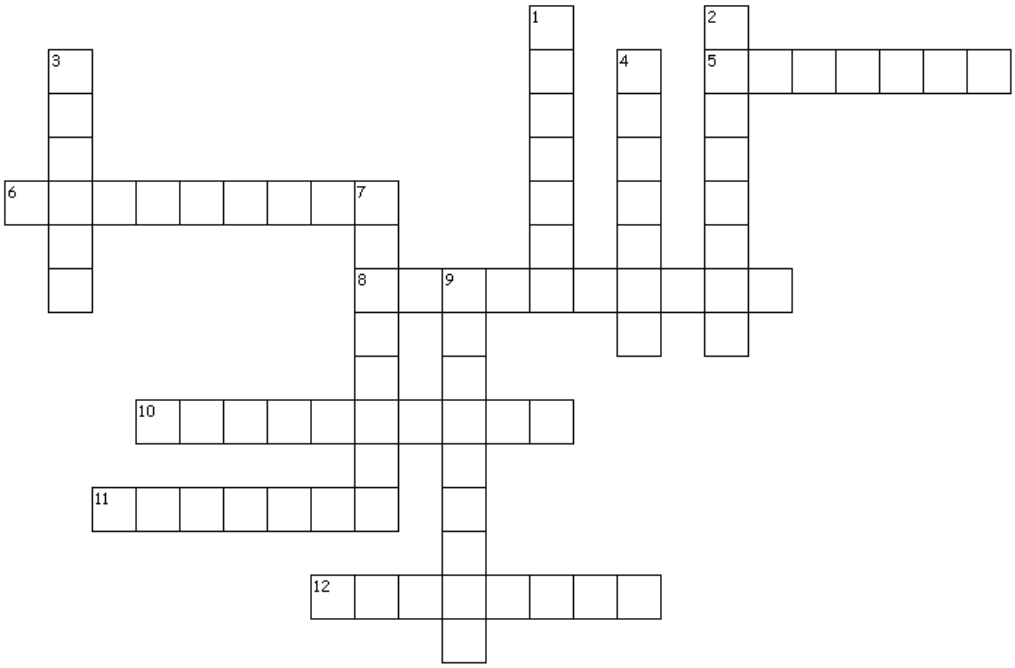
6. What bought the businesswoman?_____

7. Where waited the businesswoman?_____

8. When returned the policeman? _____

9. The businesswoman understood 54th bus or bus 54?_____

Task 2: Vacations!



Across

5. Usually purchase you your souvenirs at this last port of call.
6. When you your friends visit, maybe drink you this fun Mexican cocktail.
8. Frequently eat tourists here when they on vacation are.
10. If you in the sun want to read, likely will need you these.
11. When tourists Quebec visit, likely eat they this national dish.
12. Sometimes feel you this when you at home aren't.

Down

1. When you in a cold climate live, possibly dream you about this hot southern state.
2. Often read tourists this when they on the beach relax.
3. After you home from holidays return, unfortunately need to do you this to your luggage.
4. Maybe could suffer you from this if you your sunscreen forget.
7. When we far-flung destinations visit, usually take we this form of transport.
9. Always should use you this when you to the beach go.

(http://puzzlemaker.discoveryeducation.com/code/BuildCrissCross.asp)

Task 3: The Nasty Parrot

Really loves Jimmy gifts so Christmas his favourite holiday is. Because last year Jimmy all his chores finished, kindly decided to buy his parents him a great gift. On Christmas morning woke up Jimmy very early because he his gifts couldn't wait to open. Quickly dressed Jimmy in his Christmas sweater. In the living room could see Jimmy a big cardboard box. Really got he a shock when he the box opened. Inside could see he a parrot. A real parrot! Because the parrot so beautiful and colourful looked, really couldn't believe Jimmy his eyes. Quickly became Jimmy and the parrot firm friends. Every day fed Jimmy the parrot lots of nuts. Soon named Jimmy the parrot Chirpy because Chirpy noise loved to make. Always were the noises high-pitched and loud. Very happy sounded Chirpy. After a few weeks started to change Chirpy even though Jimmy the routine hadn't changed. In the morning ignored Chirpy Jimmy. In the afternoon bit Chirpy Jimmy. In the evening didn't talk Chirpy to Jimmy. Upset felt Jimmy although things worse were going to get. After two months started to say Chirpy swear words. Very upset felt Jimmy's mother and father because they swear words didn't condone. Soon blamed they Jimmy. Worried was Jimmy! Every day hid he the parrot because he the parrot didn't want to give up. Valiantly tried to change Jimmy the bird's personality. Every day talked he to the bird very politely. Always was he on his best behaviour. Nothing worked! One day was Jimmy angry. Loudly screamed he at the bird. Excitedly used the bird more bad words. Violently grabbed Jimmy the bird. Continually cursed the bird. Finally was Jimmy unbelievably frustrated so he the bird decided to punish. After he the cage opened, ominously reached he inside. Innocently jumped Chirpy from the cage onto Jimmy's hand. Silently carried Jimmy his parrot into the kitchen. Quickly placed he Chirpy in the freezer. For a few minutes screamed the bird bad words. Then was Chirpy completely quiet. Fortunately had not left Jimmy the room. When he the parrot didn't hear, anxiously opened he the freezer door. Really frightened was Jimmy. He had hurt Chirpy? Silently stepped back the parrot onto Jimmy's hand. Timidly said he, "Truly feel I sorry. Although I you love, genuinely have offended I you. From today will use I no bad words." Although Jimmy happy was, also was he very surprised. Really didn't understand he the parrot. Why had changed he his personality? Then pointed the parrot inside the freezer at a frozen chicken. Quietly said he to Jimmy: please don't want to be I like the chicken.

Comprehension Questions (one-word/short answers)

1. When received Jimmy the parrot? _____

2. What named Jimmy the parrot? _____

3. When changed the parrot? _____

4. Jimmy changed Chirpy's routine? _____

5. How felt Jimmy? _____

6. How felt Jimmy's parents? _____

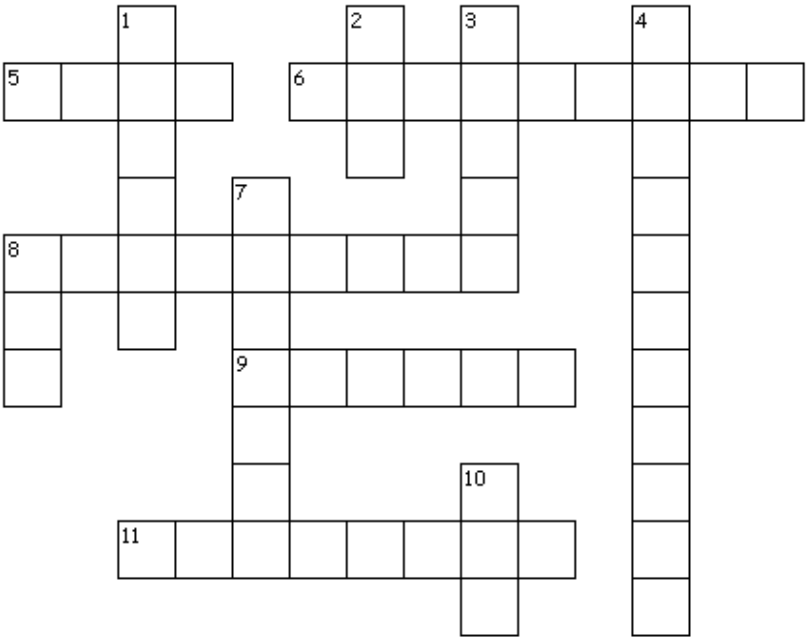
7. How grabbed Jimmy the bird? _____

8. The bird hated Jimmy? _____

9. Where put Jimmy the parrot? _____

10. Afterwards understood Jimmy the parrot? _____

Task 4: Animals



Across

5. In the winter hibernates this animal.

6. Long ago were these reptiles the kings before human beings on Earth existed.

8. If you in Florida near water live, maybe will see you this reptile.

9. When you swear words say, nearby don't want you this bird.

11.Often eat Australians this bouncing animal.

Down

1. Inside is dyed this fish red when you it consume.

2. Sometimes have people part of this animal for breakfast with an egg.

3. Always is used this animal in cowboy movies.

4. When you a difficult exam have to take, maybe have you the feeling of these insects in your stomach

7. Maybe watch you this mammal's tricks when you Sea World visit.

8. After you a mouse discover, maybe spot you this pet.

10. Traditionally is this animal man's best friend.

http://puzzlemaker.discoveryeducation.com/code/BuildCrissCross.asp

APPENDIX D – PHRASAL PATTERNS FROM TRAINING

Rule	Frequency	Pattern/Example
V2	3	AdjP+VP+NP
(simple)		Worried was Jimmy
	4	AP+VP+NP
		Continually cursed the bird
	3	AP+VP+NP+AdjP
		One day was Jimmy angry
	1	AP+VP+NP+AdjP+Cc+AdjP
		Always were the noises high-pitched and loud
	1	AP+VP+NP+AP
		Why are waiting you still?
	1	AP+VP+NP+Cc+NP+NP
		Quickly became Jimmy and the parrot firm friends
	19	AP+VP+NP+NP
		Soon blamed they Jimmy
	2	AP+VP+NP+NP+NP
		Every day fed Jimmy the parrot lots of nuts
	3	AP+VP+NP+NP+PP
		Silently carried Jimmy his parrot into the kitchen
	1	AP+VP+NP+NP+PP+PP
		Sometimes have people part of this animal for breakfast with an egg
	9	AP+VP+NP+PP

		Always was he on his best behaviour
	1	AP+VP+NP+PP+AdjP
		Every day talked he to the bird very politely
	1	AP+VP+NP+PP+NP
		Please don't want I to be like the chicken
	2	AP+VP+NP+PP+PP
		Innocently jumped Chirpy from the cage onto Jimmy's hand
	2	NP+VP+NP
		He had hurt Chirpy?
	1	PP+VP+NP
		In the winter hibernates this animal
	7	PP+VP+NP+NP
		In the living room could see Jimmy a big cardboard box
V2	1	AP+VP+NP+AdjP
(complex)		Finally was Jimmy unbelievably frustrated
	1	AdjP+VP+NP
		Upset felt Jimmy
	1	AdjP+VP+NP+Cc+NP
		Very upset felt Jimmy's mother and father
	1	AP+VP+NP
		Really couldn't understand he
	2	AP+VP+NP+AdjP
		Also was he very surprised

	23	AP+VP+NP+AP
		Ominously reached he inside
	3	AP+VP+NP+NP+NP
		Kindly decided to buy his parents him a great gift
	3	AP+VP+NP+NP+PP
		Finally crossed he the street to the bus stop
	1	AP+VP+NP+NP+PP+PP
		Maybe have you the feeling of these insects in your stomach
	3	AP+VP+NP+PP
		Maybe could suffer you from this
	1	PP+VP+NP
		After a few weeks started to change Chirpy
	1	PP+VP+NP+AP
		On Christmas morning woke up Jimmy very early
VF	2	Cc+NP+NP+VP
		So he the bird decided to punish
	1	Sc+AP+NP+NP+VP
		Because last year Jimmy all his chores finished
	1	Sc+NP+AdjP+Cc+AdjP+VP
		Because the parrot so beautiful and colourful looked
	3	Sc+NP+AdjP+VP
		Although things worse were going to get
	1	Sc+NP+AP+VP

	Because the policeman fast was walking
1	Sc+NP+NP+AP+VP
	Because she Washington D.C. before hadn't visited
2	Sc+NP+NP+PP+VP
	When there a break in the traffic was
19	Sc+NP+NP+VP
	Because they swear words didn't condone
1	Sc+NP+PP+PP+VP
	If you in Florida near water live
10	Sc+NP+PP+VP
	Before human beings on earth existed

APPENDIX E – THE TEST OF LEARNING (3 VERSIONS)

Version 1

1. *Sophie her blessings quickly counted as quietly accepted she her fate
2. *Daniel the dog carelessly pulled while carefully pushed Matthew the buggy
3. *Yesterday Olivia a solution discovered
4. *Often discovered William strange things as always cleaned he the house
5. *While Thomas the movement really supported William another candidate cleverly suggested
6. *William the burglar valiantly attacked while quickly protected Thomas the animals
7. *While carefully folded Emma the clothes Sophie the dishes quietly washed
8. *Often disconnected Emma her alarm clock as really hated she Mondays
9. *Last year Matthew the entrance exams failed
10. *While Olivia home quickly headed Hannah the party really enjoyed
11. *Often cooked Matthew spaghetti bolognese as frequently produced he *tomatoes
12. *As quickly followed Daniel the man he his arm suddenly extended
13. *Quietly prepared Sophie her presentation while carefully created Emma her website
14. *Yesterday Emma her news shared
15. *As Daniel the prize anxiously presented he the winner quickly recognised
16. *Genuinely preferred Daniel his cell phone while really enjoyed Matthew the concert
17. *Olivia her mistake suddenly realised as quickly enabled she the meeting
18. *Matthew an ambulance quickly called as suddenly appeared he distraught
19. *Cleverly avoided William his homework while quietly marked Thomas the exams
20. *Saved in the morning Emma the dog
21. *Destroyed last year Emma the evidence
22. *Sophie good points quietly raised while genuinely expressed Emma concern
23. *Last year Olivia the company managed
24. *Yesterday Hannah her wedding planned
25. *Collected in the morning Olivia her pension
26. *Hannah the floor quickly touched while carelessly dropped Olivia the cup
27. *As genuinely believed Thomas the man he an alibi quickly provided
28. *As luckily survived Hannah the crash she the criminal quickly identified
29. *In the morning Daniel his wrongdoing denied

30. *While valiantly contained Matthew the crowds Daniel the police quickly called
31. *Learned last year Sophie the truth
32. *Ordered in the morning William a drink
33. *As always delivered Emma newspapers she tips often demanded
34. *In the morning Hannah grapes picked
35. *William his troops often encouraged as valiantly protected he his country
36. *Carefully organised Hannah the papers while quietly cleaned Olivia the office
37. *Last year Thomas serious damages caused
38. *As Hannah her innocence easily proved she prison quickly avoided
39. *Revealed yesterday Matthew the truth
40. *While Emma a pay raise loudly demanded Sophie her game quietly raised
41. *Suddenly realised Sophie her worth as kindly provided she her help
42. *As Thomas the man loudly introduced he his laugh suddenly forced
43. *Noticed yesterday Daniel the mistake
44. *While Matthew the class really hated Daniel the teacher quite liked
45. *While carefully explained Olivia the information Hannah the room quietly examined
46. *As Olivia her siblings frequently encouraged she money often contributed
47. *While quickly connected Thomas the cables William computer games quietly played
48. *Delivered yesterday Sophie the good news
49. While Matthew the newspaper loudly turned quietly read Daniel the report
50. Noisily separated William the furniture while Thomas the room quickly measured
51. Quickly checked Sophie the passports while Emma the money silently counted
52. Often sold Daniel products as he a business cleverly managed
53. Often bought Matthew chocolate as he it really liked
54. As Hannah politics loudly discussed suddenly understood she her allegiance
55. In the morning represented Sophie her country
56. Quietly arranged Hannah her trip while Olivia the world confidently travelled
57. As Thomas newcomers always allowed often learnt he new names
58. As Emma her constituency frequently represented often visited she her neighbours
59. In the morning handled Thomas the documents
60. In the morning achieved Matthew his goal
61. Last year climbed Hannah a mountain

62. Carefully treated Daniel the floorboards while Matthew the holes quietly filled
63. Yesterday received William the prize
64. Often received Sophie bad marks as she her homework always avoided
65. While Olivia the cookbook carefully studied loudly promised Hannah a good cake
66. Yesterday influenced Thomas the outcome
67. Last year published Daniel his book
68. While Emma the dinner slowly cooked quickly wiped Sophie the table
69. Last year joined William the team
70. As William the snacks always supplied often increased he the price
71. While Thomas the offer really considered quickly developed William a response
72. Often mended Olivia holes as she the clothes always washed

Version 2

1. *As Sophie her fate quietly accepted she her blessings quickly counted
2. *Daniel the report quietly read while loudly turned Matthew the newspaper
3. *While Matthew the buggy carefully pushed Daniel the dog carelessly pulled
4. *While quickly measured Thomas the room William the furniture noisily separated
5. *While silently counted Emma the money Sophie the passports quickly checked
6. *While Thomas the animals quickly protected William the burglar valiantly attacked
7. *Carefully folded Emma the clothes while quietly washed Sophie the dishes
8. *As cleverly managed Daniel a business he products often sold
9. *As really liked Matthew chocolate he it often bought
10. *Suddenly extended Daniel his arm as quickly followed he the man
11. *Hannah her allegiance suddenly understood as loudly discussed she politics
12. *Represented in the morning Sophie her country
13. *As Olivia the meeting quickly enabled she her mistake suddenly realised
14. *As Matthew distraught suddenly appeared he an ambulance quickly called
15. *In the morning Emma the dog saved
16. *Last year Emma the evidence destroyed
17. *While Emma concern genuinely expressed Sophie good points quietly raised
18. *In the morning Olivia her pension collected
19. *While confidently travelled Olivia the world Hannah her trip quietly arranged

20. *While Olivia the cup carelessly dropped Hannah the floor quickly touched
21. *Thomas new names often learnt as always allowed he newcomers
22. *Emma her neighbours often visited as frequently represented she her constituency
23. *Quickly provided Thomas an alibi as genuinely believed he the man
24. *Quickly identified Hannah the criminal as luckily survived she the crash
25. *Quickly called Daniel the police while valiantly contained Matthew the crowd
26. *Last year Sophie the truth learned
27. *Handled in the morning Thomas the documents
28. *In the morning William a drink ordered
29. *Often demanded Emma tips as always delivered she newspapers
30. *Achieved in the morning Matthew his goal
31. *Climbed last year Hannah a mountain
32. *While carefully treated Daniel the floorboards Matthew the holes quietly filled
33. *As William his country valiantly protected he his troops often encouraged
34. *Received yesterday William the prize
35. *As always avoided Sophie her homework she bad marks often received
36. *Hannah a good cake loudly promised while carefully studied Olivia the cookbook
37. *Influenced yesterday Thomas the outcome
38. *Yesterday Matthew the truth revealed
39. *Published last year Daniel his book
40. *Yesterday Daniel the mistake noticed
41. *Sophie the table quickly wiped while slowly cooked Emma dinner
42. *Joined last year William the team
43. *William the price often increased as always supplied he the snacks
44. *Quietly examined Hannah the room while carefully explained Olivia the information
45. *William a response quickly developed while really considered Thomas the offer
46. *Quietly played William computer games while quickly connected Thomas the cables
47. *Yesterday Sophie the good news delivered
48. *As always washed Olivia the clothes she holes often mended
49. Yesterday discovered Olivia a solution
50. Often discovered William strange things as he the house always cleaned

51. While Thomas the movement really supported cleverly suggested William another candidate
52. Often disconnected Emma her alarm clock as she Mondays really hated
53. Last year failed Matthew the entrance exams
54. While Olivia home quickly headed really enjoyed Hannah the party
55. Often cooked Matthew spaghetti bolognese as he tomatoes frequently produced
56. Quietly prepared Sophie her presentation while Emma a website carefully created
57. Yesterday shared Emma her news
58. As Daniel the prize anxiously presented quickly recognised he the winner
59. Genuinely preferred Daniel his cell phone while Matthew the concert really enjoyed
60. Cleverly avoided William his homework while Thomas the exams quickly marked
61. Last year managed Olivia the company
62. Yesterday planned Hannah her wedding
63. In the morning denied Daniel his wrongdoing
64. In the morning picked Hannah grapes
65. Carefully organised Hannah the papers while Olivia the office quietly cleaned
66. Last year caused Thomas serious damages
67. As Hannah her innocence easily proved quickly avoided she prison
68. While Emma a pay raise loudly demanded quietly raised Sophie her game
69. Suddenly realised Sophie her worth as she her help kindly provided
70. As Thomas the man loudly introduced suddenly forced he his laugh
71. While Matthew the class really hated quite liked Daniel the teacher
72. As Olivia her siblings frequently encouraged often contributed she money

Version 3

1. *While Matthew the newspaper loudly turned Daniel the report quietly read
2. *Noisily separated William the furniture while quickly measured Thomas the room
3. *Discovered yesterday Olivia a solution
4. *As always cleaned William the house he strange things often discovered
5. *William another candidate cleverly suggested while really supported Thomas the movement
6. *Quickly checked Sophie the passports while silently counted Emma the money

7. *As really hated Emma Monday she her alarm clock often disconnected
8. *Failed last year Matthew the entrance exams
9. *Hannah the party really enjoyed while quickly headed Olivia home
10. *Often sold Daniel products as cleverly managed he a business
11. *Often bought Matthew chocolate as really liked he it
12. *As frequently produced Matthew tomatoes he spaghetti bolognese often cooked
13. *As Hannah politics loudly discussed she her allegiance suddenly understood
14. *While carefully created Emma a website quietly Sophie her presentation quietly prepared
15. *Shared yesterday Emma her news
16. *In the morning Sophie her country represented
17. *Daniel the winner quickly recognised as anxiously presented he the prize
18. *While really enjoyed Matthew the concert Daniel his cell phone genuinely preferred
19. *While quickly marked Thomas the exams avoided William his cleverly homework
20. *Managed last year Olivia the company
21. *Planned yesterday Hannah her wedding
22. *Quietly arranged Hannah her trip while confidently travelled Olivia the world
23. *As Thomas newcomers always allowed he new names often learnt
24. *As Emma her constituency frequently represented she her neighbours often visited
25. *Denied in the morning Daniel his wrongdoing
26. *In the morning Thomas the documents handled
27. *In the morning Matthew his goal achieved
28. *Picked in the morning Hannah grapes
29. *Last year Hannah a mountain climbed
30. *Carefully treated Daniel the floorboards while quietly filled Matthew the holes
31. *Yesterday William the prize received
32. *Often received Sophie bad marks as always avoided she her homework
33. *While Olivia the cookbook carefully studied Hannah a good cake loudly promised
34. *Yesterday Thomas the outcome influenced
35. *While quietly cleaned Olivia the office Hannah the papers carefully organised
36. *Caused last year Thomas serious damages
37. *Hannah prison quickly avoided as easily proved she her innocence

38. *Sophie her game quietly raised while loudly demanded Emma a pay raise
39. *As kindly provided she her help she her worth suddenly realised
40. *Last year Daniel his book published
41. *Thomas his laugh suddenly forced as loudly introduced he the man
42. *Daniel the teacher quite liked while really hated Matthew the class
43. *While Emma dinner slowly cooked Sophie the table quickly wiped
44. *Last year William the team joined
45. *As William the snacks always supplied he the price often increased
46. *While Thomas the offer really considered William a response quickly developed
47. *Olivia money often contributed as frequently encouraged she her siblings
48. *Often mended Olivia holes as always washed she the clothes
49. As Sophie her fate quietly accepted quickly counted she her blessings
50. While Matthew the buggy carefully pushed carelessly pulled Daniel the dog
51. While Thomas the animals quickly protected valiantly attacked William the burglar
52. Quietly washed Sophie the dishes while Emma the clothes carefully folded
53. Suddenly extended Daniel his arm as he the man quickly followed
54. As Olivia the meeting quickly enabled suddenly realised she her mistake
55. As Matthew distraught suddenly appeared quickly called he an ambulance
56. In the morning saved Emma the dog
57. Last year destroyed Emma the evidence
58. While Emma concern expressed quietly raised Sophie good points
59. In the morning collected Olivia her pension
60. While Olivia the cup carelessly dropped quickly touched Hannah the floor
61. Quickly provided Thomas an alibi as he the man genuinely believed
62. Quickly identified Hannah the criminal as she the crash luckily survived
63. Quickly called Daniel the police while Matthew the crowds valiantly contained
64. Last year learned Sophie the truth
65. In the morning ordered William a drink
66. Often demanded Emma tips as she newspapers always delivered
67. As William his country valiantly protected often encouraged he his troops
68. Yesterday revealed Matthew the truth
69. Yesterday noticed Daniel the mistake

70. Quietly examined Hannah the crowd while Olivia the information carefully explained
71. Quietly played William computer games while Thomas the cables quickly connected
72. Yesterday delivered Sophie the good news

APPENDIX F: CONTROL GROUP GRAMMATICALITY JUDGEMENT TEST (3 VERSIONS)

All of the items are incorrect in standard English. Therefore, the * refers to whether the item would be considered correct or incorrect in the language learnt by the experimental participants.

Version 1

1. *Failed badly Matthew the entrance exams
2. *As genuinely believed Thomas the man, he an alibi quickly provided
3. *As Thomas the man loudly introduced, he his laugh suddenly forced
4. *Hannah the floor quickly touched while carelessly dropped Olivia the cup
5. *As always delivered Emma newspapers, she tips often demanded
6. *Quietly Hannah grapes picked
7. *Sophie good points quietly raised while genuinely expressed Emma concern
8. *Valiantly Emma the dog saved
9. *Olivia money often contributed as she her siblings frequently encouraged
10. *As Hannah her innocence easily proved, she prison quickly avoided
11. *Loudly Emma her news shared
12. *Matthew an ambulance quickly called as suddenly appeared he distraught
13. *While Emma a pay raise loudly demanded, Sophie her game quietly raised
14. *Revealed loudly Matthew the truth
15. *Loudly Daniel his wrongdoing denied
16. *Collected usually Olivia her pension
17. *While quickly measured Thomas the room, William the furniture noisily separated
18. *While quickly connected Thomas the cables, William computer games quietly played
19. *As always cleaned William the house, he strange things often discovered
20. *Delivered loudly Sophie the good news
21. *Quietly Hannah her wedding planned
22. *Joined cleverly William the team
23. *While Matthew the class really hated, Daniel the teacher quite liked
24. *While quietly cleaned Olivia the office, carefully organised Hannah the papers
25. *Olivia her mistake suddenly realised as quickly enabled she the meeting
26. *While carefully created Emma her website, quietly prepared Sophie her presentation
27. *Cleverly avoided William his homework while quietly marked Thomas the exams

28. *As really hated Emma Mondays, often disconnected she her alarm clock
29. *As frequently produced he tomatoes, often cooked Matthew spaghetti bolognese
30. *Sophie the dishes quietly washed while Emma the clothes carefully folded
31. *Quickly checked Sophie the passports while silently counted Emma the money
32. *William his troops often encouraged as valiantly protected he his country
33. Often bought Matthew chocolate as he it really liked
34. Kindly received William the prize
35. Suddenly achieved Matthew his goal
36. Quietly published Daniel his book
37. While Emma the dinner slowly cooked, quickly wiped Sophie the table
38. Quietly accepted Sophie her fate as she her blessings quickly counted
39. As Thomas newcomers always allowed, often learnt he new names
40. While Thomas the offer really considered, quickly developed William a response
41. Quietly handled Thomas the documents
42. Often received Sophie bad marks as she her homework always avoided
43. Valiantly climbed Hannah a mountain
44. As Hannah politics loudly discussed, suddenly understood she her allegiance
45. Carefully treated Daniel the floorboards while Matthew the holes quietly filled
46. As Daniel the prize anxiously presented, quickly recognised he the winner
47. Often sold Daniel products as he a business cleverly managed
48. Slyly influenced Thomas the outcome

Version 2

1. *Badly Matthew the entrance exams failed
2. *Quickly provided Thomas an alibi as genuinely believed he the man
3. *While Olivia the cup carelessly dropped, Hannah the floor quickly touched
4. *As really liked Matthew chocolate, he it often bought
5. *Often demanded Emma tips as always delivered she the newspapers
6. *Received kindly William the prize
7. *While Emma concern genuinely expressed, Sophie good points quietly raised
8. *Achieved suddenly Matthew his goal
9. *Published quietly Daniel his book

10. *Sophie the table quickly wiped while slowly cooked Emma the dinner
11. *As Matthew distraught suddenly appeared, he an ambulance quickly called
12. *Loudly Matthew the truth revealed
13. *Usually Olivia her pension collected
14. *As quickly counted Sophie her blessings, she her fate quietly accepted
15. *Thomas new names often learnt as always allowed he newcomers
16. *William a response quickly developed while really considered Thomas the offer
17. *Handled quietly Thomas the documents
18. *As always avoided Sophie her homework, she bad marks often received
19. *While quickly measured Thomas the room, noisily separated William the furniture
20. *Quietly played William computer games while quickly connected Thomas the cables
21. *As always cleaned William the house, often discovered he strange things
22. *Loudly Sophie the good news discovered
23. *Climbed valiantly Hannah a mountain
24. *Cleverly William the team joined
25. *Hannah her allegiance suddenly understood as loudly discussed she politics
26. *Olivia her mistake suddenly realised, as she the meeting quickly enabled
27. *While quietly filled Matthew the holes, Daniel the floorboards carefully treated
28. *Daniel the winner quickly recognised as anxiously presented he the prize
29. *As cleverly managed Daniel a business, he products often sold
30. *Influenced slyly Thomas the outcome
31. *As he his country valiantly protected, William his troops often encouraged
32. As Thomas the man loudly introduced, suddenly forced he his laugh
33. Quietly picked Hannah grapes
34. Valiantly saved Emma the dog
35. As Olivia her siblings frequently encouraged, often contributed she money
36. As Hannah her innocence easily proved, quickly avoided she prison
37. Loudly shared Emma her news
38. While Emma a pay raise loudly demanded, quietly raised Sophie her game
39. Loudly denied Daniel his wrongdoing
40. Quietly planned Hannah her wedding
41. While Matthew the class really hated, quite liked Daniel the teacher

42. Carefully organised Hannah the papers while Olivia the office quietly cleaned
43. Quietly prepared Sophie her presentation while Emma her website carefully created
44. Cleverly avoided William his homework while Thomas the exams quietly marked
45. Often disconnected Emma her alarm clock as she Mondays really hated
46. Often cooked Matthew spaghetti bolognese as he tomatoes frequently produced
47. While Emma the clothes carefully folded, quietly washed Sophie the dishes
48. Quickly checked Sophie the passports while Emma the money silently counted

Version 3

1. *Thomas his laugh suddenly forced as loudly introduced he the man
2. *As really liked Matthew chocolate, often bought he it
3. *Kindly received William the prize
4. *Picked quietly Hannah grapes
5. *Suddenly Matthew his goal achieved
6. *Saved valiantly Emma the dog
7. *Olivia money often contributed as frequently encouraged she her siblings
8. *Quietly Daniel his book published
9. *Hannah prison quickly avoided as easily proved she her innocence
10. *Sophie the table quickly wiped while Emma the dinner slowly cooked
11. *Shared loudly Emma her news
12. *Sophie her game quietly raised while loudly demanded Emma a pay raise
13. *Denied loudly Daniel his wrongdoing
14. *Quietly accepted Sophie her fate as quickly counted she her blessings
15. *As Thomas newcomers always allowed, he new names often learnt
16. *While Thomas the offer really considered, William a response quickly developed
17. *Quietly Thomas the documents handled
18. *As always avoided Sophie her homework, often received she bad marks
19. *Planned quietly Hannah her wedding
20. *Valiantly Hannah a mountain climbed
21. *Daniel the teacher quite liked while really hated Matthew the class
22. *While quietly cleaned Olivia the office, Hannah the papers carefully organised
23. *Hannah her allegiance suddenly understood as she politics loudly discussed

24. *While carefully created Emma her website, Sophie her presentation quietly prepared
25. *While quietly filled Matthew the holes, carefully treated Daniel the floorboards
26. *While quietly marked Thomas the exams, William his homework cleverly avoided
27. *As really hated Emma Mondays, she her alarm clock often disconnected
28. *As frequently produced Matthew tomatoes, he spaghetti bolognese often cooked
29. *Sophie the dishes quietly washed while carefully folded Emma the clothes
30. *Daniel the winner quickly recognised as he the prize anxiously presented
31. *Often sold Daniel products as cleverly managed he a business
32. *Slyly Thomas the outcome influenced
33. *While silently counted Emma the money, Sophie the passports quickly checked
34. Badly failed Matthew the entrance exams
35. Quickly provided Thomas an alibi as he the man genuinely believed
36. While Olivia the cup carelessly dropped, quickly touched Hannah the floor
37. Often demanded Emma tips as she the newspapers always delivered
38. While Emma concern genuinely expressed, quietly raised Sophie good points
39. As Matthew distraught suddenly appeared, quickly called he an ambulance
40. Loudly revealed Matthew the truth
41. Usually collected Olivia her pension
42. Noisily separated William the furniture while Thomas the room quickly measured
43. Quietly played William computer games while Thomas the cables quickly connected
44. Often discovered William strange things as he the house always cleaned
45. Loudly discovered Sophie the good news
46. Cleverly joined William the team
47. As Olivia the meeting quickly enabled, suddenly realised she her mistake
48. As William his country valiantly protected, often encouraged he his troops

APPENDIX G – DEBRIEFING QUESTIONNAIRE

Thank you for reading the passages, completing the crosswords, and doing the test. Before we move on, please answer the following questions as thoroughly as possible. If you need more space, please turn over or ask the researcher for more paper.

1. Could you tell me everything that you understood about the language used in the reading passages and crossword? Did you notice any particular rule or regularity?

2. Did you realise this information when completing the crosswords/reading passages, when completing the test, or just now in answering the above question?

3. As mentioned in the experiment, the scrambling of the sentences was not random. Instead, the word order in the sentences was based on a complex system. Reflecting now specifically on the placement of words within the sentences, can you recall any specific rule (pattern) or regularity?

4. If you had to tell another person about the system of this language, what would you tell them (i.e. how would you teach them what you know about this language)?

THANK YOU FOR YOUR PARTICIPATION

Feel free to take a short break before we move on

APPENDIX H – VERBAL REPORT DATA

The verbal reports are divided into responses for each probe question. The verbal reports for the 63 participants that were classified as having processed some of the language explicitly are presented first in each section followed by the 18 participants that were classified as implicit processors only. It is important to read each participant's four responses as classification can only occur based on all responses (i.e. a participant may appear to have processed only implicitly based on question one, but his/her response to question three makes it clear explicit processing has been used). No response means that the participant did not write anything in relation to that question. However, the question was read and understood as after completing the questionnaire, I checked with each participant who left blanks.

Probe Question 1:

Could you tell me everything that you understood about the language used in the reading passages and crosswords? Did you notice any particular rule or regularity?

Explicit and Implicit Processing

1 Rather than SVO, the sentences were reversed sometimes starting with an adjective or verb rather than a subject

4 Placement of article ex. 'the' is different than normal English, the subject and the object are often reversed

5 It was very similar to English, but the words weren't in the correct order (grammatically speaking). In this language it was verb before person (as in walked he, instead of he walked), and adjectives occurred before the things they qualified, not after.

6 Pronouns were in the wrong place. Indirect objects moved places in the sentences. Verbs and subjects were inverted (e.g. speaks he). Prepositional phrases stayed the same, through.

7 In single verb sentences: adv+verb+subject+object. The rule was different in subordinate clauses (as/while) but I'm not sure exactly how

8 Subject come after the verb. Adjectives came after subject. Not SVO lang, maybe SVO?

9 Order of words: adjective, verb, noun. Example: quietly walked Emma

10 I Intuitively understood everything, but all the sentences seemed slightly weird

11 Subject came after the verb. Objects may have had a role but I'm not sure what it was

12 Adverbs verbs first. Subject second. Object third.

14 I think that the adverb went before the verb. Also the person doing it seems to go after and the last section was what the verb was describing!

15 The adverbs and verbs usually preceded the nouns in the sentences and pronouns were sometimes inverted

16 The order is reversed from typical English

17 VSO language

18 Sounds like English. Jonathon ate he the parrot. Subject/pronoun after the verb before the object

19 The verb was always before the subject

21 It reminds me of how non English speakers use English. Seems the content is first, actions last, everything seems backwards.

23 I understood that there was a pattern. I think it was that the verb went before the subject in the given sentences. However, I was so fixated on 'translating' it to proper English that I wasn't trying to follow and learn the new pattern.

26 Adverb (possibly adjective)+Object+Verb+Subject i.e. quickly the pencil lifted Bob. Sentence were structured in this format.

27 There were no prepositions. The order of the subject and the verb were all mixed up. If I recall correctly, the subject often came after the verb, and there were no prepositions like 'to' or 'for' in front of the indirect objects. Also, time expressions were not placed in the correct order instead of the end they were at the beginning of sentences.

30 Qualifiers were at the start of the sentences and there was an overuse of pronouns. Sentences were short, with few complex sentence structures, i.e. colons, semi-colons, etc.

31 I'm fairly confident that the adverb and verb came before the subject. Pronouns usually came after the verb, too.

32 The vocabulary was the same as English but the subject and object of the sentence appeared after the verb. Subjects and objects could appear in different relationships to one another.

34 The adjectives and adverbs appeared to be at the beginning of the sentences.

35 Adjective(usually?)+person/subject+verb+object

37 The verb comes at the end. The object comes before the verb. The adverb comes before the verb.

38 The language had a pattern/structure. The language seemed similar to English - I could understand it if I rearranged some words. Names, and 'she' and 'he' were often rearranged in the wrong order (to English).

40 The sentences were created in a way that made the action the final part of the sentence. The actions were also reversed in the sentence.

41 Subjects were moved out of place

42 The word order was switched in the sentence. It seems that often the order of the verb and the direct object are inversed. At times, it seemed as though the adverb (words ending in 'ly') was placed at the start of the sentence, instead of near the verb.

43 I think the verb always went at the end of the phrase or sentence. I also noticed that the pronouns were always 'he'/'she', not possessive or objects.

44 The proper pronouns and verbs were often switched.

46 It seems that the word order is very different than English. Sentences begin with an adverb and the subject and verb are inverted. Sometimes the direct object comes before the subject

47 The word order had changed. Adverbs before verbs. Complements before verbs?

48 One particular feature is that 'adjectives/adverbs' seemed to go in front of the objects, name and action being performed. Another was that 'he' and 'she' were used after the name of the he or she in particular or their action - 'loudly yelled he'

49 The subject-verb agreement remained the same in English, but the word order changed

50 It was moving too quickly for me to analyze it. Subject-object-verb instead of SVO.

51 Verbs and adjectives appeared at the beginning of the sentence. The subjects appeared in the middle of the sentence typically. Prepositions appeared before the subject.

53 It made sense but was difficult to read without its proper order. I think it the verb, adverb before the noun.

57 I did not reflects and/or analyse as I read - I focused more on converting 'sense' into regular English word order (I'm not extremely flexible of good multi-tasker - tend to relate new learning to past.) However, there was an obvious shift in word order - sometimes the verb preceded the subject, and the object of the subject/verb also shifted in word order, sometimes coming first; also the adverbial phrase that modified the verb went to the beginning.

60 I was vaguely aware that there was a regularity. At first I was trying to see if it could pass for passive voice but it quickly became clear that that wasn't it. I wanted to sort out the rule but was focused on the content and completing my task quickly so I didn't stop to.

61 The language was constructed in a way that seemed childish/childlike. Sentences were arranged in a specific order; adverb, subject, object, verb

62 Put the verb before the noun. E.g. dishes washed

63 I wasn't paying attention or on the lookout for rules or regularity.

64 Objects come immediately before subjects. E.g. I wrote it - I it wrote. Adverbs always begin the clause, e.g. As I quickly wrote - As quickly I wrote

65 It seems to me the adverbs came before the verb, often at the beginning of the sentence, or phrase. The verb was often at the end of the sentence and the object preceded the subject.

66Subjects seemed to follow the verb, rather than precede it. Adverbs tended to precede verbs. Colloquial phrases indicating time/place (i.e. 'while….') seemed to be sandwiched inside a sentence, rather than begin the phrase as is typical in English.

68 The nouns were often placed after The verbs. - Indirect and direct pronouns were used inter-changeably. - noun, verb, pronoun.

69 I think that the beginning of each sentence was started with a strong adjective that pulls the readers into the rest of the sentence. Some time the verb was put before the noun acting it.

70 Subject came after the verb. Adverbs might have been always before the verb? Verb (object came before) at the end of some sentences when it shouldn't be. The object of the verb is directly after the subject of a sentence? Difference in position if the subject was a pronoun/an actual name? (Participant had also noted down 2 sentences at top of sheet: Christmas his favourite holiday is AND violently grabbed Thomas the parrot)

71 It seemed to be using a passive tense. Very similar to the pronoun based system in some indigenous African languages. I noticed the subject often preceded the object of their action.

72 I noticed that often the subject was presented first, as well as adjectives and pronouns followed after.

73 A.) The words were well pronounced but in the wrong order. B.) Yes but I can't explain it other than to say the words were reversed at times.

74 The order of words was different (to English). The pronoun + subject - she/he etc. was often put after the verb.

75 I think it uses a different word order, so my guess is it uses verb-subject-object (i.e., planned Daniel the party), but I think only relative clauses use a different rule, although I'm not certain. Adverbs seem to come before verbs.

77 All I understood about the language used was the words were not in order. A particular rule I noticed was that name of a person appeared after the things he/she did. Like cleaned Sophie the room.

78 A rule I noticed was proper grammar, with the words arranged in an odd order. So, if you rearranged the sentence in the right order it would make sense. Also, the sentences made sense in terms of its context.

81 Yes, it seems that adjectives and action phrases (A) were switched around with the subjects of the sentence. They were put before proper nouns or central phrases (B), after which came the subject (C. i.e. Played slowlyA, ThomasB, the violinC

83 ex. Quickly accepted he the prize. The sentence structure is rearranged. The personal pronoun is after the verb.

84 I found the language easy to understand, but difficult to explain. As an EFL/ESL teacher who focused on fluency rather than accuracy with beginner learners, I find it easy to derive meaning from non-standard usage of English. However when told that the non-standard usage WAS the language, I found myself, as a learner, struggling to identify rules.

86 I'm not too sure how much I actually understood, but for some reason I felt that the adverb came first followed by the subject then the preposition, next the object then the verb?

87 Word order was different, subject followed the verb - I can't remember the pattern for objects. Adverbs after sentence initial. No words omitted.

88 The subject was never first. Verb came before subject.

Implicit Processing Only

2 I notice that subjects and verbs were presented in a different order than I am used to. Also adverbs were not presented in the order I am used to.

22 It seemed/sounded as someone for who Eng. Is a second language, or has only learnt from books not practice/exposure

24 It's a lot like English except that the words are in the wrong order. I have no idea what the rule is, I just know that when I was reading I kept on rearranging the words without even trying.

25 I particularly noticed the word 'she' and how it was used in almost a backwards sense (before the verb). As well, it seemed as though words were used in a reverse sense.

28 The language used the right tenses, spelling and vocabulary but the words order was inversed.

29 I could understand the general meaning but found the word order very strange. Reading it aloud was sometimes confusing.

33 The words were arranged differently so as to sound and appear strange but remain comprehensible.

36 Same language just different word order. Made it confusing to know which subject went with which action. Words like 'he, she' came before the actual subject. 'he the dog'.

39 Switching parts of the sentences.

52 Words that modified/described another didn't necessarily appear next to the word it was modifying/describing. Personal pronouns were used in a different way than they normally are in English.

54 Continually arrange SVO. Could not determine distinct pattern.

56 The words in a sentence fit together but the order and organisation did not follow the typical English rules. For instance, when 'he' should precede a word it would often follow it.

58 Yes but I'm not privy to the names of such rules. The order was mixed up. It made sense in some way still.

59 Patters in subject and verb placement and placement of pronouns and pronoun references. I am undecided about the use of commas.

76 Everything made sense, but I couldn't identify any rules or patterns without more time to study it.

80 The narrator refers to the character as he/she before describing their actions. And when it's a quote like the example with Chirpy he uses "I" then "you" to describe how he feels/wants from or with Jimmy.

82 She and he's were mixed up and at the end of the sentence often

85 The word he or she would often be used too soon in the sentence. The end of each sentence was also in the wrong order.

Probe Question 2:

Did you realise this information when completing the crosswords/reading passages, when completing the test, or just now in answering the above question?

Explicit and Implicit Processing

1 Yes, I did realise it before the above question

4 While listening and reading passages

5 In a way I feel like I did but my brain was fighting it so that I could read this language as if it actually was English

6 Throughout, only now put into concrete ideas

7 The 1st element, in the reading etc. 2nd part in the test

8 I realised something was not right but didn't have time to figure out what exactly (argh!)

9 Just now in answering the questions where I had to indicate if the words/sentences were correct

10 No, they just felt strange when compared to usual English usage in reading and speaking

11 When completing I realised the were in a strange word order, but hadn't formed a rule

12 During the passages

14 I realised during the surprise test. Some just sounded more familiar and then I quickly analysed the ones that did (could have by mistake analysed the wrong ones).

15 Crosswords/reading passages

16 I could see it wasn't written properly, but I don't think I can explain it very well

17 Only in answering the above question

18 When completing the test was formulating rule. When answering the question, saw it. When reading and listening to the samples I took it to be English and tried to block out the inconsistencies

19 I realised it before

21 I picked up on it right away.

23 I realised this new, strange pattern when doing the crosswords but only realised it was an actual system, rule-based pattern when doing the computer activity.

26 I only explicitly realised it now. I was formulating it during last test.

27 Realised from the beginning, knowing there's a pattern but I didn't hear the pattern exactly for what it is - a general idea only.

30 I noticed the pronoun use early on, but did not realise that the qualifiers (adverbs, adjectives) were at the start of the sentences until late in the test.

31 While completing the test and now.

32 I realised the syntax was different. However, I am still uncertain about the exact rule of the language.

34 Just now.

35 I noticed the verb came before the object

37 When completing the crosswords/reading passages.

38 Realised it when completing the crosswords/reading passages.

40 Completing the crosswords/reading passages.

41 I noticed it right away.

42 When completing the crosswords/reading passages.

43 I think I realised it when listening and also reading out loud. The was a rhythm to the sentences.

44 During the reading and crosswords.

46 I realised it more when completing the test

47 When completing the crosswords/reading passages and just now in answering

48 Around completing the second crossword, but the various rules I made up are quickly being forgotten without a text to reference

49 Immediately upon listening and reading.

50 I didn't actually think about it when doing the activities. I was focused on comprehending the content.

51 Crosswords/reading passages

53 Completing the test.

57 I began to realise this while completing the final questionnaire with ratings (test) and I'm trying now in answering to generate a rule. However, when I was rating, I often chose 'intuition (3)' because I felt the sentence sounded 'wrong' in the same way the story/puzzle passages 'felt wrong'.

60 I realised it when completing the crosswords and reading passages but was focusing too much on the content and completing my tasks quickly to sort out the structure.

61 During the test, maybe subconsciously during the written texts?

62 Yes

63

64 While reading and while answering questions about readings.

65 Just now.

66 When completing the test, mostly.

68 From the very first listening activity.

69 I realised it subconsciously, but while doing these sentences I tried to focus/remember what the previous sentences had been.

70 Yes while completing.

71 It was pretty obvious at the beginning but it felt less so as the exercises progressed.

72 I realised when completing the first section however the test solidified what I think I understood.

73 I realised it from the beginning.

74 Just now - I didn't think that there was a certain rule to the language while completing the crosswords/reading passages. I thought that it was incorrect English.

75 I realised the word order was different immediately, but didn't look for a rule until I was completing the test - I was more focused on comprehension initially.

77 Yes I realised when completing crosswords, passages etc.

78 When completing the test

81 To some extent with the crosswords/passages, and then a lot more clearly with the test.

83 When doing the exercises

84 I did not realise consciously the rules/regularity while taking the test. I am now struggling to recall the rules of the language.

86 A little bit during each.

87 While listening and reading

88 Realised it before.

Implicit Processing Only

2 Throughout

22 It's obvious to me from 1st sentence.

24 When reading and even when hearing the passages.

25 When listening and reading the crosswords/reading passages. More so while listening though to the audio parts.

28 When completing the crosswords/reading passages.

29 While completing the test.

33 From the beginning I had noticed the strange sentence structure.

36 Now

39 I realise this when completing the crosswords/passage.

52 I realised as I was reading.

54 Completing crosswords/passages

56 More often with the reading passages but it was also present in the crossword task.

58 From the beginning I noticed.

59 Noticed them during the crosswords/reading, but did not heavily try to identify the pattern.

76 While completing the tests.

80 Just now in answering the above question.

82 I think when completing the task

85 When reading the passage, I became more aware of the structure of the sentences.

Probe Question 3:

As mentioned in the experiment, the scrambling of the sentences was not random. Instead, the word order in the sentences was based on a complex system. Reflecting now specifically on the placement of words within the sentences, can you recall any specific rule (pattern) or regularity?

Explicit and Implicit Processing

1 VSO or AdVSO

4 Ex: Quickly Sam the sandwich made (Adverb, subject, noun, verb) not sure but this seems to be the general trend

5 I'm having a hard time remembering: He the (adjective + qualifier)

6 People', either as subject, indirect object etc. changed positions in sentences

7 I don't remember any complex sentences, it's too big a chunk for my auditory memory.

8 I think? (same as Q1)

9 adjective, verb, noun

10 The adjective came before the subject of the sentence followed by the noun

11 Subject followed verbs

12 Verbs + adverbs first. Subject second. Object third.

14 See above

15 See above

16 Instead of saying somebody was doing something, the something being done would be followed by a person's name

17 See 1

18 The subject pronoun after the verb before the object

19 That the subject was always placed after the verb. The sentences were short. I don't remember if there was just 1 subject in each sentence, or maybe sometimes more than 1. Also adjectives were before the subject and sometimes the verb.

21 I would have to reread the experiment in order to answer this question.

23 The verb was before the subject, I don't remember more than that.

26 See 1. That structure can be compounded with connecting words like 'while', 'as'….

27 Mainly the mixing up of indirect and direct object. It was all about trying to follow who gave what to whom, or who was the real subject. Something like "Jim the parrot he feed": there were no auxiliary verbs or the right placement of verbs.

30 As stated in my answer to question 1, the qualifiers were at the start. Aside from that, it is difficult to remember the location of the verb with regards to the subject. Also, pronoun placement seemed too close to the subject.

31 Adverb (if applicable), then verb, then subject,. Pronouns came after the noun, too.

32 Subjects and objects appear after verbs. Objects appear before subjects.

34 Adjectives or adverbs came before the subjects.

35 Adj + sub + verb + obj

37 Q1

38 Verbs came before nouns.

40 The reversal of verbs and the actions in the sentence.

41 The subject was often moved but I didn't pay close attention to finer details. I just translated it back to SVO in my head. I was thinking more about meaning than how the language was structured.

42 Q1

43 Adverbs first, then subject, then object, then verbs last. (I'm not totally confident here, but I think it may have been this way).

44 (what I wrote in question 1). That was all… a lot of the time I made my decision based on intuition.

46 Adverb + verb + subject (direct object before or after verb. The direct object could come before or after the subject. Sometimes the position of the subject and verbs are variable.

47 See 1.

48 Only the biggest two for me. That the adjectives/adverbs were placed before the noun, and that 'he' and 'she' were used frequently, I thought at first as reinforcement but I think now for when the character is addressing someone/something.

49 Usually the subject was obvious and placed either before the adverb and after the verb

50 I think SOV instead of SVO, although at the time of the test, I was just going on intuition. I was aware there was a word order issue but

51 See 1.

53 Verb/adverb before the noun.

57 I have noted this in answer 1. I think the inversion of subject/verb was most obvious, and the shift in the adverbial phrase to the beginning. But I couldn't generalise where/how the object turned up - and it seemed more jarring in some sentences (more complex ones?) than others.

60 It seemed to be different for simpler sentences (single-clause, maybe?) - i.e. "violently grabbed Jimmy the bird" = adjective-verb-subject-object. When (for example) two people were doing two separate things it changed - possibly subject 1-object1-adjective1-verb1, conjunction, subject2, object2, adjective2, verb2 (these might be wrong; hearing all of the sentences in quick succession scrambled my thoughts about them.

61 As above: simple sentences were arranged: "adverb, subject, object, verb". Complex sentences (2 subjects in two actions) had: "adverb 1, subject 1, object 1, verb 1" then "subject 2, object 2, adverb 2, verb 2".

62 The verb was placed before the noun.

63 No except the pronoun seemed to follow the action.

64 Mentioned above.

65

66 1. Verbs precede subject. 2. Direct objects are immediately before the subject.

68The nouns and pronoun were placed at the end fo the sentences, after the verbs and adverbs.

69 Sentences beginning semi-normal using an adjective then the verb was put before the noun - (person/thing doing it).

70 See question 1

71 Verb, adverb, subject, object of action. The complex sentences were a bit harder to follow and I couldn't make out a clear pattern for the prepositions and conjunctions.

72 Not particularly, pronouns such as he, him, she etc. were often placed after the subject.

73 Yes, ex. Instead of saying 'he carefully placed the cup on the table', they would say 'carefully placed he the cup on the table'

74 The pronoun was often after the verb?

75 Yes, as above. I think it goes VSO and not SOV. I think Gaelic uses this, actually.

77 As I mentioned earlier the name of person doing the things appeared after their name while as a general English rule is should appear before.

78 Nouns never started a sentence. Usually adjectives, example: Quietly, Emma… Valiantly, Thomas…

81 Often identifiers like 'he', 'she', 'this', 'that', were placed next to each other without putting a verb or noun between them. The grammar was close enough to English to still be contextually intelligible and maintain narrative structure.

83 yes, I think I can write it, but it's difficult to explain. The subject is at the beginning of the sentence, the verb at the end. Ex. The parrot violently grabbed he. The parrot violently grabbed him.

84 object, subject, verb?

86 See above

87 See above

88 Adjective, verb, then subject.

Implicit Processing Only

2 Not so much

22 No.

24 I think if I was supposed to look at the written stuff again now, I could, but without having it in front of me I couldn't say.

25 She, it was used before the verb, perhaps? I just really remember it being used strangely and thinking it was backwards wording. Names (proper names) seemed to be out of place too.. But I may just be confusing all the words I listened to.

28

29 ?

33 I cannot remember many specifics, I just remember the sentences structured oddly

36 No

39 Putting the actor 'at the end'??

52

54 Nope

56 He/she should follow verbs. Adjectives were misplaced.

58 I can but I can't name it. I need to take and English 101!

59 Not without a sentence to form/use as example.

76 No, I can't.

80 Yes as mentioned in the answer at the first question

82 No

85 I can't identify a regular pattern though I was aware that there seemed to be a trend which I recognised.

Probe Question 4:

If you had to tell another person about the system of this language, what would you tell them (i.e. how would you teach them what you know about this language?)

Explicit and Implicit Processing

1 I would write it for them to see, writing SVO and then VSO: Quietly planned Hannah the wedding (Adj V S O)

4 I would likely use examples. I could explain the structure, but examples seem to be more straight-forward

5 I'm not sure I could with confidence. I would tell the person that the sentence structure is completely different from the English language, but the words are all the same

6 Verbs and adverbs and prepositions stay the same, but more attention must be paid to the 'doer' of actions, i.e. who is doing what to whom

7 I wouldn't until I had actually learned the rules! Probably through induction though and if the student knew many languages, explicit description using grammar rules.

8 Basically something along the lines of no. 1 answer

9 Always start the sentence with the adjective then verb

10 The language is inverted

11 I would teach them that the verb precedes the subject

12 First name the action then name the person or thing doing it then name anyone or anything else.

14 Think of the verb and its adverbs and put that first then think of who is going that verb and put it second then write out what the verb is describing. Sounds a bit like Yoda.

15 I would explain that the adverbs and verbs precede the noun they are referring to and that pronouns are sometimes inverted in the sentences

16 Not sure: I wouldn't know how to explain it.

17 See 1. Watch for pronouns

18 The subject pronoun follows the verb. The subject pronoun precedes the object. The subject pronoun reinforces the relationship between subject and object.

19 I would teach them to place adjectives at the beginning of the sentences followed by the verb and then the subject. It's 'upside down' English.

21 It's like talking backwards.

23 I wouldn't be able to teach it to them. I could only tell them that I could tell them the verb and the subject were mixed up.

26 I would tell them that basic rule, for constructing a 'basic phrase' and then how to compound them (formulated at just one or two rules). I would NOT say it's complex, or use any such intimidating words.

27 I would say something to the effect that you need to put the subjects you're talking about close/next to one another, that you don't need 'to' or 'for' to indicate direction and that the verb goes at the end of the sentence.

30 My main advice would be to fight the urge to auto-correct. The word order threw me off from the start, and I found myself rearranging the words in my head, slowing down the comprehension slights. This would make communicating complex information difficult. That being said, the language seems to use the same word functions as English and French, i.e. verb, subject, adjective, adverb, etc...

31 I would say it's similar to languages like Italian where you can sometimes put the verb before the subject, although I guess you can do that in English too. For example, in English, we can say "quickly grabbing his keys, Jimmy rushed out the door". In this new system of language, however, I think the pronouns come after. For example, "Quickly grabbing keys his..."

32

34 Regardless of the order o the words, it is still understandable.

35 I would tell them to listen to the whole phrase before judging the meaning.

37 It seems to be like Latin or German (I think). You must wait until the end to find out what the action was.

38 It seems similar to English, and you will probably understand the meaning without knowing the language's system. Seems that verbs always come before nouns, and your mind will automatically rearrange the words to make sense of the sentence.

40 Most of your action verbs are going to be changed and if more than one subject in the sentence, mix up.

41 I would say it sounded like Yoda. Subject never came first. I think they went after the verb, but it is hard to remember now.

42 Speak like Yoda from Star Wars

43 I would probably teach them the pattern above.

44 It reminds me of Old English, but with modern vocabulary that we can understand. I would teach them by doing exercises like this… reading, listening and speaking out loud.

46 I would tell them that if there is an adverb in the sentence, it has to be at the beginning (except if there is an adverbial subordinator). I would also say that the main verb is usually at the end.

47 Adverb + direct/indirect object + subject + verb

48Almost like building a sentence backwards and taking out all of the commas you would put in. I would tell them the two rules I somewhat remembered.

49 As in number 3, plus note the verb usually came at the end of the sentence.

50 I would tell them about the word order.

51 I would teach them the grammar structure, followed by their comprehension of what they just read.

53 Maybe the same way, but allow them to go back and check the reading while doing the test.

57 I would not have learned enough to tell another person much that was meaningful, perhaps I would say they required extra concentration to link the subject of the action to the correct verb and object, especially in sentences with multiple phrases. This was an effort I was making with 'comprehension' my goal - understanding what would be 'intended' by a 'regular' order that linked subject to predicate. So in effect I was translating, I think, rather than generating new rules upon which to proceed because the test for me was of immediate comprehension, not grammar/generalisational knowledge.

60 I would look at a few correct examples first and then sort out the rules (right now my thoughts are pretty scrambled!). Then I would explain to them the orders in which the parts of speech should appear and get them to produce some sentences (some simple and some more complex) to make sure they picked it up.

61 If the sentence is simple (only one action), describe who (subject did to whom (object) what (verb), and modify the verb at the beginning. If more than one thing is occurring, then do as above first the who to whom how did what.

62 You would tell them that the verb goes before the noun. E.g. bird black song sung. E.g. cross street watch cars.

63 The verbs seem to come at the end of the sentences.

64 Above rules.

65 It's very similar to English but the word order is different. It is easy to understand by listening to the complete sentence. Going over the rules (as mentioned above, if they are right) would enable you to produce it with not too much difficulty.

66 I would provide examples of sentences (i.e. "if you this system want to learn, then learn you must these rules"). And mainly focus on the relationship placement of verbs and subjects.

68 The subject of the sentences usually appears at the end, and the verbs and adverbs at the beginning.

69 I would tell them to focus on the beginning of the sentence and the verb and let everything flow.

70 Write things in the opposite way from how they are naturally said in English.

71 I would start by diagramming normal sentence structures to identify the different parts of speech then go over how their order is changed in this new language. I would probably encourage the person to relax and listen as comprehension isn't difficult, and speech patterns/grammatical structures are learned over time.

72 I'm not really sure. For sure to listen to the placement of the words, the sentences are mixed up but the order to them makes the subject easily understood.

73 I would need to learn it better before teaching someone else.

74 It is very similar to English but there is a different word order. It seems like it is back to front with the subject often coming after the verb?

75 I would tell them they have to learn the rules concerning word order, but that the vocabulary is exactly the same. Once they mastered the word order they'd be fine.

77 I will tell that sentences are scrambled. However if the person has good knowledge of English he can easily understand what these sentences actually mean

78 I would tell them it sounds very robotic. I would each them never to mention a person's name at the beginning of a sentence. (the first word). It sounds backwards, but the idea is always grasped: take short break feel free, before move on we.

81 They have to have a flexible tongue if They want to try and speak it. - try not to spit on yourself or others. - Always say a thought or idea by first saying what happened, then who or what it happened to, and then where or how it happened

83 I would give them several examples to practise. I would have them compare the sentence structure of the same sentence in both this language and English as an example

84 If I had to teach this language to someone, I would focus on syntax: object, subject, verb because that is the only rule I think I have picked up.

86 I would say start out with a simple sentence like "John bit into the apple" and say that with this system of English that sentence would be transformed into "John into the apple bit". Next I would say that the transformation needs to still render the sentence moderately comprehensible. That's it!

87 Like English but without the usual SVO order. I would need to be a bit more sure of the actual pattern before teaching someone else.

88 I would tell them the ordering of the phrases are different than normal English (almost the reverse?)

Implicit Processing Only

2 I would tell them what I said in 1 and that it was hard to tell who the object and subject were.

22 Something about rearranging the order of the subject and the verb. Cannot articulate it better.

24 That your brain wants to rearrange the words so that the stories/questions make sense and that it does this without trying

25I don't think I could teach anyone this language because I am still confused as to how it works. It seems backwards, perhaps reversed in some way. I would maybe tell the person I was teaching to mix/reverse every 3rd and fourth word.. I'm not completely sure. It was/seems like a very mixed up language.

28 The object in the language precedes the subject ; the word order is reversed and the sentences become scrambled.

29 ?

33 I would them it is very similar to English and because of that it is easily understood.

36 I don't know enough

39 It not that important where elements of the sentence are, as long as they are there.

52

54 Rearrange SVO.

56 The sentences mix words around using an order that you do not normally see. See question 3.

58 The subject is placed before the action (?) I think. It was understandable despite the mixing up of elements.

59 Tell them about the placement/structure of nouns and their references.

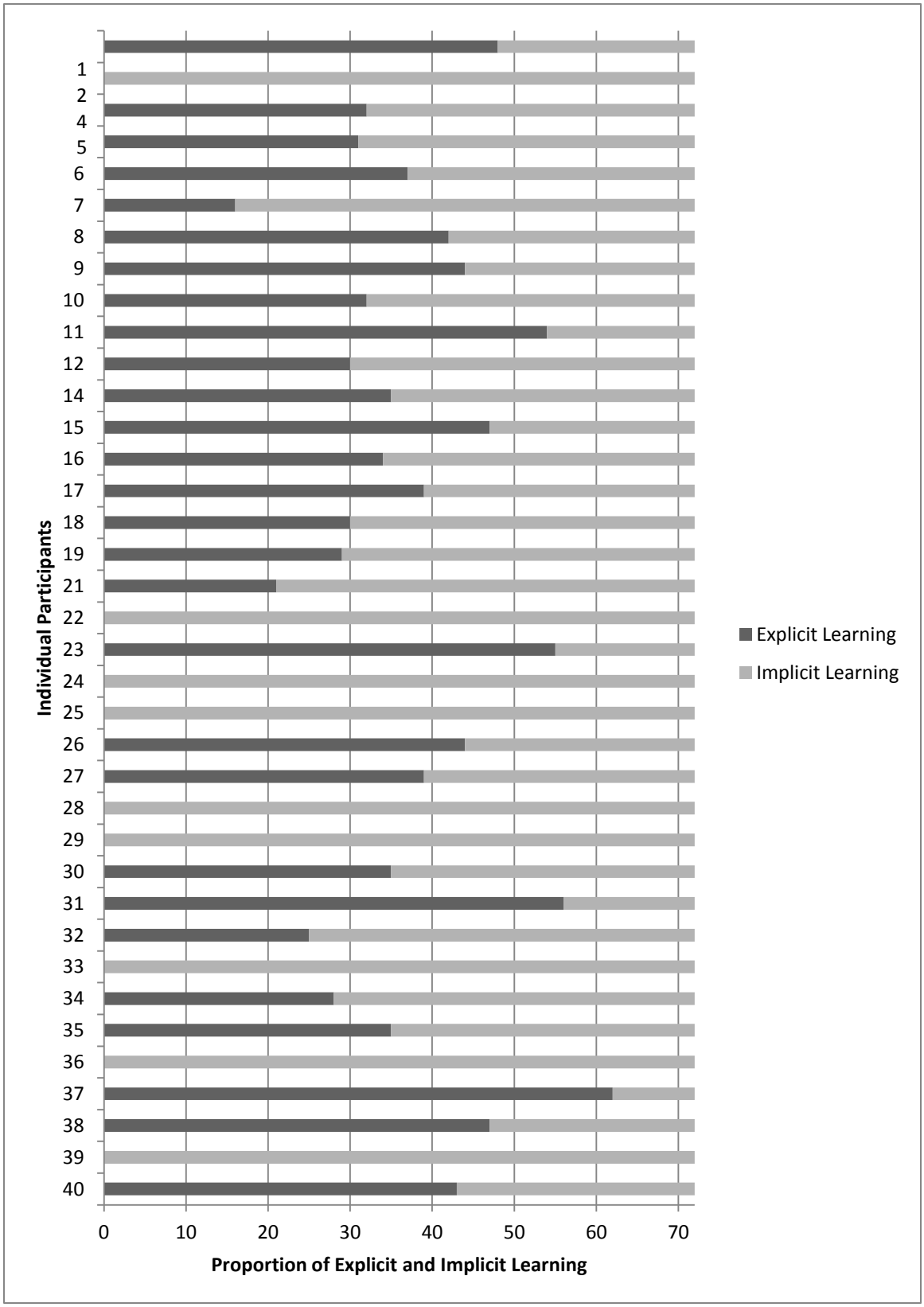
76 I would say the words are mixed up but it's still understandable.

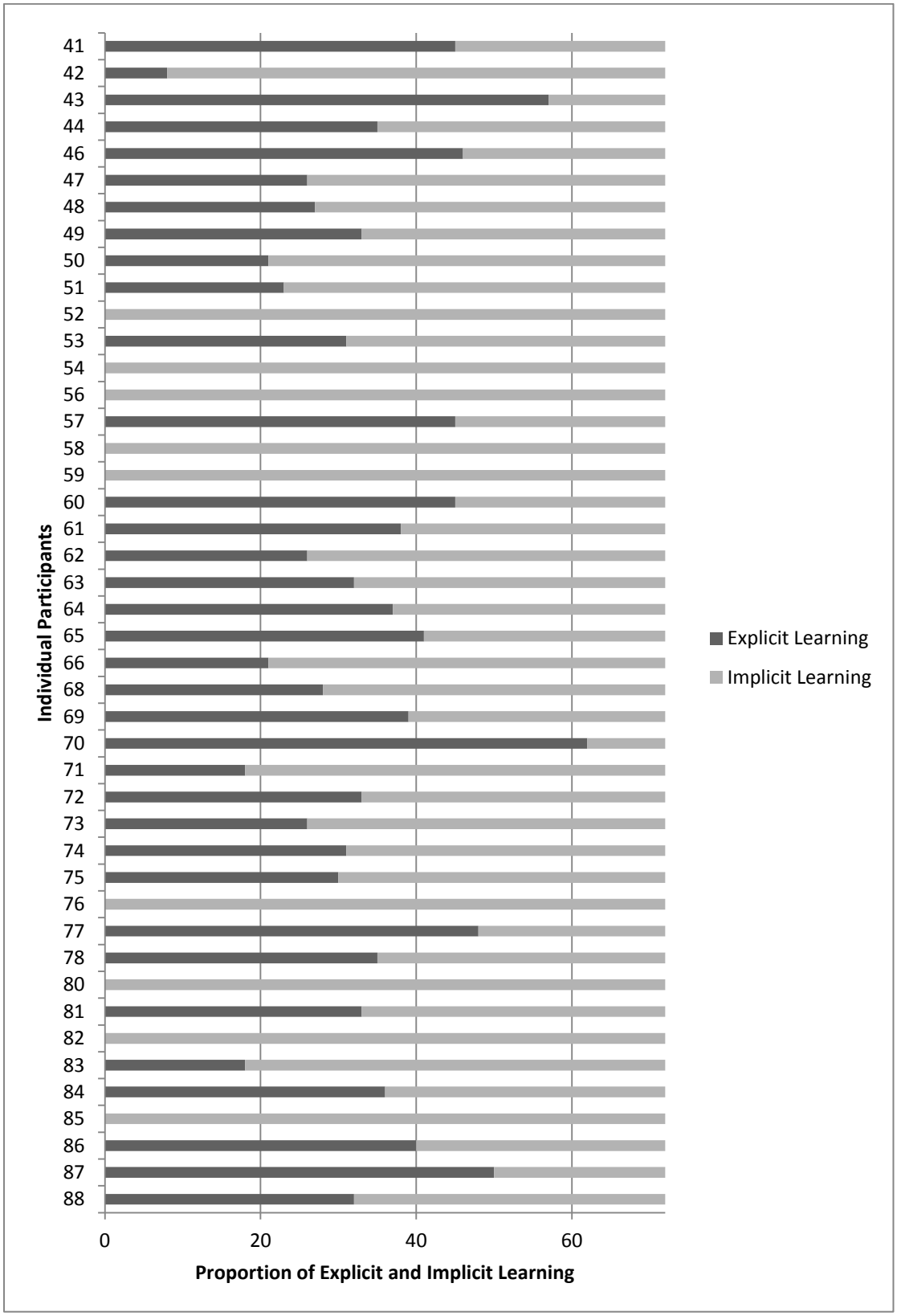
80 It sounds similar to Trinidad patva where the sex of the person is emphasized before describing their action

82 I would say the words are scrambled in a way that is not found in English but that it's easy to understand. I wouldn't know any rules to tell them.

85 The words referring to an individual were often in the wrong place and towards the beginning of the sentence. The end of each sentence also seemed muddled and out of place.

APPENDIX J – EXPLICIT AND IMPLICIT LEARNING PROFILES FOR ALL PARTICIPANTS




Individual Participants
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Proportion of Explicit and Implicit Learning
Explicit Learning
Implicit Learning

APPENDIX J – CALCULATING THE FALSE DISCOVERY RATE

The 56 *p* values are listed below:

1. .001 (All accuracy one-sample t-test RQ1)

2. .001 (V2 accuracy one-sample t-test RQ1)

3. .001 (V2VF accuracy one-sample t-test RQ1)

4. .001 (VFV2 accuracy one-sample t-test RQ1)

5. .011 (VF and V1 difference endorsement RQ1)

6. .047 (V1 and V2 difference endorsement RQ1)

7. .005 (V2V2 and VFVF difference endorsement RQ1)

8. .038 (V2V2 and VFV2 difference endorsement RQ1)

9. .032 (V2V2 and V2VF difference endorsement RQ1)

10. .134 (accuracy differences confidence ratings RQ3)

11. .965 (V2 accuracy differences confidence ratings RQ3)

12. .861 (V2VF accuracy differences confidence ratings RQ3)

13. .254 (VFV2 accuracy differences confidence ratings RQ3)

14. .001 (accuracy differences knowledge and test behaviour trichotomy RQ3)

15. .106 (post-hoc analysis difference between explicit, and explicit/implicit RQ3)

16. .001 (post-hoc analysis difference between explicit, and implicit RQ3)

17. .968 (post-hoc analysis difference between implicit/explicit, and implicit RQ3)

18. .24 (V2 accuracy differences knowledge and test behaviour trichotomy RQ3)

19. .169 (V2VF accuracy differences knowledge and test behaviour trichotomy RQ3)

20. .086 (VFV2 accuracy differences knowledge and test behaviour trichotomy RQ3)

21. .049 (accuracy differences knowledge and test behaviour continuous RQ3)

22. .041 (V2 accuracy differences knowledge and test behaviour continuous RQ3)

23. .017 (V2VF accuracy differences knowledge and test behaviour continuous RQ3)

24. .001 (VFV2 accuracy differences knowledge and test behaviour continuous RQ3)

25. .225 (regression incidental acquisition and cognitive abilities RQ5)

26. .34 (confidence ratings and aptitude inductive RQ6)

27. 1.00 (confidence ratings and working memory RQ6)

28. .37 (confidence ratings and processing speed RQ6)

29. .56 (confidence ratings and verbal reasoning RQ6)

30. .007 (knowledge and test behaviour inductive and type of learner RQ6)

31. .008 (post-hoc analysis: inductive and type of learner explicit vs. implicit RQ6)

32. 1.00 (post-hoc analysis: inductive and type of learner e/i vs. explicit RQ6)

33. .198 (post-hoc analysis: inductive and type of learner e/i vs. implicit)

34. .692 (knowledge and test behaviour working memory and type of learner RQ6)

35. .126 (knowledge and test behaviour processing speed and type of learner RQ6)

36. .625 (knowledge and test behaviour verbal reasoning and type of learner RQ6)

37. .407 (knowledge and test behaviour continuous explicit learning regression RQ6)

38. .004 (knowledge and test behaviour continuous implicit learning regression RQ6)

39. .000 (post-hoc analysis: inductive and implicit learning RQ6)

40. .824 (post-hoc analysis: working memory and implicit learning RQ6)

41. .409 (post-hoc analysis: processing speed and implicit learning RQ6)

42. .601 (post-hoc analysis: verbal reasoning and implicit learning RQ6)

43. .362 (step 1 regression confidence ratings and explicit accuracy RQ7)

44. .367 (step 2 regression confidence ratings and explicit accuracy RQ7)

45. .626 (step 1 regression confidence ratings and implicit accuracy RQ7)

46. .336 (step 2 regression confidence ratings and implicit accuracy RQ7)

47. .037 (step 1 regression knowledge and test behaviour and explicit accuracy RQ7)

48. .026 (post-hoc analysis processing speed and explicit accuracy RQ7)

49. 2.79 (post-hoc analysis verbal reasoning and explicit accuracy RQ7)

50. .042 (step 2 regression knowledge and test behaviour and explicit accuracy RQ7)

51. .049 (post-hoc analysis step 2 processing speed and explicit accuracy RQ7)

52. .906 (post-hoc analysis verbal reasoning step 2 and explicit accuracy RQ7)

53. .023 (post-hoc analysis inductive step 2 and explicit accuracy RQ7)

54. .336 (post-hoc analysis working memory and explicit accuracy RQ7)

55. .400 (step 1 regression knowledge and test behaviour implicit accuracy RQ7)

56. .931 (step 2 regression knowledge and test behaviour implicit accuracy RQ7)

Input and output (in bold) for R programme:

> pvalue<-
c(.001,.001,.001,.001,.011,.047,.005,.038,.032,.134,.965,.861,.254,.001,.106,.001,.968,.24,.169,.086,.049,.041,.017,.001,.225,.34,1.00,.37,.56,.007,.008,1.00,.198,.692,.126,.625,.407,.004,.000,.824,.409,.601,.362,.367,.626,.336,.037,.026,2.79,.042,.049,.906,.023,.336,.400,.931)

> sorted.pvalue<-sort(pvalue)

> j.alpha<-(1:56)*(.05/56)

> dif<-sorted.pvalue-j.alpha

> neg.dif<-dif[dif<0]

> pos.dif<-neg.dif[length(neg.dif)]

> index<-dif==pos.dif

> p.cutoff<-sorted.pvalue[index]

> p.cutoff

[1] 0.011

> p.sig<-pvalue[pvalue<=p.cutoff]

> p.sig

[1] 0.001 0.001 0.001 0.001 0.011 0.005 0.001 0.001 0.001 0.007 0.008

[12] 0.004 0.000