Implicit and Explicit Functions in the Acquisition of a Phonics Rule in the Word Recognition of Learning Disabled and Non Learning Disabled Students

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Abstract

One group of 12 non learning disabled students and two groups of 12 learning disabled students between the ages of 10 and 12 were measured on implicit and explicit knowledge acquisition. Students in each group implicitly acquired knowledge about 1 of 2 vocabulary rules. The vocabulary rules governed the pronunciation of 2 types of pseudowords. After completing the implicit acquisition phase, all groups were administered a test of implicit knowledge. The non learning disabled group and 1 learning disabled group were then asked to verbalize the knowledge acquired during the initial phase. This was a test of explicit knowledge. All 3 groups were then given a posttest of implicit knowledge. This test was a measure of the effectiveness of the employment of the verbalization technique. Results indicate that implicit knowledge capabilities for both the learning disabled and non learning disabled groups were intact. However, there were significant differences between groups on explicit knowledge capabilities. This led to the conclusion that implicit functions show little individual differences, and that explicit functions are affected by ability difference. Furthermore, the employment of the verbalization technique significantly increased posttest scores for learning disabled students. This suggested that the use of metacognitive techniques was a beneficial learning tool for learning disabled students.

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CHAPTER ONE: THE PROBLEM

Introduction

The purpose of this thesis was to examine the relationship between implicit and explicit functions in the process of word recognition. The functions include implicit and explicit learning, as well as implicit and explicit knowledge. Implicit learning is acquisition of knowledge about the underlying structure of a complex stimulus environment by a process which takes place without conscious operations. Explicit learning is a conscious operation in which the individual makes and tests hypotheses in a search for structure (Ellis, 1994). Implicit knowledge is knowledge that is not accessible to consciousness and cannot be verbally reported. It can be acquired either implicitly or explicitly (Ellis, 1994). Explicit knowledge is knowledge that is accessible to consciousness and can be verbally reported (Berry & Broadbent, 1988). It also can be acquired either implicitly or explicitly. The distinction between learning and knowledge is important. This study was concerned primarily with the relationship between implicit learning, implicit knowledge and explicit knowledge. Specifically, the study focused on the associations between implicit and explicit knowledge within the learning disabled population and across the learning disabled and non learning disabled populations. The study examined learning disabled children's scores on implicit and explicit knowledge tests. These scores were examined and compared with implicit and explicit knowledge scores of non learning disabled children. The examination of these data will provide researchers and educators with some idea

of the similarities and differences of learning and knowledge capacity between learning disabled and non learning disabled children.

This study was also intended to examine metacognition. The explicit knowledge task used in this experiment was a role reversed teaching strategy and was a measure of students' verbalization ability. This strategy was also defined as a metacognitive strategy. One group of learning disabled children was given the opportunity to use this strategy. They were compared to a group of learning disabled children that was not given the opportunity to use this strategy. Metacognition is taught in regular classrooms, but often teachers believe that learning disabled students lack the cognitive capacity to employ this type of thinking (Means & Knapp, 1991). This may not be true. In fact, metacognition may be beneficial to learning disabled children.

The acquisition of letter/sound correspondences was also of interest within this study. This ability may or may not require (conscious) phonological awareness. It also may or may not involve explicit rule learning and rule knowledge. This research attempted to examine these issues and how they may be related to individual difference in reading ability.

Rationale

There has been a trend in the literature to dissociate implicit knowledge and verbalizable, explicit knowledge (Berry & Broadbent, 1984; Broadbent, FitzGerald & Broadbent, 1986; Lewicki, 1986; Mathews, Buss, Chinn, & Stanley,

1988; Sanderson, 1989; Stanley, Mathews, Buss, & Kotler-Cope, 1989). As some of the recent literature has pointed out, however, the dissociation may not be as great as originally thought (Berry, 1994; Berry & Broadbent, 1984; Ryan, 1970; Stanley, Mathews, Buss, & Kotler-Cope, 1989). Research pointed out errors in methodology which may have led to the assumption of the dissociation between implicit and explicit knowledge (Berry & Broadbent, 1984; Ryan, 1970; Stanley, Mathews, Buss, & Kotler-Cope, 1989). This study intended to focus on this dissociation. This research addressed methodological issues and eliminated previous errors, illustrating that the dissociation between implicit learning and explicit knowledge may not be as great as first thought. It was hypothesized that subjects would show some ability to verbalize knowledge, that they had implicitly learned, to a naive pseudopartner (Berry & Broadbent, 1984; Mathews, Buss, Stanley, Blanchard-Fields, Cho, & Durham, 1989; Stanley et al., 1989). Subjects were given the opportunity to verbally explain how they learned the implicit learning task. It was also thought that at least some of the knowledge would be explicitly transferred from the original subject to their naive pseudopartner (Berry & Broadbent, 1984; Mathews, Buss, Stanley, Blanchard-Fields, Cho, & Durham, 1989; Stanley et al., 1989).

There was a gap in the research literature pertaining to implicit and explicit learning and knowledge in the learning disabled. Learning disabilities is a general term that refers to a heterogeneous group of disorders manifested by significant difficulties in the acquisition and use of listening, speaking, reading,

writing, reasoning, or mathematical abilities (Torgenson, 1991). These disorders are intrinsic to the individual, presumed to be due to central nervous system dysfunction, and may occur across the life span (Torgenson, 1991). Although learning disabilities may occur concomitantly with other handicapping conditions, they are not the result of those conditions. Many learning disabled children have difficulties throughout their academic careers. They are confronted with issues such as self-esteem, mainstreaming and destreaming, as well as low academic performance (McNamara, 1996). However, it has been suggested (Winter & Reber, 1994) that implicit functions should be robust in the face of disorders and dysfunctions. Therefore learning disabilities might not greatly interfere or impact on ability to learn implicitly. One of the intentions of this study was to examine the implicit learning abilities of learning disabled children.

As implicit modes of learning and explicit modes of knowledge were examined, so were the effects of metacognitive strategies on learning disabled children. The test used to examine explicit knowledge was defined as a metacognitive strategy. Therefore, as the relationship between implicit learning and explicit knowledge was studied, so was the effect of a metacognitive strategy on learning disabled children's learning ability. Specifically, this study examined the effects of a role reversed teaching strategy on learning disabled children's implicit learning performance scores. Role reversed teaching is a metacognitive strategy which was operationally defined as an explicit mode of knowledge. Only

recently have metacognition and learning disabilities been examined (Westerna & Moore, 1995). Thus there is room for research in this area of study.

There was a secondary component to this research which deserves attention. The pseudowords presented to students followed one of two phonics rules. It was the job of the students to decipher and understand the phonics rule to the best of their ability. In order to do this, students must be able to decode each pseudoword. As a result, students may become aware of the relationships between the particular letters and sounds within each word. The students might then become aware of the underlying rules governing the relationships between each of these letters and sounds. The task of deciphering the phonics rule can be broken down into a hierarchical system of three tasks. First, students must have the ability to break down the pseudoword into phonemes. Second, students must perceive the letter/sound relationships within the word. Third, students must abstract out the underlying phonics rules governing these relationships. An examination of these stages was an important element to this research.

Definition of Terms

Association - a term used to describe the relationship between functions which are dependent and related to one another.

Cognition - involves how we acquire, store, retrieve, and use knowledge. Cognition involves a wide range of mental processes (Matlin, 1983).

Consciousness - a term used to describe the mental state of being aware (Matlin, 1983).

Dissociation - a term used to describe the relationship between two functions which are independent and unrelated to one another.

Domain Specific Knowledge - knowledge which encompasses a specific academic region.

Explicit Learning - a conscious operation where the individual makes and tests hypotheses in a search for structure (Ellis, 1994).

Explicit Knowledge - knowledge acquired either implicitly or explicitly, and accessible to consciousness (Ellis, 1994).

LD Pos - 12 learning disabled children with a reading age 2 years below their non learning disabled peers. This group will be exposed to both implicit learning conditions, and explicit knowledge conditions.

LD Neg - 12 learning disabled children with a reading age 2 years below their non learning disabled peers. This group will only be exposed to the implicit learning conditions.

ND Pos - 12 non learning disabled children with a reading age appropriate to their grade level. This group will act as an experimental as well as a control group. This group will be exposed to the implicit learning condition as well as the explicit knowledge condition.

Implicit Learning - the acquisition of knowledge about the underlying structure of a complex stimulus environment by a process which takes place naturally, simply and without conscious operation (Ellis, 1994).

Implicit Knowledge - knowledge acquired either implicitly or explicitly, and not accessible to consciousness (Ellis, 1994).

Learning Disability - a heterogeneous group of disorders manifested by significant difficulties in the acquisition and use of cognitive abilities. It is intrinsic to the individual and presumed to be due to a dysfunction in the central nervous system (Torgenson, 1991).

Metacognition - any knowledge or cognitive activity that takes as its object or regulates any aspect of any cognitive enterprise (Wong, 1991).

Metacognitive Knowledge - being aware of factors that affect learning and to teach oneself to take control of one's thought processes (Wong, 1991).

Normal I.Q. - having an Intelligence Quotient score of between 93 - 107.

Reading Disabled - reading at least two grade levels below the grade levels norms for the specific individual. Otherwise, the individual is functioning at relatively normal levels.

Role Reversed Teaching - a method of teaching where the child takes the role of the teacher.

Unconsciousness - refers to the mental state of being unaware (Matlin, 1983).

CHAPTER TWO: REVIEW OF RELATED LITERATURE

Introduction

The acquisition of language has been a topic of interest for many years. As infants develop into school aged children language acquisition becomes a primary focus of parents and educators. There are two schools of thought pertaining to the theory of language acquisition. Nativists such as Noam Chomsky believe that children are born with a device which allows them to acquire language without explicit instruction (Chomsky, 1980). On the other hand, cognitive theory suggests that, in order to acquire language, children must engage in explicit processing mechanisms (Slobin, 1973). Language then, can be acquired either through implicit or explicit learning. This may also be the case for language subskills, such as learning to read.

The remainder of this chapter was divided into four primary sections. Phonics rule awareness, implicit and explicit functions, metacognition, and a summary of the literature review. The chapter was concluded with a statement of the present research problem.

Phonics Rule Awareness

What does it mean when we say that we know the language? Language has many subsystems that has to do with sounds, letter/sound relationships, grammar, semantics, and vocabulary. Language also includes knowing the right way to say something on a particular occasion in order to accomplish a specific purpose

(Gleason, 1985). In other words, knowing the language entails knowing its phonology, morphology, syntax, and semantics, as well as its rules for language use.

As children progress through elementary school, they are inundated with new words and word families. Nagy and Anderson (1984) estimated that printed school English contains around 88,500 word families. They defined family as a group of words with clear and predictable relationships of form and meaning. Furthermore, they suggested that the average fifth grader encounters around 10,000 new reading words per year. The obvious question which follows is: how can a child learn so many words. Share (1995) suggested that there are three options that may serve to foster this learning. These include direct instruction, contextual guessing and phonological recoding. Share goes on to suggest that due to the vast amount of words a child encounters, phonological recoding is the only viable means for reading vocabulary acquisition. Direct instruction may be successful in teaching children how to recognize and decode familiar words within common word families, but does not take into account the vast amount of unfamiliar words children encounter. Contextual guessing may be successful when the unfamiliar word is a functional word within a familiar schema. However a child in elementary school consistently encounters a vast amount of words and sentences that lay in unfamiliar schemas. Therefore contextual guessing is, often unsuccessful (Share, 1995).

On the other hand, phonological recoding was found to be the principal means by which learners attain word recognition proficiency. This processing skill

gradually develops as a child progresses and becomes proficient in reading and language acquisition. Ehri (1986) examined beginning readers and found that they begin with initial sets of simple one to one letter - sound relationships. She found that this process offered beginning readers a minimum number of rules with a maximum generative power. These simple one to one letter/sound relationships then become modified and expanded as students gain experience and automatize these simple functions. The outcome of this maturity is the production of a skilled reader whose knowledge of the relationships between print and sound has evolved to a degree that allows advanced grammatical and vocabulary rules to be understood (Ehri, 1986).

Karanth and Suchitra (1993) also examined beginning and advanced readers and found that beginning readers do not have full linguistic understanding of text. These readers used a great deal of their cognitive capacity on phonological decoding and comprehension. Thus it is possible that beginning readers have limited cognitive space available when asked to reflect on linguistic rule systems. Karanth and Suchitra (1993) found that advanced readers were able to separate their thought from phonological processes and even from the content of the sentence, in order to make grammatical judgments. These researchers refered to the process of being aware of underlying linguistic rules as metalinguistic.

Learning to decode has been viewed as a stage based process model similar to Piaget's stages of cognitive growth (Dickson, Wolf & Stotsky, 1993). In stage 1 of this model (Grades 1.5 - 2.5) decoding is the focus and is applied to single words and simple sentences. In stage 2 (Grades 2.5 - 4) reading becomes

more fluent, and more attention is directed to understand the meaning of what is read. At this stage more inferential skills are used to analyze unknown words, while lower level skills are consolidated. Stage 3 (Grades 4 - 6) marks a major change in the reading process. During this stage, children moved from an emphasis on decoding to comprehension of text. The reader could now focus attention on the components of reading and can complete demanding cognitive tasks. In stage 4 (Grades 6 - 12) lower level processes are consolidated and the reader finds it easier to develop metalinguistic knowledge. However, a developmental model of this nature should not be taken to imply that the beginning Grade 1 reader has no conscious metalinguistic awareness of the letter-sound correspondences underlying his/her word recognition. Rather, what is implied in a developmental model of this nature is that children at the beginning stages of learning to decode will have less working memory capacity left over in word recognition for the conscious coding of letter/sound relationships or phonic rules than older more experienced readers. It is hypothesized that this will also be the case for the learning disabled reader who shows developmental lag in word recognition.

One element of this research is the examination of the emergence of the explicit awareness of underlying letter/sound correspondences used in word recognition. Specifically of interest is the conscious awareness of phonological rules. There is of course, considerable research on the development of phonological awareness (Gleason, 1985). Yet, little research has been done on the degree to which phonics rule acquisition is conscious or unconscious. This

research problem is, in one sense, deeply confounded with the way in which word recognition and phonics is taught. Obviously, direct teaching of phonics involves the development of an explicit conscious awareness of phonics rules. However, it can be argued that sight-word or whole-word instructional approaches often leave the letter-sound relationships within words at an implicit level. This may also be true of some word family instructional approaches. Whether or not this is desirable or to what degree teachers do this is not the point of this research. Rather, the goal here is to discuss to what degree conscious awareness of letter-sound relationships develop as a function of learning to read words in word families. In other words, when a child learns to read a group of words in a word family correctly, does a conscious awareness of the underlying phonic rule common to the word family, spontaneously emerge? Furthermore, if it does, does it have any effect on subsequent word recognition?

The model which examines the spontaneous emergence of the child's conscious awareness of an underlying phonics rule may depend on several factors. Learning to understand a phonics rule is a complex and developmental task. In order to reach this stage, the child must first develop phonological awareness (Cunningham, 1990). A primary element of phonological awareness is phonemic awareness. Phonemic awareness is the ability to explicitly manipulate speech segments at the phoneme level. Children may not need complete understanding and facility with linguistic structure to begin to read, but some understanding of letter-sound relationships is necessary in order to read (Cunningham, 1990). As children become experienced in decoding and understanding letter-sound

relationships, they begin to develop fluency in word recognition tasks. Fluency is important so that some working memory, previously used to decode, is freed up. This allows some attentional capacity to be used for metalinguistic processing (Karanth & Suchitra, 1993). As metalinguistic ability develops, children are able to examine letter-sound relationships and eventually phonics rules governing these relationships (Dickson et al., 1993). Understanding of phonics rules develops through experience and repetition of the rules within specific word families. As this occurs children begin to develop the ability to detect letter-sound correspondences (Fletcher & Prior, 1990). As this developmental trend continue, children develop the ability to make conscious and verbally explain a letter-sound correspondence. In other words, children develop the ability to construct a metalinguistic language that allows them to think about and talk about the letter-sound correspondence as a conscious object of their cognition (Fletcher & Prior, 1990).

The question then becomes, does this model pertain to learning disabled children in the same manner as it does to non learning disabled children? Fletcher and Prior (1990) investigated this issue and found that learning disabled children do differ from non learning disabled children. Manis, Savage, Morrison, Horn, Howell, Szeszulski and Holt (1987) suggested that phonics rule learning depends on two processes that occur simultaneously. First, children must encode the elements of the letter/sound correspondences into a small number of mediators, corresponding to whether the relevant attributes of the phonics rule are present or not. Second, children must assign these mediators to the appropriate response

class, either positive or negative. Manis et al. (1987) found that learning disabled children matched for chronological age with non learning disabled children showed some ability to understand phonics rules governing letter/sound relationships. However, it was difficult for these children to understand the variability in pronunciation if the rule governing the pronunciation does not follow a specifiable pattern. These children also had difficulty with abstracting grapheme-phoneme rules when learning to read words. Manis et al. (1987) suggested the presence of basic difficulties in the acquisition and application of phonics rules under conditions where memory and processes demands are high, as well as under irregular rule conditions. The pattern of errors were highly suggestive of a phonological deficit which interferes with rule learning (Manis et al., 1987). A further finding within the research done by Manis et al. (1987) suggested that learning disabled readers were aware of the phonics rule but could not apply it as effectively as non learning disabled children. Vellutino and Scanlon (1982) suggested that this inability to apply phonics rules to basic word recognition stems from verbal cognitive deficits.

Psychology has examined conscious and unconscious awareness in general cognitive processing. The following section is a review of consciousness and unconsciousness.

Implicit and Explicit Functions

Definitions

As children begin to read they encounter grammatical rules that must be learned. This learning can take place implicitly and explicitly.

Implicit learning is acquisition of knowledge about the underlying structure of a complex stimulus environment by a process which takes place without conscious operations (Ellis, 1994). Explicit learning is a more conscious operation where the individual makes and tests hypotheses in a search for structure (Ellis, 1994). Knowledge attainment can take place either implicitly, where knowledge is attained through nonconscious and automatic abstraction of the structural nature of the material, or explicitly, where the learner searches for information, then builds and tests hypotheses.

Winter and Reber (1994) stated that implicit learning is a process whereby complex knowledge of richly structured stimulus domains is acquired largely independent of conscious operations and largely independent of explicit knowledge of both the process of acquisition and the knowledge base that is acquired. Dulany, Carlson, and Dewey (1984) discussed the essence of the implicit process in the following manner. First, information may be encoded by a nonconscious abstraction system. What is learned is "tactic knowledge", an unconscious and abstract representation of structure in the information given. The judgment that new information does or does not satisfy that representation is implicit in the sense that subjects are not consciously aware of the aspects of the stimuli that lead them to their decision. This process is evoked when the subjects

are not actively trying to break the code. Implicit learning is proposed as a mechanism for acquiring a variety of complex structures underlying language, socialization, perception, and sophisticated games. Dulany et. al. (1984) contrasted the implicit process with an explicit process in which one tries to decipher rules by testing conscious rules that describe the domain and guide judgment. Reber (1976) characterized implicit learning as a process whereby a subject becomes sensitive to the structure inherent in a complex array by subconsciously developing a conceptual model which reflects the structure to some degree. Nesbitt and Wilson (1977) viewed implicit learning as having no direct access to higher order mental processes such as those involved in evaluation, judgment, problem solving, and the initiation of behaviour. Only the products of cognitive and mental activities are available to consciousness. Berry (1994) explained implicit and explicit knowledge simply by noting that explicit knowledge is accessible to consciousness and can be communicated or demonstrated on demand. In contrast, implicit knowledge is less accessible to consciousness and cannot be easily communicated or demonstrated on demand.

Winter and Reber (1994) made four assumptions about implicit functions which will play an important role in this research. First, implicit systems should be robust in the face of disorders and dysfunctions that compromise explicit cognitive systems. Second, implicit cognitive functions should show fewer effects of age and developmental level than explicit cognitive functions. Third, measures of implicit functions should show less individual to individual variability than corresponding measures of explicit functions. Fourth, the underlying processes of

implicit acquisition and memorial representation should show cross species commonality. Due to the nature of this specific project the first three assumptions are important to note. This research will examine a learning disabled population and their ability to learn and exhibit knowledge implicitly. According to Winter and Reber (1994) their ability to function implicitly should not be as greatly affected by their specific learning disability as their conscious learning.

Implicit Learning versus Explicit Learning

Children learn both implicitly and explicitly. This section of the literature review focused on which mode of learning, implicit or explicit, is more successful.

Many researchers have found that, on some tasks, implicit learning is a better mode of learning than explicit learning. Mathews, Buss, Blanchard-Fields, Cho and Durham (1989) examined students' acquisition of artificial grammars. Artificial grammars are pseudo grammatical rules designed by the researchers, in order to study acquisition patterns. Mathews et al. (1989) measured subjects who implicitly learned rules of artificial grammars, and subjects who explicitly learned the rules of artificial grammars. They found that subjects who learned the rules implicitly did as well or better on future attempts to discriminate between new valid versus invalid artificial grammars as subjects who explicitly learned the rules. This tends to be the common finding. Stanley, Mathews, Buss, and Kotler-Cope (1989) found evidence that implicit learning mechanisms, occurring automatically without any conscious effort to abstract the complex relations, are capable of detecting more subtle and complex relations than are discoverable

through explicit thought. Reber (1976) found that an explicit search can jeopardize the user in that the individual fails to find the correct rules which are necessary to solve the problem. This leads to poor performance. The implicit process seems to be most effective when the subjects are in a relatively neutral passive set, and allow themselves to be inundated by the stimulus materials. Dulany, Carlson and Dewey (1984) found that given artificial grammatical strings of letters and implicit learning instruction, subjects are significantly accurate when they have a later opportunity to judge the grammaticality of novel grammatical and non grammatical strings. Berry and Broadbent (1988) found that subjects who were given explicit learning instructions before seeing the material to be learned, in order to discover the rules for letter order, performed worse on both the memorization and subsequent discrimination tasks than those who were told merely to memorize the strings

Learning Versus Knowledge

Once individuals acquire a language rule, either through being exposed to it and acquiring it implicitly, or being taught it explicitly, they can be seen to have acquired some sort of knowledge. How do subjects exhibit this knowledge? More importantly, as teachers how do we know that students have acquired knowledge? Individuals can exhibit knowledge implicitly and explicitly. This section is intended to distinguish implicit from explicit learning, and implicit from explicit knowledge.

Researchers such as Berry and Broadbent (1988) made distinctions between implicit and explicit learning and implicit or explicit knowledge. Learning is explicit when deliberate instructions are given to search for the rules that underlie some set of materials. It is considered implicit when people are merely told to memorize the specific material presented, but nevertheless learn about the underlying rules (Berry & Broadbent, 1988). The terms implicit and explicit may also be applied to knowledge. Explicit knowledge refers to knowledge that has been acquired either implicitly or explicitly, which is accessible to consciousness and can be verbally articulated. Implicit knowledge refers to knowledge, that has been acquired either implicitly or explicitly, which is not accessible to consciousness and cannot be verbally reported. This distinction between knowledge and learning is one of importance.

Dissociation

There is a common finding in the literature that points to the dissociation between implicit learning and explicit knowledge. This dissociation is usually found in a discrepancy between task performance and the ability to verbalize what has been done. This is a critical factor when linking this type of learning and knowledge to educational implications. If a dissociation exists, it would be difficult for a teacher to conclude that a child had not acquired a vocabulary rule simply because the child could not verbalize it. In other words, a child could have knowledge of a vocabulary rule without being able to verbalize the rule. Therefore it is important to examine this dissociation.

Mathews et al.(1988) found implicit learning processes to be automatic

and unconscious and, therefore, to result in knowledge that cannot be verbalized. Stanley, Mathews, Buss, and Kotler-Cope (1989) found frequent reports of a dissociation between subjects' task performance and their ability to answer questions or verbalize their knowledge. Sanderson (1989) found that some information processing is done in such absence of conscious awareness that it will never be available for conscious report. Lewicki (1986) has proposed that implicitly acquired knowledge is totally independent of explicit knowledge. Berry and Broadbent (1984) posit some form of dissociation between an individual's performance on a given task and the explicit or reportable knowledge associated with that performance. These authors also found that through practice and exposure subjects improved in ability to control the variables in the problem, but did not improve in ability to verbally answer questions. Berry and Broadbent (1984) concluded that verbal explanation had no effect on task performance. Broadbent, FitzGerald and Broadbent (1986) also see a distinction between the general database of knowledge and other relatively specific processes that act upon this database. Some such processes will result in verbal outputs. Lewicki, Hill, and Bizot (1988) go one step further and state that subjects are able to acquire specific working knowledge not only without being able to articulate what they have learned, but even without being aware that they had learned anything. These researchers found that subjects were not aware of the knowledge that they had been using during the testing phase of the experiments, nor could they reconstruct this knowledge even when they were asked very specific questions. These results are consistent with studies done by Lewicki, Hoffman, and

Czyzewska (1987). These researchers concluded that subjects acquire some form of implicit knowledge about patterns of stimuli and how to process them, although the subject is unable to articulate these processing rules. These researchers concluded that the process was unconscious in the sense that subjects were neither aware that they were learning the rule, nor aware of how the acquired knowledge facilitated their performance. Schmidt (1994) found that through exposure to examples, subjects become sensitive to underlying regularities in input. This is shown by the fact that they can accurately characterize new strings which they have never seen before as grammatical or ungrammatical at above chance levels. These subjects are generally unable to verbalize the rules of the underlying grammar. Berry (1994) found that teams of managers making decisions on a model of the British economy improved in decision making performance with practice. Yet individuals making up the team did not improve on multiple choice questions about the principles governing the economic model. It was concluded that ability to control the task bore little connection with the ability to answer verbal questions about it. Hence, a dissociation was noted.

In reviewing the literature, there is no doubting the presence of a dissociation between implicit learning and explicit knowledge. Why does this dissociation occur? The following literature review will attempt answer this question.

Berry and Broadbent (1988) offer one reason for a dissociation. In a complex learning situation a learner has to acquire knowledge about a number of variables without knowing which variables are relevant to the problem. Berry and

Broadbent (1988) discuss two possible routes a learner may take. First, a person may observe the variables unselectively and attempt to store all of the contingencies between them. The correct factors as well as the incorrect ones will be stored, and, after much experience, the person will retain a large number of condition - action links that will produce effective performance. Reporting or verbalizing so many links will be difficult for the learner to do. Use of this unselective, implicit model of learning is unlikely to be associated with accurate verbalizable knowledge. On the other hand, an alternative mode of learning is a selective one in which a few variables are selected and only the contingencies between these key variables are observed. Provided that the correct variables are selected this will be an effective method of learning. It will also be a model of knowledge which can be made explicit because of the relatively small number of relationships involved (Berry & Broadbent, 1988). Reber, Kassin, Lewis and Cantor, (1980) refer to this as "salience." These researchers defined salience as the obvious nature of the variables needed to solve the problem. In the study by Berry and Broadbent (1988) salience, then, can be regarded as the probability that, if a person learns by the selective rather than the unselective mode, the key variables in the task will be chosen. Reber (1967) discusses salience, and notes that when salient stimuli are presented to subjects who have appropriate coding schemes then they will be able to organize the data. When non salient stimuli are presented, then subjects will impose their own organizational schemes. Broadbent et al. (1986) hypothesized that an increase in information load can make tasks show the dissociation of performance and verbalization. The system that produces verbal

accounts is relatively limited and serial. If the number of possibilities is reduced, the subject may show a lower degree of dissociation. Broadbent et al. (1986) also refer to this as "salience." Berry (1994) described two modes of learning. The first mode was described as an implicit or unselective one in which a person encountering a complex task may observe the variables unselectively and attempt to store all of the contingencies between them. Although effective performance may be achieved, verbal reporting of all of the contingencies will be difficult. This implicit or unselective mode of learning is likely to show a dissociation between performance and verbalizable knowledge. Berry (1994) also described a selective mode where a subject selects key variables. Performance is attained and verbalization is likely to occur. Berry (1994) argues that if the underlying relationships between variables were made more salient, performance and verbalizable knowledge might be positively associated.

Another reason for the dissociation may be linked to skill development. Stanley et al. (1989) suggest that declarative, verbalizable, knowledge develops after procedural knowledge; thus subjects may verbalize their knowledge of the task more readily at higher levels of expertise. In this respect, a dissociation may be found with beginning learners, while more advanced learners may show less of a dissociation. Berry (1994) found a considerable difference between the amount of time it takes to acquire verbalizable knowledge, and knowledge used to perform the control task. Subjects were found to become skilled in controlling the tasks long before there is much gain in verbalizable knowledge. Sharwood-Smith (1994) concurred with the idea that explicit knowledge capability develops with

the normal course of learning. Sharwood-Smith (1994) noted that the difference between implicit and explicit knowledge is quantitative. A person's explicit knowledge capabilities require much more analysis than do their implicit knowledge capabilities. Therefore, they usually develop later. Lewicki et al. (1988) discussed why a dissociation occurs in terms of cognitive properties. The human cognitive system is capable of memorizing more information about encountered stimuli than can be processed through consciously controlled channels. This property of the cognitive system allows a person to acquire and take advantage of much more information than can be verbalized.

A few researchers refer to the development of a mental model which may decrease the dissociation between performance and verbalizable knowledge. McGeorge and Burton (1989) explained that verbal ability only attains levels comparable with performance after subjects have developed a mental model of the system. Prior to the development of this model only an instance - based store is available to which verbal processes do not have access. McGeorge and Burton (1989) explained that this mental model appears to be developing after 90 exchanges between the subject and the system. Berry (1994) also referred to a mental model. She found that subjects who were exposed to a stimulus many times developed the ability to give correct verbal statements. It is also noted that this mental model begins to develop after 90 exposures to the stimuli.

Stanley et al. (1989) discussed another reason for a dissociation between performance and verbalizable knowledge. It is suggested that procedural knowledge may be guided by prior knowledge. When faced with a particular

situation, subjects may recognize a similar past sequence of events in which they made a certain response and were successful. If this recognition of prior experiences is implicit, subjects may only experience a feeling of knowing what to do. They will not consciously recall the past episode that is implicitly recognized by the memory system.

Many recent studies have shown that, because of errors in methodology, the dissociation between performance and explicit knowledge may not be as great as originally thought. Stanley et al. (1989) have shown that the dissociation between verbalizable knowledge and task performance in some implicit learning tasks is not as great as suspected when more powerful measures of verbalizable knowledge are obtained concurrently with the performance of the task. Stanley et al. (1989) described a study in which subjects in artificial grammar experiments generate instructions for an unseen partner to perform the task under the same learning conditions. These instructions were given to a naive subject who attempted to perform the task without any prior training. The results demonstrated that much (although not all) of the original subjects' knowledge could be successfully transmitted to their partners.

Berry and Broadbent (1984) noted that many researchers obtain their verbalization scores through a written questionnaire. Written questionnaires are not accurate predictors of verbal knowledge and furthermore many researchers did not ensure that the questionnaires are accurately understood by the subject. Berry and Broadbent (1984) pointed out another interesting methodological problem. For many researchers, the number of attempts to reach a specific criterion target

affected post test scores. Individuals who needed a greater number of trials to criterion had far more experience with the task at the time of answering the post task questionnaire. It was found that this factor could increase post test scores to an unrepresentative level. An alternative is to give all subjects the same amount of trials. However, Berry and Broadbent (1984) found that giving each subject the same number of trials limits researchers' assurance that each subject has met criterion. In any account, this is an interesting methodological issue that researchers must address in each particular experiment.

It is not enough to conclude that a dissociation exists because there has been failure to find a positive association. A stronger approach is to introduce factors which might have differential effects on task performance and question answering (Berry, 1994). Ryan (1970) suggested that in many experiments verbal reports may be elicited inadequately. It is suggested that any type of knowledge is, in principle, accessible given appropriate questioning techniques. Ryan (1970) noted that questionnaires may not always be an appropriate method of obtaining accurate verbal reports. It is important to sample different ways of accessing verbal knowledge so that everything a subject might be able to report about a system is considered.

It is important that this dissociation be examined because of the educational implications that are entailed. It is critical that teachers understand how children acquire language rules and how knowledge of these rules can be exhibited by the child. Indeed, it is the lack of understanding of this dissociation that may be lie at the heart of many pedagogical problems such as the great debate

on how to each word recognition skills in reading (Chall, 1967).

On a Correct Methodology

As the preceding literature review has shown , the dissociation between performance and explicit knowledge may not be as large as originally thought. The following section will outline a methodology that may be a stronger method of examining verbalizable knowledge.

Allowing subjects to verbalize by giving instruction to another subject may be a more advantageous method of examining verbalized knowledge. As mentioned earlier, Stanley et al. (1989) had subjects in artificial grammar experiments generate instructions for an "unseen partner" to perform the same task. The results of this experiment demonstrate that original subjects could transfer much of the information to their partner. Stanley et al. (1989) demonstrated that subjects' verbalization of instruction to a naive partner facilitated the original subjects' performance on the task. Also, the naive subject was able to use the knowledge verbalized by the original subject, to perform the original task. In fact, they performed better than control subjects who were not given these instructions. These results suggest that under proper methodological conditions, the dissociation may not be as great as originally thought. Berry and Broadbent (1984) suggested that subjects interact with another person. This form of interaction may elicit more accurate verbal reports than would questionnaires. Mathews et al. (1989) described a "teach aloud" procedure in which subjects were asked to give verbal instructions to someone else in order that they perform the task. Later, these instructions were given to another group of students who

attempted to perform the same task without the benefit of any prior experience. Several advantages were noted. The relative level of performance of the second group versus their experimental partners provides a direct measure of the extent to which knowledge of the grammar can be communicated verbally to another person. Palincsar and Brown (1984) noted an interesting fact in that the role reversed teaching method forces the student to respond, even if the level of which they are capable is not yet that of an expert. Because the students do respond, the experimenter has an opportunity to gauge their competence. In this way, the procedure provides an opportunity for students to make overt their level of competence; a level that in many procedures is masked by students' tendency not to respond until they approach full competence. This "role reversed teaching approach" will be one which this researcher will adapt in this experiment.

Metacognition

Explicit knowledge can be measured through a subject's ability to verbalize the knowledge which they have implicitly learned. In order to verbalize the knowledge subjects can be asked to take the role of the teacher and teach a naive subject, in this case the researcher, how to perform the experimental task. When a subject takes the role of the teacher they must use advanced monitoring functions in order to understand how to teach (Palincsar, 1986). In other words, the subject must use metacognitive processes (Palincsar, 1986). This study, therefore, built in a test which measures whether or not the use of metacognitive processes increases performance scores of the original implicitly learned

knowledge. This research carries important educational implications. The execution of metacognitive processes may indeed increase learning disabled subjects' performance scores. Such a finding would support research indicating that metacognition is a critical element in the education of learning disabled students.

Within the procedures of this study subjects engage in a process where they verbalize knowledge in a role reversed teaching atmosphere. During the verbalization stage, the responsibility (of doing) the teaching shifts from the researcher to the student. The student takes on a cognitive process where they must monitor their own thinking and reasoning skills. In essence, the student is employing metacognitive skills to verbalize the appropriate response so that their implicitly learned knowledge can be transferred to the naive learner.

Metacognition has been the focus of research for the past decade. It is defined as our knowledge about how we perceive, remember, think and act (Metcalfe and Shimamura, 1994). In essence metacognition is what we know about what we know (Forrest-Pressley, MacKinnon, & Waller, 1985; Wong, 1991). Metacognition develops as children become cognitively mature within a specific domain. Therefore, it can be understood how metacognition can be seen as a developmental process. Research has pointed out that children acquire these metacognitive skills at different rates as a function of the schooling they undergo (Westerna & Moore, 1995). This is an important aspect of metacognition and instruction. Non learning disabled children are taught basic cognitive skills. As they progress through these stages of growth, and when it is deemed appropriate,

teachers begin to teach children metacognitive techniques (Westerna & Moore, 1995). It is evident that a distinguishing characteristic of good academic performance, particularly reading, is the use of metacognitive skills in the reading or cognitive process (Westerna & Moore, 1995). Furthermore, many studies have found that young and poor readers do not use effective metacognitive strategies for monitoring and learning new text (Baker & Brown, 1984).

In the past there has been an assumption on the part of some educators that learning disabled students lacked the capacity to perform complex advanced academic tasks (Means & Knapp, 1991). Studies document the fact that learning disabled students receive less instruction in higher order skills than more non learning disabled students (Means & Knapp, 1991). It is true that disabled students typically have failed to demonstrate advanced cognitive skills, but this could be due to the fact that educators believe that learning disabled students lack this capacity. Consequently, educators may not provide the instruction required to execute such techniques. Means and Knapp (1991) found three common educational beliefs about learning disabled students and metacognition. First, educators underestimate what learning disabled students are capable of doing. Second, educators often postpone giving learning disabled students more challenging and interesting work for too long, and in some cases, forever. Third, educators often deprive learning disabled students of a meaningful or motivating context for learning or using the skills that are taught. In essence what educators may be doing is providing little or nothing to foster the growth of reasoning, problem solving, and independent thinking. As this happens throughout academic

years, "the rich get richer and poor get poorer" (Stanovich, 1986, pp.365). Stanovich (1986) referred to this as the "Matthew effect" (pp.361). Stanovich (1986) studied organism-environment correlations and found two correlations. Both active and passive organism-environment correlations can contribute to the Matthew effect. Passive effects may be an unavoidable function of genotype which may effect home environment as well as cognitive capacity. This labeling may be followed up with a poor school environment. In such an environment students may be given an inferior education, which would not provide opportunities to execute higher order functions. On the other hand students can be enriched by having an active organism-environment correlation. This creates a rich environment where the student is encouraged to execute higher order functions. Thus, the "Matthew effect" dictates that some students are genetically and environmentally advantaged and are more likely to experience an academic environment which will bootstrap the advancement of educational processes. Conversely, disadvantaged children are most often exposed to inferior ability environments which will not further their educational processes (Stanovich, 1986). When this occurs, the difference between the two groups continues to increase. Hence, "the rich get richer and the poor get poorer"(pp.365).

Wong (1991) also examined metacognition and learning disabilities and noted the importance of distinguishing performance failures that reflect deep seated cognitive processing problems from those problems which are a failures of a strategic nature. Wong (1986) noted that that there are limitations of metacognitive skills in students with learning disabilities. There are occasions

when learning disabled children have insufficient cognitive ability and therefore would not benefit from being given metacognitive instruction. It is also important to understand that learning disabled students typically have a deficit in one particular cognitive domain. Therefore, metacognitive techniques may increase performance in unaffected domains. Furthermore, such techniques may compensate for specific cognitive deficits. In any case, it is important for educators to understand that learning disabled students can benefit from metacognitive strategies. As Westerna and Moore (1995) pointed out, metacognitive growth is a function of instruction and this must be considered.

Kelly, Moore and Brown (1994) examined poor readers and found that they did not use effective strategies for monitoring and constructing meaning from text. These researchers proposed a few reasons for this ineffectiveness. One possibility is that metacognitive skills develop gradually and generally appear later than other skills. Also, poor readers have been shown to lack knowledge about the actual purposes of reading. If this is the case, these children will not use metacognitive skills effectively. The third reason given by Kelly et al. (1994) is that poor readers are not given the proper instruction needed to execute such functions. They suggested that studies clearly show that poor readers can be taught higher order skills, and that significant gains in students' reading may be brought about through such metacognitive instruction.

Role Reversed Teaching

Role reversed teaching is similar to a technique referred to as reciprocal teaching. It is similar in that they can both be defined as a set of learning

conditions in which children first experience a particular set of cognitive activities in the presence of experts and gradually come to perform these functions by themselves (Rosenshine & Meister, 1994). This activity has two major features. The first is instruction and practice of strategies including self question generating, prediction and clarification. The second consists of the use of the reversed teaching dialogue as a vehicle for both verbalizing and consolidating knowledge.

Palincsar (1986) examined metacognitive activity of disabled students and found that these students, when reading and using a role reversed teaching technique, must use self questioning techniques whenever they question themselves about the type of information that is being presented. Students must also use predicting techniques when they hypothesize about what the structure and content of the text will be presented next. The use of such a technique proved advantageous to the disabled students. Lovett, Borden, Warren-Chaplin, Lacerenza, DeLuca & Giovinazzo (1996) found that the employing metacognitive techniques, such as role reversed teaching, was an effective method of improving performance of disabled learners. Kelly et al. (1994) agreed that this type of activity allows students to execute higher order functions, such as self questioning and monitoring. They found that this teaching process appears to be effective in making novice readers more expert in the cognitive encoding, organization, and integration of material they read and in the executive functions of self monitoring and control of comprehension.

Role reversed teaching is a technique which enables students to practice

self questioning, monitoring and summarizing skills. These skills are higher order or metacognitive functions. Research has found that the execution of metacognitive skills enables a student to grow and advance, cognitively (Westerna & Moore, 1995). A child not given the instruction to execute such functions will soon fall further and further behind. Research has shown that many learning disabled children are not given the proper instruction needed to execute metacognitive strategies (Means & Knapp, 1991). Learning disabled students may lack the cognitive ability to perform adequately in some academic areas. Although, usually this deficit is domain specific. Therefore, educators must understand that metacognitive instruction can help learning disabled children increase their cognitive ability. Not only will it increase cognitive ability, but it may increase self esteem and self concept.

Summary of Literature Review

A critical element of reading is phonological awareness (Ehri, 1986; Gleason, 1985; Share, 1995). There are stages within the phonological awareness model (Dickson et al., 1993; Ehri, 1986; Karanth & Suchitra, 1993). At some point within the model students develop metalinguistic awareness. As this is achieved, students can focus on letter/sound relationships as well as the underlying rules governing the relationships. However, to what degree is the awareness of the rules governing phonological relationships conscious?

The learning of words and language can take place implicitly or explicitly. As explained by Dulany, et al. (1984), Ellis (1994), Reber (1976) and Winter and Reber (1994), implicit learning takes place naturally, simply and without conscious operations, while explicitly, learning takes place consciously as individuals test hypotheses in a search for structure. There are advantages to both methods of learning, but a great deal of research (Berry & Broadbent, 1988; Dulany et al., 1984; Mathews et al., 1989; Reber, 1976; Stanley et al., 1988) found that implicit learning which takes place naturally is a more advantageous method of learning.

Once information has been learned it can be exhibited either implicitly or explicitly. Implicit knowledge refers to acquired knowledge which is not accessible to consciousness and cannot be verbally reported, while explicit knowledge refers to acquired knowledge which is accessible to consciousness and can be verbally articulated (Berry & Broadbent, 1988).

There is a trend in the literature to dissociate implicit learning and explicit knowledge (Berry & Broadbent, 1984; Broadbent et al., 1986; Lewicki, 1986; Lewicki et al, 1987; Mathews et al., 1988; Sanderson, 1989; Stanley et al., 1989). Generally, this means that knowledge which has been acquired through implicit functions, is not available to consciousness and subsequently, cannot be articulated. The existence of this dissociation has raised many questions. Does this dissociation definitely exist? If so, why does it exist? What are the theoretical and educational implication? In the case of this research, how does this dissociation effect learning disabled students?

Recently, research has examined this dissociation and found that it may not be definite. There are reasons for the existence of a dissociation and with remediation the dissociation may be decreased. Berry and Broadbent (1988), Reber et al. (1980) and Reber (1967) discuss a term called "salience". Salience refers to the obvious nature of the variables which must be examined within a problem or situation. A problem containing many variables may be non-salient, meaning that the critical variables are not obvious to the learner. This may make the learned knowledge difficult to verbalize. A second problem includes the cognitive maturity or development of the student. As individuals become cognitively mature, they become experts in certain academic domains. As this occurs, individuals become able to control higher functions and therefore become able to verbalize the knowledge they have acquired (Berry, 1994; Lewicki, 1988; Sharwood-Smith, 1994; Stanley et al., 1989). McGeorge and Burton (1989) examine the development of mental models which students acquire. Mental

models of specific knowledge occur after individuals have experienced information a great deal. Once a mental model exists, individuals are more able to verbalize the knowledge they have acquired. A final reason discussed is errors in previous methodologies (Berry & Broadbent, 1984; Mathews et al., 1989; Palincsar & Brown, 1984; Stanley et al., 1989). It is suggested that interaction with another person is an advantageous method to measure explicit knowledge. Taking the above mentioned issues into account, the dissociation between implicit learning and explicit knowledge is questionable. Continued research in this area is needed.

Metacognition can be defined as our knowledge about what we know (Metcalfe & Shimamura, 1994; Forrest-Pressley et al., 1985; Wong, 1991). Metacognition is a developmental process which is fostered by instruction. As children become familiar with their own cognitive ability, educators further academic growth through giving metacognitive instruction. Research has pointed out a lack of this type of instruction with the learning disabled population (Means & Knapp, 1991; Stanovich, 1986; Wong, 1986). Although learning disabled students may have a cognitive deficit in specific academic areas, metacognitive instruction may prove to be helpful in increasing unaffected areas as well as increasing self concept. Role reversed teaching is one such activity which will be examined within this research.

When combined, this literature suggests that the relationship between implicit learning and conscious explicit knowledge in the acquisition of a phonics rule may be characterized in terms of the following model;

1. Initial letter/sound correspondences may be encoded at an implicit unconscious level during word recognition (Van Orden, Pennington & Stone, 1990).

2. The implicit learning of a letter-sound correspondence can result in rule like transfer in word recognition (Van Orden, Pennington & Stone, 1990).

3. Phonological awareness may be necessary for the spontaneous perception of the letter-sound relationships in words (Dickson et al., 1993).

4. Conscious explicit awareness of the letter-sound relationships in words may emerge after implicit rule acquisition (Berry, 1994; Smith, 1994; Stanley et al., 1989).

5. This conscious awareness will be the result of the learners attempt to construct a model of the underlying implicit processing rule and this model will be based on those fragments of implicit processing that are salient enough to be made conscious (Berry, 1994; Berry and Broadbent, 1988; Broadbent et al., 1986; Cantor, 1980).

6. Conscious rule descriptions will also depend on the metalinguistic language capabilities the child can bring to bear in order to describe their implicit processing rule (Karanth & Suchitra, 1993).

7. Both non learning disabled and learning disabled students should show evidence of implicit letter-sound correspondence and phonics rule acquisition in their ability to read new exemplars of the rule, however non disabled readers are expected to do better in this type of word recognition.

8. Both non learning disabled and learning disabled students should be able to make some (although not all) of their implicit learning conscious in the form of verbal descriptions, however non disabled readers are expected to do considerably better on this task.

9. The process of verbalizing (trying to construct a conscious rule model) is expected to facilitate subsequent implicit word recognition processing.

10. Learning disabled students who engage in conscious rule construction processes should show benefits relative to a learning disabled control group.

Problem Statement

There were three primary components to the present research. First, to examine the relationship between implicit and explicit knowledge. Subjects implicitly learned a task, in which they acquired a phonics rule. They were then measured to gauge how much of the knowledge they acquired had been transferred to memory. It was hypothesiaed that there would be a difference in the implicit knowledge scores of learning disabled children (LD Pos) and non learning disabled children (ND Pos). They were then given the opportunity to "teach" a naive subject how to complete the same task. In order to do this the original student had to verbalize what they have learned. It was thought that the non learning disabled group would be able to transfer more knowledge to the pseudo partner than would the learning disabled group. This would indicate that the difference between groups increased when comparing the explicit knowledge scores. If this occurs, the dissociation between implicit learning and explicit knowledge was not as great as for the non learning disabled population as it was for the learning disabled population. It was hypothesized that the dissociation would be greater for a number of reasons. First, implicit functions have been shown to be robust in the face of disorders (Winter & Reber, 1994). On the other hand, explicit functions have been shown to exhibit greater individual differences, therefore being affected by learning disabilities (Winter & Reber, 1994). Second, non learning disabled students should be more familiar with the use of a metacognitive technique and therefore will be accustomed to the cognitive processes needed to execute such a technique (Westerna & Moore, 1995).

However, the learning disabled students may not have the same degree of experience with this approach and may not be familiar with the cognitive processes needed to execute it (Westerna & Moore, 1995). Third, the non learning disabled students may have reached an advanced stage of phonological awareness, where phonics rules governing decoding become available to consciousness. Learning disabled students, on the other hand, may not have reached this stage.

The second component to this research examined the role reversed teaching of a performance task. This technique was used in the second phase of this experiment. It was defined as an exhibition of explicit knowledge, in that children will have to verbally explain the rules of a performance task that they were previously exposed to and which they learned implicitly. This role reversed technique was also defined as a metacognitive strategy. It was hypothesized that children who could verbally explain a rule of a performance task to another student would increase their score on the post test of the original implicit knowledge test (Lovett, Borden, Warren-Chaplin, Lacerenza, DeLuca & Giovinazzo, 1996; Palincsar, 1986; Rosenshine & Meister, 1994). Hence, the use of a metacognitive strategy should be beneficial learning tool for such students. This finding will also strengthen the hypothesis that the dissociation between implicit and explicit functions is not as definite as originally thought.

The third component examined metacognition and how the employment of metacognitive strategies can assist learning disabled children. More specifically, this study examined the effects of role reversed teaching techniques on the implicit learning performance scores of learning disabled children. These scores

were compared to implicit learning performance scores of learning disabled children who were not given the opportunity to experience the role reversed teaching techniques. It was hypothesized that learning disabled children (LD Pos) who are given a performance task in which they use implicit learning techniques, and after which perform a metacognitive strategy on the same task, will increase their original scores when given the original performance task for a second time (Lovett, Borden, Warren-Chaplin, Lacerenza, DeLuca & Giovinazzo, 1996; Palincsar, 1986; Rosenshine & Meister, 1994). The scores of these children (LD Pos) were compared to the scores of a group of learning disabled children (LD Neg) who were given the original performance task but not given the opportunity to employ metacognitive techniques.

These possibilities were summarized in four hypotheses;

1. It was hypothesized that there would be a dissociation between implicit and explicit learning and knowledge in the acquisition of phonics rules in both non disabled and disabled readers.

2(a). It was hypothesized that non disabled readers would show more implicit learning and more explicit knowledge (conscious awareness) of new phonics rules than disabled readers.

2(b). It was hypothesized that the difference between the performance of non disabled and disabled readers would be less in the implicit acquisition of phonics rules than in their explicit knowledge of these rules

3. It was hypothesized that explicit knowledge (conscious awareness) of implicitly learned phonics rules would emerge in terms of partial fragmented verbal

descriptions as opposed to full (all or nothing) verbal descriptions in both non disabled and disabled readers.

4. It was hypothesized that the process of attempting to teach someone else an implicitly learned phonics rule would facilitate subsequent implicit rule processing during word recognition in both non disabled and disabled readers.

CHAPTER THREE: METHODOLOGY AND PROCEDURES

Overview

The purpose of this study was to examine the relationship between implicit and explicit functions, as they pertain to phonics rule acquisition, within a sample of learning disabled and non learning disabled students. To do this I adapted a paradigm from Stanley, Mathews, Bus, and Kotler-Cope (1989). The design of this experiment was chosen in order to test implicit learning, explicit knowledge and metacognition. It was expected that implicit learning scores will be much higher than explicit knowledge scores. Although this is expected in all cases, the learning disabled group was expected to show a greater difference between implicit learning scores and explicit knowledge scores.

Sample and Population

This research was concerned with two populations. First, the research examined learning disabled students between 10 and 12 years of age. The sample included two groups of 12 learning disabled students, both male and female, from medium sized schools within urban areas of a city of southern Ontario. These students were chosen based on a match of chronological age and IQ. These students had a men chronological age of 11.8 years with a standard deviation of 0.45 and an IQ between 85 and 110. The sample of learning disabled students had amean reading score of 4.02 years with a standard deviation of 0.48.

The second population consisted of non learning disabled students. The sample included 12 non learning disabled students, also both male and female, from

medium sized schools within areas of a city of southern Ontario. This groups was matched with the learning disabled groups for age and IQ. This group had a mean chronological age of 11.25 years with a standard deviation of 0.54, and an IQ between 85 and 110. This group had a mean reading grade score of 6.16 years with a standard deviation of 1.10. This group of non learning disabled students was used as a control group when making comparisons between the learning disabled groups. This group was also comnpared to the previous groups in order to draw comparisons of implicit and explicit learning. The groups were defined as follows:

LD Pos - Twelve learning disabled students exposed to phase 1, 2, 3 and 4.

LD Neg - Twelve learning disabled students exposed to phase 1, 2 and 4.

ND Pos - Twelve non learning disabled students exposed to phase 1, 2, 3 and 4.

The Rule

Students were presented with sentences each containing one pseudoword. All pseudowords were two syllable words. Pseudowords found in this experiment conformed to either one of two phonics rules. Rule one was defined in the following manner. Each pseudoword contained an initial consonant. This consonant could be any letter in the alphabet (C, B, T, S, etc.). This was proceeded by a vowel digraph. The vowel digraph in each word was always an "ai" (C<u>ai</u>, T<u>ai</u>, S<u>ai</u>, V<u>ai</u>, etc.). The vowel digraph was proceeded by a second single consonant. Again, this consonant could be any letter in the alphabet (Cai<u>t</u>,

Saiv, Tais, etc.). This in turn was proceeded by a single vowel. In the case of rule 1, this vowel was always an "a" (Caita, Taisa, Saiva, etc.). The pseudoword was completed with a single consonant. This consonant was always an 'r' (Caitar, Taivar, Saivar, etc.). Pseudowords which conformed to rule 1, were pronounced using basic phonetic principles. However, the first digraph (ai) was pronounced as a short "ai" sound, as in the word 'said'. Thus this rule was characterized as follows: if the second vowel in the pseudoword was an "a" the first vowel digraph was pronounced as a short "ai" (said).

Rule 2 was characterized in the following manner. Again, each of these pseudowords contained an initial consonant. This consonant could be any letter in the alphabet (B, D, K, M, etc.). This was proceeded by a vowel digraph. The vowel digraph in each word was also always an "ai" (Bai, Tai, Kai, Vai, etc.). The vowel digraph was proceeded by a second consonant digraph. This consonant was a basic "ph", "sh", "th", or "ch" blend. (Caith, Saiph, Taich, Baish, etc.). This, in turn, was proceeded by a single vowel. In the case of rule 2, this vowel was always an "e" (Caiphe, Taithe, Saithe, etc.). The pseudoword was completed with a single consonant. This consonant was always an "r" (Caither, Taisher, Saipher, etc.). Pseudowords which conformed to rule 2, were also pronounced using basic phonetic principles. However, the first digraph (ai) was pronounced as a long "ai" sound, as in the word "paid". This rule can be characterized as follows: if the second vowel in the pseudoword was an "e" the first vowel digraph was pronounced as a long "ai" (paid).

All pseudowords were always found in the form of a proper name (Mr or Mrs Caisar). This was done in order to make the pseudowords as meaningful as possible. It is important to note that the children in the study had no trouble treating the pseudowords as surnames set in sentence contexts (see Appendix A).

It is also important to note that this rule was more complex than the average phonics rule. Normally, pronunciation of a vowel digraph is not conditionalized on a following suffix. However, by constructing the phonics rule so that the pronunciation of the target letters was a function of the following letters "er" or "ar", it can be argued that the rule was made more salient while at the same time, unfamiliar. This was important as it is difficult to find a phonics rule that is completely new to every student, particularly within the age group that was tested. Thus, the construction of a rule of this nature controlled as much as possible for previous learning experience with the vowel digraph "ai". Of course, it is realized that no rules such as this exist in our language. Nevertheless, it should be noted that the pronunciation of "ai" in "said" and "paid" is in fact conditionalized on the surrounding letter context.

Instrumentation

The instrument (see Appendix A) used in this study was divided into four sections. The first section of the instrument was designed as an implicit training tool. This section contained three sets of sentences. Within each set there were twelve sentences, each contained a pseudoword conforming to one of two vocabulary rules. Six sentences within the set conformed to one rule while the

other six conformed to the other. There are three sets of twelve sentences within this section. The first set was labeled "intro". This was an initial exposure set designed to be read by the researcher to the student. It was similar to all sets in that it contains twelve sentences, six containing a pseudoword conforming to one rule and six containing a pseudoword conforming to a second rule. Students then began to independently read the set labeled "trial 1". After completing this set, students continued to independently read the set labeled "trial 2". Again, after completing this students independently read "trial 3". Note that "trial 3" is the same set as the "intro" set. The sets were designed in a continuously cyclic pattern. Students continue this cycle through the sets following the trial number until they have reached criterion.

Section 2 of the instrument contained two tests of implicit knowledge. One test contained 12 sentences, each containing one pseudoword. The second test contained twelve isolated pseudowords. This was a pre test of implicit knowledge.

Section 3 of the instrument consisted of a verbalization technique which was employed by each student. Students had to verbalize the knowledge gained through the employment of section 1 of the instrument. This was done through students' manipulation of cards containing pseudowords isolated and pseudowords found in sentences.

Section 4 of the instrument consisted of two tests which were identical to the ones found in section two. One test contains 12 sentences, each containing one pseudoword. Likewise, the second test contained 12 isolated pseudowords. This was a post test of implicit knowledge.

Procedure

The experiment was divided into four phases; the implicit rule acquisition phase, the isolated implicit testing phase, the role reversed teaching phase, and the repeat implicit rule acquisition phase. Before commencing phase one of the testing, each student was administered the Woodcock Word Analysis Test and the Woodcock Work Identification Test. These tests were designed to give an accurate reading grade score for each student. This was necessary to compare implicit and explicit functions between reading age matched groups.

Testing took place within the schools usually within the resource room or the library. Each student was tested individually for approximately 1 hour.

Phase 1

In phase 1 of the experiment, LD Pos (12 learning disabled students), LD Neg (12 learning disabled students) and ND Pos (12 non learning disabled students) will all be exposed to the original implicit rule acquisition phase. Here, each group was asked to repeat 12 sentences. Each one of the sentences contained a pseudoword. The pseudoword followed one of two possible word family rules. The first syllable contained three letters, the second two always being an "ai". The first syllable of the word was always a consonant, but not always a constant. An example of this is, "Cai" or "Tai". The second syllable have either three or four letters. The second syllable may have begun with a single consonant followed by an "ar", or a consonant blend, such as "ph", followed by an "er". How the "ai", in the first syllable, was pronounced depended on which letters are contained in the

second syllable. For example, if the words is spelled "Caitar", the "ai" in the first syllable was pronounced as a short "ai", as pronounced in the word "said". On the other hand, if the word is spelled "Caipher", the "ai" in the first syllable was pronounced as a long "ai", as in the word "rain". Other examples of this included; "Taivar" versus "Taither", or "Satar" versus "Saicher". These pseudowords were placed in sentences. An example of a sentence is, "Mr. Taivar is cutting the grass", or "I saw Mrs. Saipher at the Blue Jays game". Each group began with a training phase where they were asked to repeat 12 sentences. Each sentence in this phase contained one pseudoword which coincided with one of the two rules. The researcher read each sentence, pronouncing the pseudoword correctly, after which each student repeat the sentence. This continued until all 12 sentences were read. Within this twelve sentence training phase, there were 6 sentences containing pseudowords following the "ai" and "ar" rule (Taivar), and 6 sentences following the "ai" and "ther" rule (Taipher). Each of the 12 pseudowords in this training phase had a different consonant construction, but always followed the phonics rule. At no time during this phase was the student be told the rule. They were simply asked to read the sentence and words which they heard.

Students were then asked to read sets of 12 sentences. Each trial contained 12 sentences. As in the training phase the trial contained 6 sentences following the "ai" and "ar" rule, and 6 sentences contained the "ai" and "ther" rule. The difference in this phase was that students were asked to read each sentence on their own. After reading the sentence containing the pseudoword students were given feedback on whether they have pronounced the pseudoword correctly. If the

students pronounced the word correctly, they continued on to the next sentence. On the other hand, if the students pronounced the pseudoword incorrectly, they were given the correct pronunciation, and asked to move on to the next sentence. When the students had read twelve sentences they had completed one trial. They were then asked to read sentences in trial 2, which contained 12 more sentences, which were different to sentences found in trial 1, but follow the same pseudo word rule. Students continued to read through trial 1, trial 2, trial 3, etc., until they had reached criterion. Criterion was defined as students reading through two consecutive trials pronouncing the pseudoword in 10 of the 12 sentences correctly. Again, at no time during this phase were students told the particulars of the rule. This ensured that, if learning did in fact occur, it occurred implicitly. Once the student reached criterion, the first phase was complete. Trials and errors to criterion were recorded.

Phase 2

The second phase consisted of a test of implicit knowledge. The three groups were administered two tests of implicit knowledge. The first test contained 12 sentences similar to those the students experienced during phase 1 and phase 2. The second test contained 12 pseudowords. The first test measured the implicit knowledge which each student acquired during phase 1 and 2. The second test measured whether or not the context of the sentence played a role in the implicit learning of the pseudo word.

Phase 3

The third phase involved a role reversed teaching task. This was a measure of explicit knowledge. Only LD Pos and ND Pos were involved in the role reversed teaching phase. In this phase students had to verbally explain and teach the newly acquired rule to another naive (pseudo) student. In this study, the researcher acted as the naive student. Students were given a set of 12 sentences and asked to explain how to pronounce the pseudoword found in each sentence. Each pseudoword followed the rule found in phase 1 and 2. In each case students were told to explain the rule, in their own words, to the researcher. During this phase the researcher remained consistent and unbiased with responses. In each case, the researcher responded once that the instructions given by the student were not understood and also mispronounced 6 of the 12 pseudo words. At the end of this phase the researcher once again asked the student how to pronounce the pseudo word. The students' ability to transfer the knowledge they had acquired to another student was defined as explicit knowledge. The question of interest was whether or not this knowledge would be transferred and if so how much of the knowledge would be transferred.

Role reversed teaching was also defined as a metacognitive strategy. It was also of interest to find out if this technique was a useful learning technique for learning disabled students.

Phase 4

The fourth phase consisted of all groups repeating phase 2. LD Pos, LD Neg and ND Pos were administered the original test of implicit knowledge, both

in sentences and as isolated words. The improvement in scores were of interest. Specifically, it was of interest whether or not the groups which were treated with phase 3 would increase their implicit knowledge score when given the phase 2 task for a second time. It was predicted that LD Pos and ND Pos would increase their scores on the second tests of implicit knowledge. This increase should be due to the opportunity to execute the metacognitive strategy of role reversed teaching. (for procedure worksheet see Appendix B).

Assumptions and Limitations

When examining this research, there are limitations that should be taken into account. Metacognition is a difficult concept to measure (Metcalfe & Shimaramura, 1994). It is difficult to assess how well students are using metacognitive skills. Therefore, if students in LD Pos should show an increase in their score on the implicit performance task when performing it after completing a metacognitive task, the possibility that the employment of the metacognitive strategy caused the increase in the score needs to be considered with caution. Admittedly, there are pitfalls to this assumption. In order to achieve more representative results, the employment of a metacognitive strategy would need to take place gradually over an extended period of time under controlled classroom environments. Obviously, this was not possible within time frames and financial constraints. This is an area of research that is worth consideration.

The sample employed was one of convenience. It would be nearly impossible to obtain a random sample of learning disabled students. It would also

be difficult to obtain a sample in which all social variables was controlled. The students in this study will have different social backgrounds. However, I did control for IQ and other mental disabilities which may impede performance. Within these parameters, the samples will be as similar as possible.

One also has to take into account that each child may be feeling unusual on the day of testing. Some students may be tired, while others may be fit for testing. These observations were noted, but due to time and travel constraints, these variables may be present.

CHAPTER FOUR: RESULTS

Introduction

The results of this study are presented in seven sections. The first section describes the data analysis that was used to measure similarities and differences between groups and variables. Section two describes results which point out the general differences found between the learning disabled groups, both LD Pos and LD Neg, and the non learning disabled group, ND Pos.

The third section examines findings related to phase one of the experiment. This phase was the acquisition of knowledge. Each student was asked to implicitly learn the pseudoword rules. In the fourth section findings were examined related to the phase 2 of the experiment. During this phase, students' implicit knowledge was measured. In other words, this is a measurement of the knowledge which has been learned and transferred to the students' memory. The test used in this phase is referred to as the pre test of implicit knowledge. The fifth section outlines the findings related to phase 3 of the experiment. This phase only includes LD Pos and ND Pos. During phase three, students were asked to verbalize the knowledge which they acquired during phase 1. Verbal responses were coded accordingly.

The sixth section looks at findings related to phase four of the experiment. This phase includes a post test of implicit knowledge. This test was administered to all groups to measure the effects of the verbalization phase of the experiment.

All of the results are then reviewed and related to the proposed hypotheses in the seventh and final section.

Data Analysis

To begin, the reading grade score (RGS) for each student was calculated by averaging the Woodcock Word Attack grade score and the Woodcock Word Identification grade score. Then during phase 1 of the study which was labeled the implicit acquisition phase, both the trials (TC) and errors (EC) to criterion were recorded.

After completing phase 1, students were administered a test of implicit knowledge, containing both isolated words (TIK-IS) and sentences (TIK-S). These scores were recorded and then averaged to give an implicit knowledge score (IKS). Phase 2 consisted of students in LD Pos and ND Pos verbalizing about the knowledge which they acquired during the acquisition phase. Students' verbal responses were coded according to how they responded. The phase 2 data were coded accordingly; fully stating the rule (FR) (ex. "You pronounce the 'ai' like 'paid' when there is an 'e' at the end, and when there are two consonants together (th) as the second consonant in the word".), stating that the rule consists of memorizing which word are pronounced in a particular manner (MW) (ex. "You pronounce this pseuoword in the following manner because I remember that it is like the other words".), stating that the rule consists of pseudowords rhyming to other particular pseudowords (SR) (ex. "This word is pronounced in the following manner because it just sounds like these other words".), stating that the

pseudowords are pronounced differently according to the suffix of each word (Suf) (ex. "You pronounce the 'ai' like 'paid' when there is an 'e' at that end, and you pronounce it like 'said' when there is an 'a' at the end".), and stating that each word is pronounced according to the second consonant blend of the word (CB) (ex. "You pronounce the 'ai' like 'paid' when there is a consonant blend at the end and like 'said' when there is a single consonant at the end".). These categories were scored by giving students a 1, if they responded, or 0, if they did not respond. In order to examine the degree to which students were able to verbalize about their acquired knowledge, the 'SR' and the 'MW' variables were averaged together and defined as the 'no rule' variable (NR). Likewise, the 'Suf' and the 'CB' variables were averaged together and defined as the 'part rule' variable (PR). However, the sound rhyme and memorized word variables as well as the suffix and consonant blend variables are important. Observations will be made and differences will be noted regarding each of these variables.

The students in all groups were then administered a post test of implicit knowledge, with both isolated words (PTIK-IS) and sentences (PTIK-S). These scores were averaged and recorded as post implicit knowledge scores (PIKS).

Once the data had been collected, a one way ANOVA was employed in order to compare test variables between all three groups. If a significant difference existed, the Tukey Kramer b post hoc test was used to determine exactly where the difference occurred. When examining variables between two groups, t-tests were used to determine if a significant difference between means existed. Paired t-

tests were used to measure two variables within one group. For all tests an alpha level of .05 was used.

The data collected from the verbal reports measured in phase 3 was categorical data. This type of data is often tested using non parametric or distribution-free statistical tests. This data was tested using parametric statistical tests rather than distribution-free statistical tests.

The general principle behind distribution free tests is that they make very few assumptions about the distribution of the data being measured (Howell, 1989). On the other hand, parametric tests assume that the distribution within the population being studied is normally distributed. There are advantages and disadvantages to both of these types of tests.

Distribution-free statistical test only make general assumptions about the shape of the sampled population (Howell, 1989). Therefore, these tests are not sensitive to differences in population means. This means that the hypothesis under test is not directed specifically to differences in means but only to differences in distributions between populations, and since no parameters are assumed, parametric estimation is difficult (Lordahl, 1967). Because these tests do not assume the normal distribution of the scores within the population, the variability of the scores in the population is actually ignored. Therefore, the median is the measure of central tendency rather than the mean (Lordahl, 1967). This can be a disadvantage if the mean is of interest. Another disadvantage to using distribution-free test is their low power relative to the corresponding parametric test (Maritz, 1995). These tests require more observations for the same level of power obtained

using parametric tests. Therefore with a small sample, even when the distribution assumptions are violated, the parametric tests hold an advantage (Howell, 1987).

Many researchers believe that parametric tests are remarkably unaffected by violations of distribution assumptions (Howell, 1987). Parametric tests are sufficiently robust and therefore almost always exhibit accurate results (Bradley, 1968). Because of the robust nature of parametric tests, some researchers believe that there is no need for using non parametric or distribution-free statistical tests.

This research had a relatively small sample and was concerned with the mean number of responses of verbal reports. Therefore, based on this literature, parametric test were used to measure and test the verbal reports collected in phase 3. However, this data was also measured using distribution-free statistical tests which yielded similar results. A copy of these analyses can be found in Appendix C.

General Differences

All the groups in this experiment were matched for chronological age. The mean age for LD Pos (learning disabled) was $\underline{M}$=11.25 (0.45), for LD Neg (learning disabled) $\underline{M}$=11.14 (0.45), and for ND Pos (non learning disabled) $\underline{M}$=11.25 (0.54). An ANOVA revealed that there was no significant difference between groups, $\underline{F}(1,33)=2.67$, $\underline{p}=.894$. For the purpose of this research, learning disabled students were operationally defined as having a reading grade score two grades below their non learning disabled peers. In order to ensure this, each student was administered the Word Attack and Word Identification subtests of the

Woodcock Mastery Test of Reading Ability. The Word Attack subtest is a test of phonetic decoding ability. The Word Identification subtest is a test of sight word recognition as well as a test of phonetic decoding ability. Two tests were administered in order to ensure that both phonetic decoding and sight word reading processes were accounted for when measuring reading ability. Reading ability is an independent variable within this experiment. A single reading grade score variable would enable reading level to be examined as a single entity. A within group paired samples t-test indicated no significant difference between Word Attack scores and Word Identification scores, LD Pos $t(1,11)= 0.0277$, $p>.05$; LD Neg $t(1,11)= 0.1018$, $p>.05$; ND Pos, $t(1,11)= 1.9234$, $p>.05$. Therefore, the Word Attack and Word Identification scores were averaged together to create a Reading Grade Score variable. The Word Attack and Word Identification scores were recorded individually but were then averaged in order to indicate a reading grade score for each student. Means and standard deviations for all three variables within each group are illustrated in Table 1.

The reading grade score differences were measured between groups. Results indicate that at a .05 alpha level a significant difference was found between groups, $F(1,33)=36.61$, $p=.000$. A Tukey b Post Hoc analysis indicated that the difference occurred between the non learning disabled group and both learning disabled groups. These differences are illustrated in Figure 1.

Table 1.

Word Attack, Word Identification and Reading Grade means (M) and standard deviations (SD).

	Word Attack		*Word Identification*		*Reading Grade*	
	M	*SD*	*M*	*SD*	*M*	*SD*
LD Pos	4.06	0.51	4.04	0.50	4.04	0.44
LD Neg	3.99	0.33	3.92	0.35	3.98	0.34
ND Pos	7.00	1.79	5.28	0.61	6.16	1.10

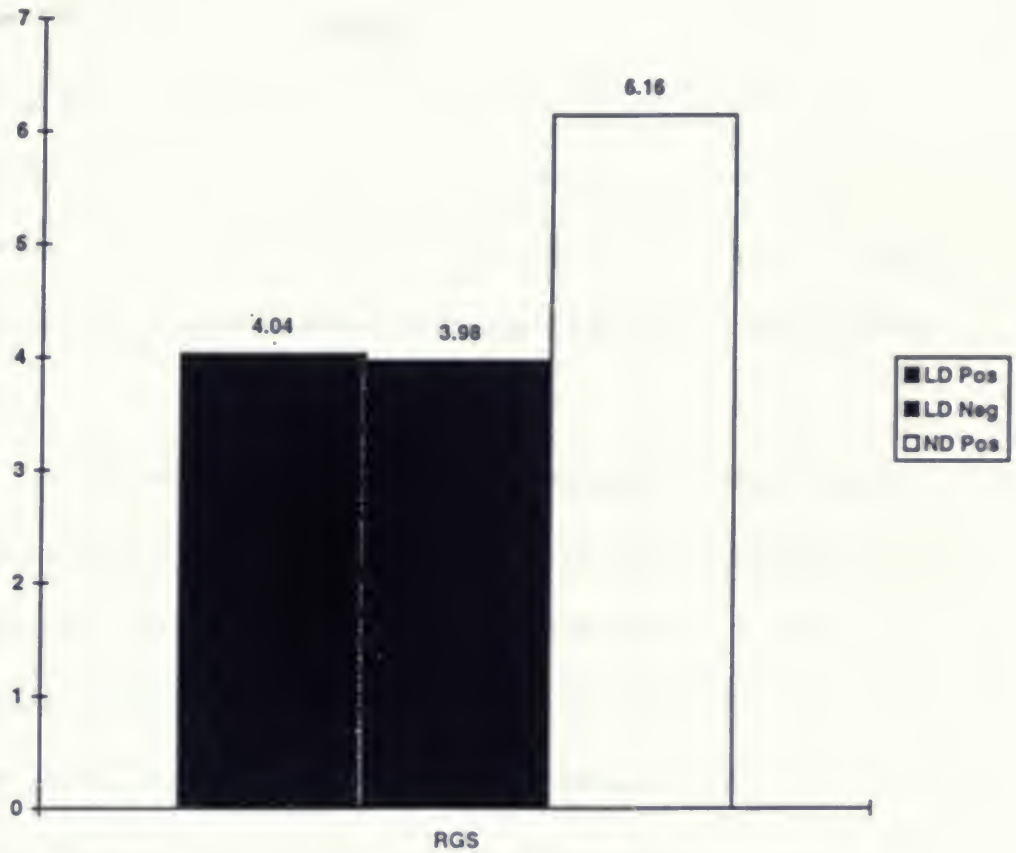

Figure 1. Reading grade score for LD Pos, LD Neg, and ND Pos.

Phase 1; Implicit learning

All groups were administered phase one of the experiment. Within this phase, students were exposed to pseudowords which had to be learned implicitly. Once this was completed, students were measured on trials to criterion and errors to criterion. Measuring trials to criterion, LD Pos had a mean of M=7.33 (1.07), LD Neg, M=7.58 (1.00), and ND Pos, M=5.75 (0.75). With an alpha level of .05, a significant difference was found between groups on trials to criterion, F(1,33)=9.55, p=.013. A Tukey b Post Hoc analysis showed that the difference occurred between the non learning disabled group and both learning disabled groups.

An analysis of errors to criterion produced similar results. Measuring errors to criterion, LD Pos had a mean of M=41.75 (7.00), in LD Neg, M=44.50 (4.62), and in ND Pos, M=30.75 (4.49). A one way ANOVA showed a significant difference between groups on errors to criterion, F(1,33)=18.17,p=.017. Similarly, a Tukey b Post Hoc analysis showed that the differences occurred between the non learning disabled group and both learning disabled groups.

Differences between groups on trials to criterion and errors to criterion are illustrated in Table 2.

Table 2.

Trials and Errors to Criterion

Group	*Trials to criterion* *Means*	*Trials to criterion* *SD*	*Errors to criterion* *Means*	*Errors to criterion* *SD*
LD - Pos	7.33	1.07	41.75	7.00
LD - Neg	7.58	1.00	44.50	4.62
ND - Pos	5.57	0.75	30.75	4.49

Phase 2; Implicit Rule Transfer

During the second phase of this experiment, students in all groups were administered a transfer test designed to assess whether or not they were using the phonics rules acquired in Phase One. This test measured the degree to which implicit knowledge, acquired in phase one, had been learned and transferred to memory. Two tests were administered, one consisting of isolated words and the other consisting of sentences (see appendix C.1). This was done in order to assess to what degree the reading of the pseudoword in the sentence was a function of sentence context cueing. Each of the tests was scored out of a possible twelve marks. A paired sample t-test showed no significant differences between both isolated word and sentence tests within each group, LD Pos, $t(1,11)= -1.1959$, $p>.01$; LD Neg, $t(1,11)= -0.1016$, $p>.01$; ND Pos, $t(1,11)= -0.0331$, $p>.01$. Therefore, the scores on both tests were collected together to give an implicit knowledge score (IKS). This score is a single variable indicating the amount of knowledge which was implicitly acquired during phase one and subsequently transferred to memory. LD Pos had a mean implicit transfer score of $M=8.25$ (1.22), LD Neg had a mean of $M=8.33$ (1.05), while ND Pos had a mean of $M=9.38$ (1.13). The implicit transfer scores are illustrated in Figure 2.

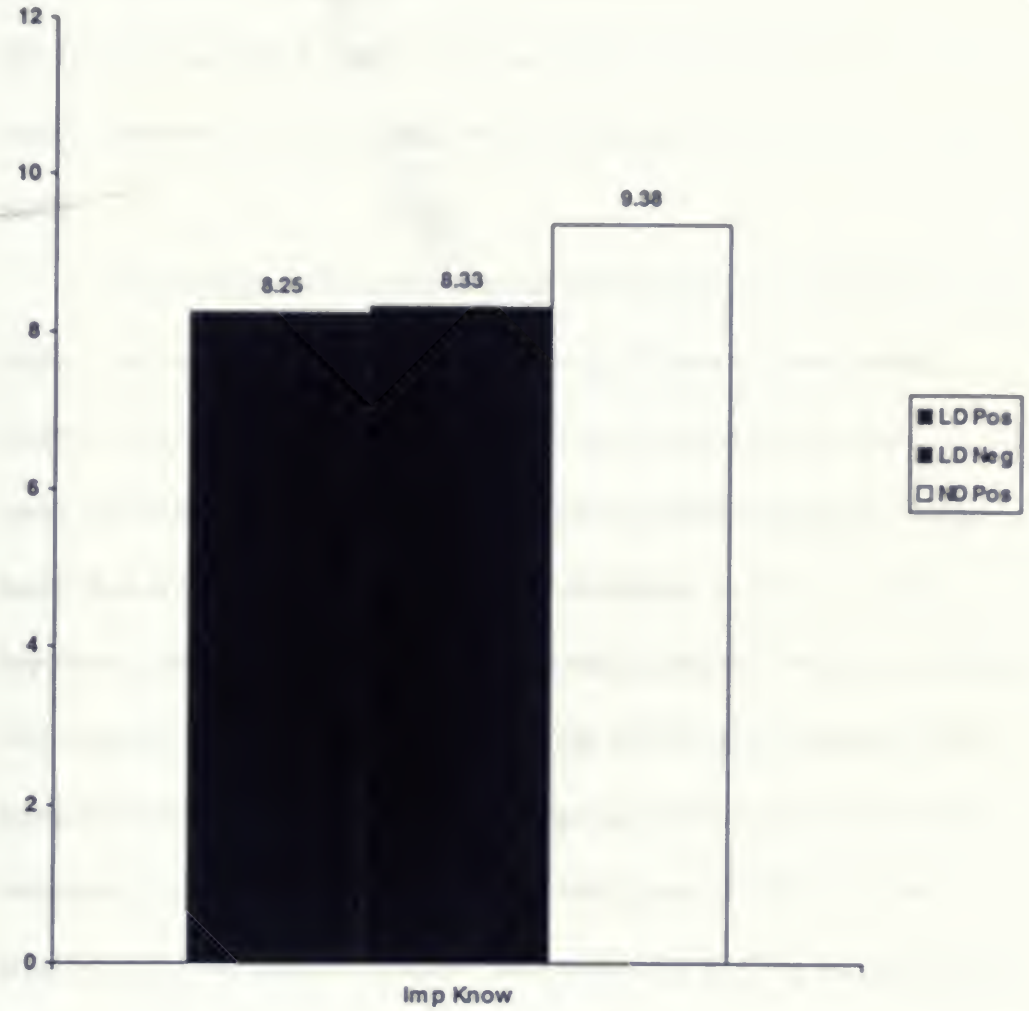

Figure 2. Implicit knowledge transfer scores for LD Pos, LD Neg and ND Pos.

Between group differences of implicit transfer was also measured. Results indicated that there was a significant difference between the three groups, $F(2,33)=3.89$, $p=.030$. A Tukey b Post hoc analysis indicated that the difference occurred between the non learning disabled group and both learning disabled groups.

The first hypothesis of this research examined the dissociation between implicit and explicit knowledge across learning disabled and non learning disabled samples. In order to test this hypothesis, test transfer data and verbalization scores were examined. This data examined implicit knowledge acquisition as well as explicit knowledge performance. In order to test this hypothesis, only two groups were needed (Learning Disabled Positive, LD Pos & Non Learning Disabled Positive, ND Pos). The LD Pos group and the ND Pos group both underwent the implicit knowledge acquisition phase as well as the verbalization phase of this experiment. The third group (LD Neg) was not involved in the verbalization phase of this experiment. LD Neg was included in this research in order to test the third hypothesis. This hypothesis examines the effectiveness of the verbalization technique which was defined as a metacognitive technique. LD Neg was excluded from the verbalization phase therefore enabling comparisons to be made between the learning disabled group using the verbalization technique (LD Pos) and the learning disabled group which did not (LD Neg). Therefore, LD Neg will not be examined again, until the effects of the verbalization technique are examined in Phase Four of the experiment.

In order to compare implicit knowledge with explicit knowledge, the implicit knowledge scores had to be converted to non parametric data. Within the verbalization phase of the experiment, responses were coded and scored either as a response (1) or a non response (0). The initial implicit knowledge scores were scored out of a possible twelve points. This data contained means ranging from 0.00 - 12.00. In order to make comparisons between implicit knowledge scores and verbal responses, the implicit knowledge scores had to be converted to non parametric data. This was done by operationally defining a pass or a fail on the implicit knowledge test. A score of 8.00-12.00 was defined as a passing score. A score of 0-7.99 was defined as a failing score. This result was recorded as a separate dichotomous variable and was scored as a pass (1) or a fail (0). This design allowed relationships between implicit knowledge and verbal responses to be examined. When scoring implicit knowledge as a pass or fail, the LD Pos group had a mean passing score of, $\underline{M}$=.667 (.22), and the ND Pos group had a mean passing score of, $\underline{M}$=.917 (.31). There was no significant difference in the passing implicit knowledge scores between the learning disabled and non learning disabled group, $\underline{F}(2,22)=1.32$, $\underline{p}$=.281. These results suggest that there is no significant difference in the ability to pass the implicit knowledge transfer test between the learning disabled and non learning disabled groups. The dichotomous variable implicit knowledge passing score values for LD Pos and ND Pos are illustrated in Figure 3.

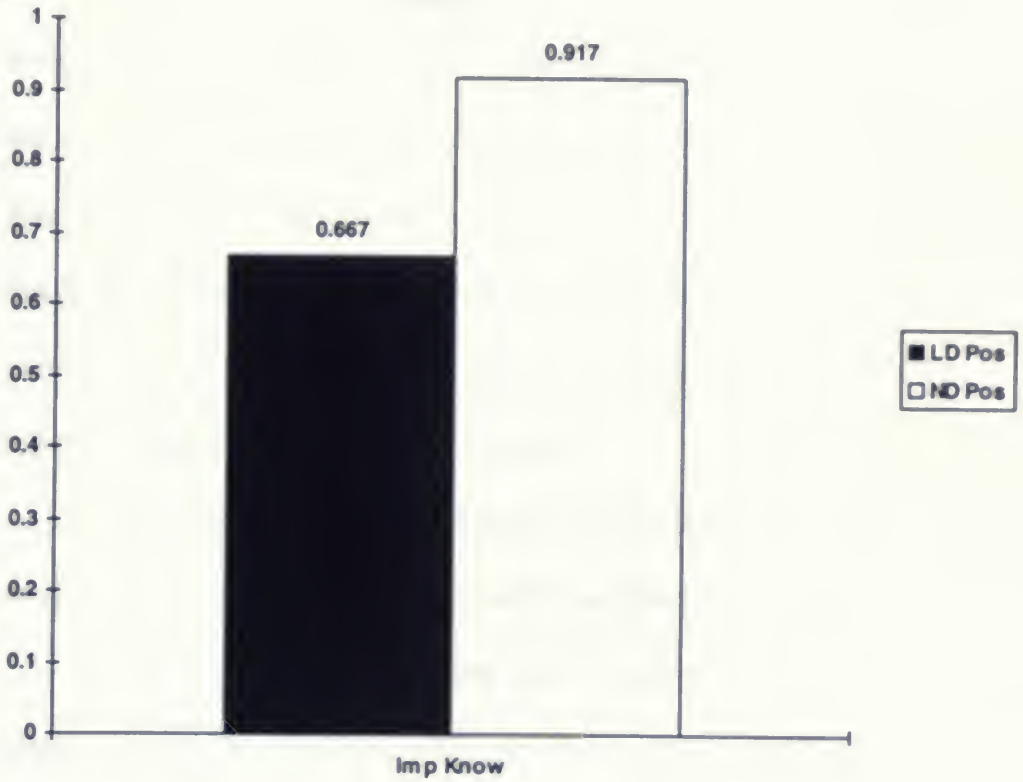

Figure 3. Implicit knowledge transfer scores for LD Pos and ND Pos.

Phase 3; Verbal reports

During phase three students in the LD Pos and the ND Pos group were asked to verbalize the knowledge which was learned in phase 1 and measured in phase 2.

As students began to verbalize, their responses were coded. These codes were then used as variables, to which a student could respond or not respond. If a student's response did not fit into a variable, a zero (0) was recorded. On the other hand, if a student's response did fit into a variable, a one (1) was recorded. This is important to note, in that a score of (0) in a particular variable does not represent a poor score, it only indicates a non response. Likewise, a score of (1) does not represent a good score, it indicates a response.

The possible responses were coded, and the differences between groups were recorded. The results of the verbalization phase are illustrated in Figure 4.

There are important qualitative differences between all of these variables. Hence, the differences within each individual response variable will be examined throughout this section. However, in order to determine the degree to which students were able to verbalize about the knowledge they acquired in phase one, a method of defining full, partial and no verbalization ability was needed. Full verbalization ability was measured independently within the full rule variable. However, it was necessary to operationally define a partial verbalization ability. This was done by combining the "suffix" and "consonant blend" variables. Although these variables are qualitatively different, they both represent a partial verbalization ability. They will be addressed separately, but will also be averaged

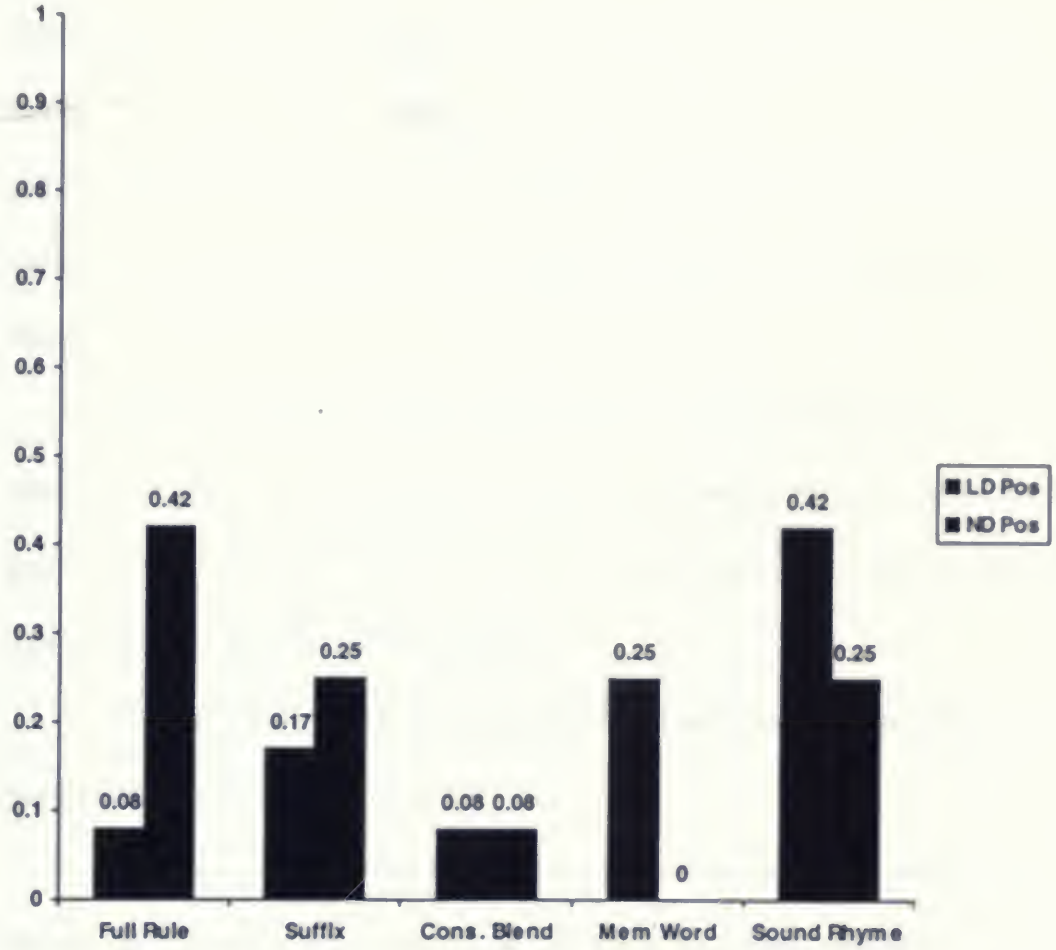

Figure 4. Verbal responses for LD Pos and ND Pos.

together and defined as a partial verbalization variable. Likewise, there was a need to operationally define a no verbalization variable. This was done by averaging the "memorized word" and "sound rhyme" variables. These variables are also qualitatively different, however, they both represent an inability to verbalize the knowledge acquired in phase one. Again, these variables will be examined individually, but will also be averaged together and defined as a no verbalization variable. The full, partial and no verbalization response scores for both groups are illustrated in Figure 5.

Between group differences were measured for each verbal response. However, equally as interesting is each group's percentages of successful implicit knowledge transfer compared with each group's percentages for verbal responses. The percentages are illustrated in Table 3.

The combined variable full rule, partial rule and no rule verbalization percentages are illustrated in Table 4.

The first possible response during this phase was the full verbalization of the rule (FR). For a response point to be warranted, the subject needed to fully state that the pseudowords differed in pronunciation in accordance to each word's suffix and with each word's consonant blend. For the full rule response, LD Pos had a mean of $\underline{M}$=0.08 (.29), and ND Pos had a mean of $\underline{M}$=0.42 (.51). Although a trend was noted, at a .05 alpha level there was no significant difference of full rule responses between groups, $t(1,22)= -1.96$, $p=.067$. Figure 6 illustrates the between group differences for full verbalization ability, compared to the between group differences for implicit knowledge scores.

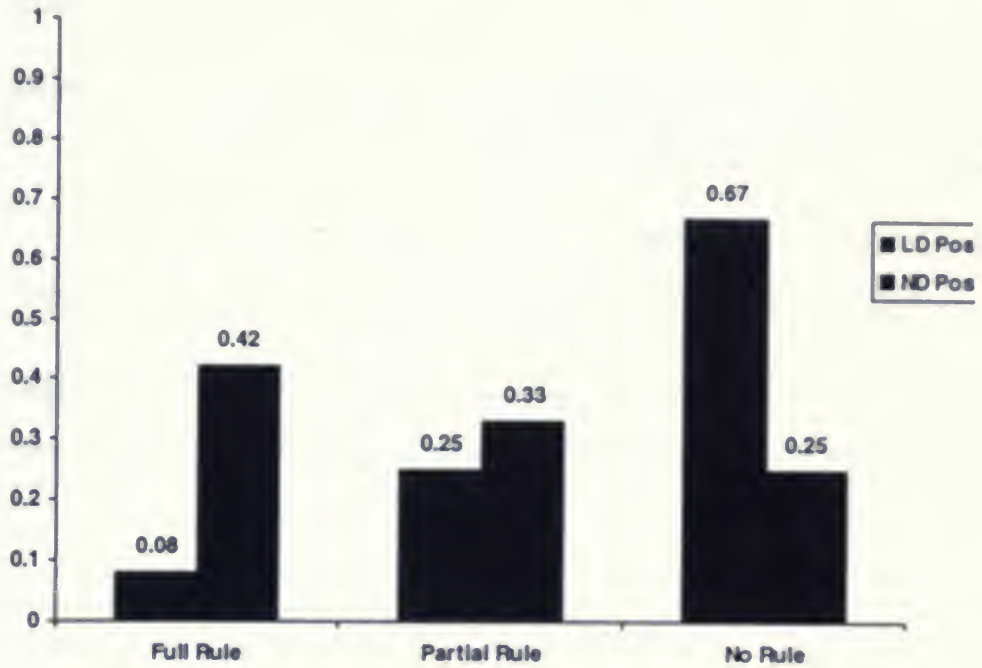

Figure 5. Combined verbal responses for LD Pos and ND Pos.

Table 3.

Percentages of implicit knowledge transfer and verbal responses

	Implicit learning	*Full Rule*	*Suffix*	*Conson. Blend*	*Mem. Word*	*Sound Rhyme*
LD Pos	66.7%	8.3%	16.6%	8.3%	25.0%	41.7%
ND Pos	91.7%	41.7%	25.0%	8.3%	0%	25.0%

Table 4.

Percentages of implicit knowledge transfer and combined verbal response scores.

	Implicit learning - %	*Full Rule - %*	*Part Rule - %*	*No Rule - %*
Learning Disabled	66.7%	8.3%	25.0%	66.7%
Non learning Disabled	91.7%	41.7%	33.3%	25.0%

The second possible response was coded as part rule verbalization (PR). As stated earlier, this variable was a combination of two verbal response variables, "suffix" and "consonant blend". Both of these responses taken separately were incomplete descriptions of the underlying vocabulary rule. For the partial rule response, LD Pos had a mean score of M=0.25 (.45) and ND Pos had a mean score of M=0.33 (.45). With an alpha level of .05 a significant difference between groups was noted, $t(1,22)= -1.87$, $p=.047$. Figure 7 illustrates the between group differences for partial verbalization ability, compared to the between group differences for implicit knowledge scores.

The third possible response was coded no rule verbalization (NR). This variable was also a combination of two response variables coded "memorized word" and "sound rhyme". Again, both of these responses taken separately were non descriptions of the underlying vocabulary rule. For the no rule verbalization response, LD Pos had a mean score of M=0.67 (.51) and ND Pos had a mean score of M=.25. With an alpha level of .05 a significant difference between groups was noted, $t(1,22)=2.16$, $p=.042$. Figure 8 illustrates the between group differences for no verbalization ability, compared to the between group differences for implicit knowledge scores.

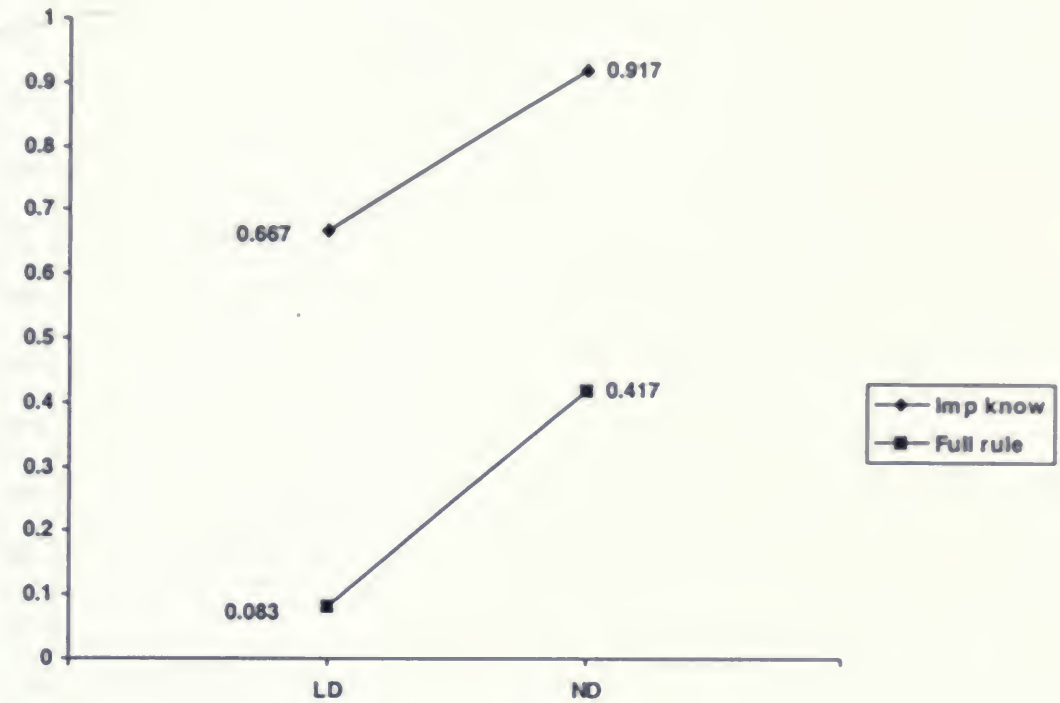

Figure 6. Implicit knowledge - Full rule by ability.

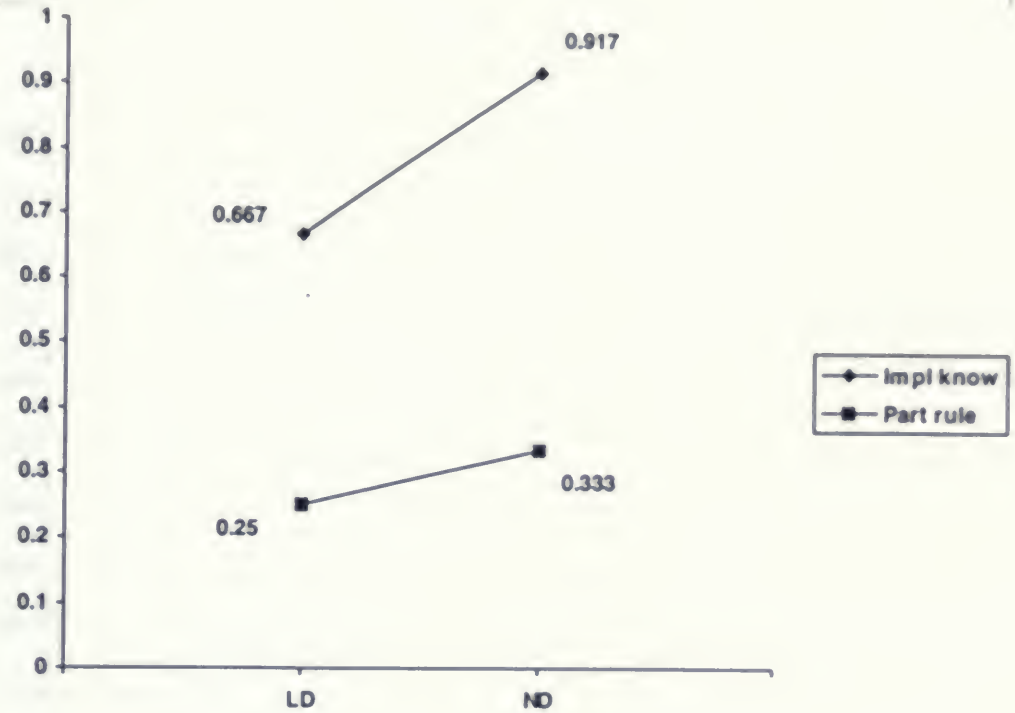

Figure 7. Implicit knowledge - Part rule by ability

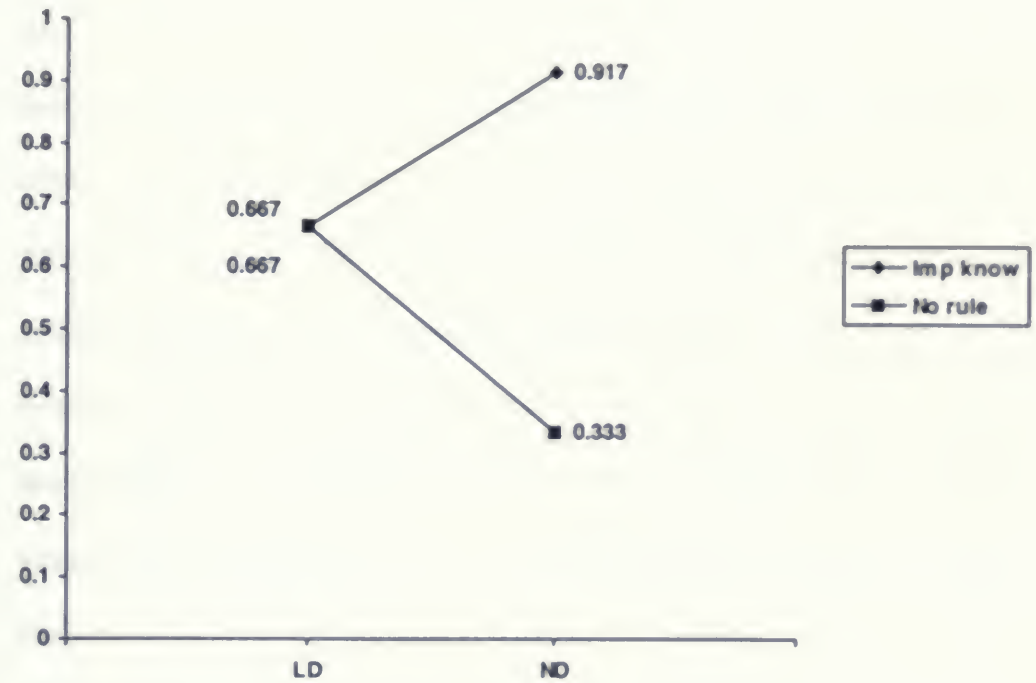

Figure 8. Implicit knowledge - No rule by ability

Within the no rule variable, there are important distinctions to be made between the memorized word and sound rhyme variables. Students stating that the words were pronounced differently because they memorized the words which are pronounced in a particular fashion, were given a response score for "memorized word". This responses indicates that students were not able to identify a particular pattern in the pseudowords and therefore felt the only way to learn the underlying rule was to memorize it. This is a definite indicator that these students had no explicit knowledge of the rule. However, students stating that the words are pronounced differently because they sound similar to another word, are employing a different cognitive process. Sound rhyme is a process which many researchers believe to be the beginning stage of phonetic awareness. The students employing this technique are exhibiting are primary element to phonetic decoding. Although sound rhyme is considered a non verbalization ability, it is important to make distinctions between this variable and the memorized word variables. In fact, when examining the individual variables, some interesting results occur. 80% of the learning disabled students whose responses fit into the "sound rhyme" variable also passed the implicit knowledge transfer test. Only 33.3% of the learning disabled students whose responses fit into the "memorized word" variable also passed the implicit knowledge transfer test. When examining the non learning disabled sample, no students responded according to the "memorized word" variable. Sixty-six point seven percent of the students whose response fit into the "sound rhyme" variable also passed the implicit knowledge transfer test.

The results of this section suggest two important findings. First, when examining learning disabled and non learning disabled students, there appears to be a greater difference in explicit knowledge capability than implicit knowledge capability. When examining the passing implicit knowledge transfer test scores, there was no significant difference between the LD Pos and ND Pos groups. Also, there were no between group differences with the full verbalization ability responses. However, there are significant differences between groups on both the part rule and no rule variables. These results suggest that when examining these two groups there is a greater difference between partial and no verbalization ability, than there is with implicit knowledge capability.

Second, these findings suggest that there is evidence of some dissociation between implicit and explicit knowledge. Only 41.7% of non learning disabled students and only 8.3% of learning disabled students were able to verbalize the full pronunciation rule. The observation is strengthened by the fact that 66.7% of learning disabled students could not verbalize the pronunciation rule and only 25% of these students could verbalize part of the rule. However, this dissociation is not definite. Thirty-three percent of non learning disabled students were able to verbalize part of the rule and only 25% of these students were not able to verbalize the pronunciation rule. Furthermore, the examination of the individual variables within the partial rule variable present some interesting findings. 16.6% of learning disabled students were able to verbalize about the second suffix governing the vowel digraph. This percentage drops to 8.3 when measuring students successfully verbalizing about the consonant blend governing the

pronunciation of the vowel digraph. Although percentages were higher, non learning disabled students show a similar trend. 25% were able to verbalize about the suffix variable, while 8.3% were able to verbalize about the consonant blend variable. These findings suggest that it was easier for students to understand the governing nature of the suffix than it was for them to understand the governing nature of the consonant blend. It is hypothesized that this occurs because the suffix variable may have been more salient and therefore easier to understand. It is also suggested that conscious explicit capacities may be developmental in nature. At least some students were successful in verbalizing about less salient variables. Perhaps as students became more experienced with this type of task they would begin to develop explicit capabilities about these less salient variables. This could be further generalized by suggesting that these skills may continue to develop until full explicit knowledge was achieved. In any case, all students, both learning disabled and non learning disabled showed different levels of partial verbalization ability. This finding supports the suggestion that students may develop levels of partial explicit capability and furthermore, may continue to develop full explicit capability.

Phase 4; Posttest of Implicit Knowledge

The fourth phase of the experiment was a posttest of implicit knowledge. This test was administered to all three groups including LD Neg. This test was administered in order to test the hypothesis that the use of the verbalization technique would improve implicit knowledge scores. This test was a repetition of the test administered in phase 2. Again, two tests were administered, one consisting of isolated words and the other consisting of sentences. This was also done in order to assess to what degree the reading of the pseudoword in the sentence was a functions of sentence context cueing. For all three groups , no significant differences were found between groups, LD Pos, $t(1,11)= -).2243$, $p>.05$; LD Neg, $t(1,11)= -).1387$, $p>.05$; ND Pos, $t(1,11)= -0.0363$, $p>.05$. Therefore, these test scores were averaged together to give a single post score of implicit knowledge. Although LD Neg did not participate in the verbalization phase, the group was administered the implicit knowledge test for a second time in order to control for number of test exposures confounding the data. On the post test of implicit knowledge LD Pos had a mean score of M=8.79 (1.30), LD Neg had a mean score of M=8.42(.90), and ND Pos had a mean score of M=9.67 (1.13).

During phase 2 of this experiment a pretest of implicit knowledge was administered. In order to compare pre and posttest scores, the original pretest scores were used, as parametric data is preferable when making pre-post statistical comparisons. Table 5 illustrates the pre and posttest results.

Table 5.

Pre and post test results of implicit knowledge scores

	Pre Test		*Post Test*	
	Means	*SD*	*Means*	*SD*
LD Pos	8.25	1.22	8.79	1.30
LD Neg	8.33	1.03	8.42	0.90
ND Pos	9.38	1.05	9.67	1.13

When examining the pretest of implicit knowledge, a significant difference was found between all three groups, $F(1,33)=3.89$, $p=.030$. A Tukey b Post hoc analysis showed differences occurring between the non learning disabled group and both learning disabled groups. An analysis of the posttest results also indicate a significant difference between groups, $F(1,33)=3.89$, $p=.030$. However, a Tukey b Post hoc analysis indicates that the difference only occurs between the non learning disabled group and the learning disabled group which did not participate in the verbalization phase of the experiment. Hence, after the completion of the verbalization phase of the experiment, there is no longer a significant difference between the non learning disabled group and the learning disabled group which did execute this phase. These results suggest that the use of a verbalization technique, not only increased the implicit knowledge scores of the learning disabled group, but did so to such an extent that there was no longer a significant difference between this learning disabled group and the non learning disabled group. A further examination of the pre and posttest scores indicates that the learning disabled group which took part in the verbalization phase showed a 4.50% increase in score, while the learning disabled group which did not participate in this phase showed only a 0.75% increase, and the non learning disabled group showed a 2.42% increase. Pre and posttest increases and differences are illustrated in Figure 9.

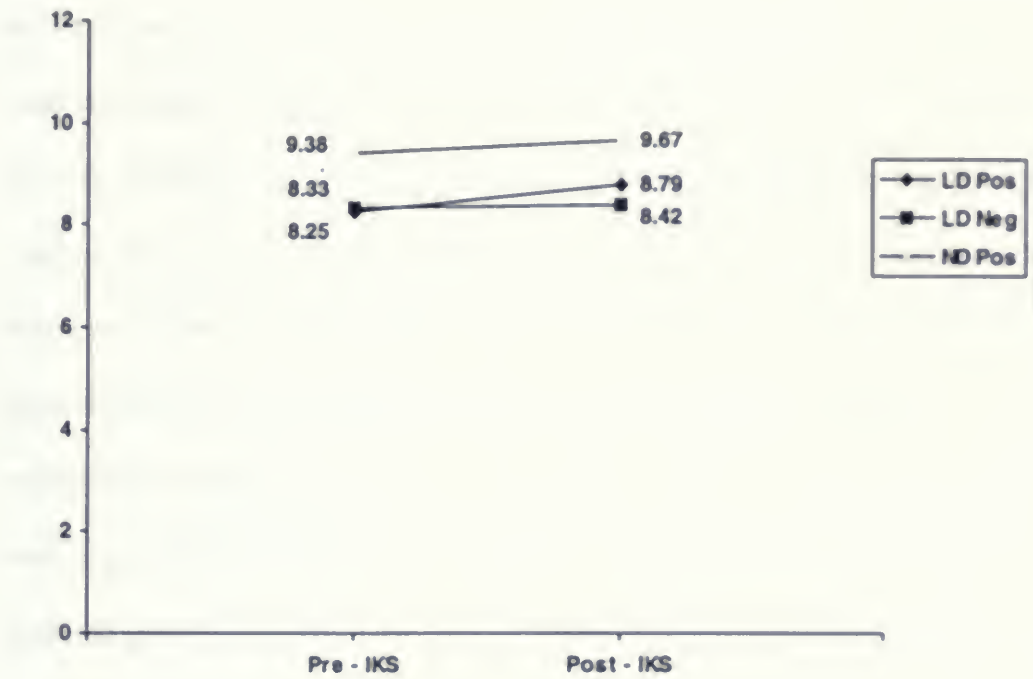

Figure 9. Implicit knowledge scores - Pre and posttest.

The effectiveness of the use of the verbalization task is also illustrated when measuring within group differences. Within group differences for pre and post implicit knowledge test scores indicate that at a .05 alpha level, a significant difference was found between pre and post test scores for LD Pos, $t(1,11) = -3.46$, $p=.005$. It is important to understand that this learning disabled group was involved in the verbalization phase of the experiment. In comparison, there was no significant difference between pre and posttest scores for either LD Neg, the learning disabled group not involved in the verbalization phase, $t(1,11) = -0.34$, $p=.740$, or ND Pos, $t(1,11) = -1.47$, $p=.171$. The learning disabled group which did participate in the verbalization phase showed significant difference in pre and post test scores. However, there were no significant differences found between pre and posttest scores for the learning disabled group which did not execute the verbalization phase of the experiment. Perhaps even more interesting is that there was no significant difference in pre and posttest scores for the non learning disabled group even though they did participate in the verbalization phase.

Summary

The three groups were matched for chronological age. There was a significant difference of reading ability between the non learning disabled group and both of the learning disabled groups. During the acquisition phase both trials and errors to criterion were measured. There was a significant difference between groups on both of these measures. Again, the differences occurred between the learning disabled group and both learning disabled groups.

Each group was then administered tests of implicit knowledge. This was done to measure how much information was implicitly learned and transferred to memory. There was evidence of learning and transfer in each of the three groups. This suggests that both learning disabled and non learning disabled students had some cognitive capacity to implicitly learn. In fact, when measuring the dichotomous variable scores, there was no significant difference in implicit learning between the learning disabled and non learning disabled group which executed the verbalization phase.

A between group difference was found when examining explicit functions. Verbal reports were coded and scored as responses. The between group differences and similarities for the full rule, partial rule and no rule variables were measured. The was no significant difference found between groups for the full rule variable. However, significant differences were noted between groups on both the partial rule and no rule variables. Although there were no between group implicit knowledge differences, significant differences did appear as each of these groups began to verbalize their implicitly acquired knowledge. This suggests that learning disabled students, when compared to non learning disabled students show, greater difference between explicit knowledge capability than between implicit knowledge capability.

Only one of the learning disabled groups was chosen to execute the verbalization phase of the experiment. This was done to compare this group with the learning disabled group which did not execute this phase. Each of the three groups were administered a pre and posttest of implicit knowledge. It was

hypothesized that the use of the verbalization technique would significantly increase the implicit knowledge score for the learning disabled group which had the opportunity to execute the technique. The role reversed teaching technique used in this phase was a method of verbalizing the implicit knowledge acquired in phase one. This technique was also defined as metacognitive. Before students started the verbalization phase, there was a significant difference between all three groups on the continuous variable pretest of implicit knowledge. The difference occurred between the non learning disabled group and both of the learning disabled groups. Results of the post test suggest that the difference still occurred, although it did not include the difference between the non learning disabled group and the learning disabled group which executed the verbalizing technique. In other words, after using the verbalizing technique, the learning disabled group was no longer significantly different from the non learning disabled group on the implicit measure of rule learning.

Within group difference between pre and post implicit knowledge test scores were also measured and a significant difference was found between scores within the learning disabled group which did execute the technique. However, no significant difference was found between scores within the learning disabled group which did not execute the technique. These results also suggest that the use of such a technique may be a useful learning technique within the learning disabled population.

CHAPTER FIVE: SUMMARY, CONCLUSIONS AND IMPLICATIONS

Summary

The acquisition of reading vocabulary is an essential building block in a child's academic career. It is important for educators to understand how children acquire new reading words. It is equally important for educators to understand if learning disabled children engage in different acquisition processes. The purpose of this research was to examine how children, both learning disabled and non learning disabled, acquire and verbalize pseudo word phonic rules. It was expected that all students would exhibit some amount of implicit learning. It was also expected that all students would be able to transfer some of this implicitly acquired knowledge to memory. However, it was also expected that learning disabled students would have less ability to verbalize about the knowledge which they had acquired. Such a result would indicate more of a dissociation between implicit knowledge and explicit knowledge within the learning disabled sample. It was expected that this dissociation would not be as great for the non learning disabled students.

Verbalizing the phonics rule was defined as a metacognitive technique. It was expected that the use of this technique would benefit all students but particularly the learning disabled students. This would be apparent in the implicit knowledge posttest scores.

A great deal of research points out a dissociation between implicit and explicit learning and knowledge (Berry & Broadbent, 1984; Broadbent et al., 1986; Lewicki, 1986; Lewicki et al., 1988; Mathews et al., 1988; Sanderson, 1989; Stanley et al., 1989). Although some dissociation was expected, it was questioned whether it would be absolute. It was expected that some of the students would be able to at least partially verbalize their implicitly acquired knowledge. This partial awareness would discredit the existence of such an absolute dissociation.

The remainder of this chapter will be sorted into sections according to the findings of Chapter 4. Findings of general difference will be examined, each hypothesis will be examined, and both theoretical and educational implication will be addressed.

Conclusions

Phonics Rule Awareness

Very little research has been done on the role of consciousness in the acquisition of phonic rules. Within this study both learning disabled and non learning disabled students were exposed to two types of pseudowords conforming to one of two phonics rules. Proceeding the implicit acquisition phase both groups were administered a test of implicit knowledge. Both groups had an average passing score greater than 60%. This result indicates that both groups had acquired the phonics rule in some implicit sense. Students were able to learn to decode the pseudowords. The majority of students were also able to pass the

transfer test which meant that they had some implicit knowledge of the underlying rules governing the pseudowords. However, only 8% of learning disabled students and only 42% of non learning disabled students had a full conscious awareness of these rules. This suggests that most of the knowledge the students acquired was implicit. A great deal of psychological research has point out a dissociation between conscious and unconscious functions. However, reading research has not ventured into this area. Results of this study suggest that neither the learning disabled group nor the non learning disabled group had a full conscious phonological awareness of the governing phonics rule. The non learning disabled students were at a Grade 6 reading level and, 42% of these students had full conscious awareness of the rule, while 33% had a partial conscious awareness of the rule. This meant that at least 75% of these students were able to at least partially verbalize about the phonics rules. It is possible that as these students continue to increase in their processing fluency and automaticity, they would progress to a stage where the underlying rules governing words would become fully conscious. This possibility could result in the belief that conscious awareness of phonics rules is the same thing as the underlying processing.

It is important to note that the results show that 91% of non learning disabled students had a passing implicit knowledge score. This suggests that almost all of these students had implicit knowledge of the governing phonics rule. On the other hand, the learning disabled students are not as advanced in terms of their conscious awareness of these rules. Again, it could be hypothesized that

these students had not advanced in their learning to a point where phonics rules such as this were available to consciousness.

Results of this study suggest that there may be a point in learning where knowledge about underlying rules becomes conscious. Results also indicate that before this conscious state occurs, students have an unconscious awareness of these types of rules.

Implicit Knowledge

All groups were exposed to phase one of the experiment where students had to implicitly learn the two phonics rules. Students were required to read the pseudo words until they had achieved criterion. They were then measured on how many trials it took to reach criterion, and how many errors they made within each trial. A significant difference was found between learning disabled and non learning disabled groups on both trials and errors to criterion. These results suggest that non learning disabled students showed a quicker rate of implicitly learning. However, these results did not indicate that learning disabled lack the capacity to learning in this mode. In fact, the learning disabled groups did reach criterion soon after the non learning disabled group. There was not one case in which a learning disabled student did not reach criterion.

After the acquisition phase, students were tested to measure how much of the knowledge presented during the acquisition phase could be transferred to memory. At least 65% of all students, both learning disabled and non learning disabled, had a passing score on the implicit transfer test. Furthermore, there was no significant differences found between groups on implicit knowledge scores.

Therefore, although there is a difference in the rate in which learning disabled and non learning disabled students implicitly acquire knowledge, both groups are successful in acquisition. These results are in accordance with the findings of Winter and Reber (1994) who made three assumptions about implicit functions. First, implicit systems should be robust in the face of disorders and dysfunctions that compromise explicit cognitive systems. Second, implicit cognitive functions should show fewer effects of age and developmental level than explicit cognitive functions. Third, measures of implicit functions should show less individual to individual variability than corresponding measures of explicit functions.

All groups were then tested on their implicit acquisition of knowledge. It was found that both learning disabled and non learning disabled groups could transfer some of their implicitly acquired knowledge to memory. In fact, there was no significant difference between learning disabled and non learning disabled groups. Both learning disabled and non learning disabled were able to transfer some of their acquired knowledge to memory. These results suggest that implicit cognitive functions show few effects of ability and show little individual difference.

Explicit Knowledge

Students exposed to the verbalization phase of the experiment were measured on their ability to verbalize the knowledge implicitly acquired in phase 1. There was no significant difference between learning disabled and non learning disabled groups on the ability to fully verbalize the rule. Only 41.7% of non learning disabled students and only 8.3% of learning disabled students could fully

verbalize the pseudo rules. These results suggest that neither group had full explicit knowledge of the pseudo vocabulary rule. Therefore, there is some evidence that a dissociation between implicit and explicit knowledge does exist. Although over 60% of all students had implicit knowledge of the pseudo rules, less than 42% of all students had full explicit knowledge of the rules.

However, this dissociation is not definite. Verbalization scores suggest that many students could partially verbalize the implicitly acquired knowledge. Thirty-three percent of non learning disabled students were able to partially verbalize the pseudo rules. Therefore, over 75% of these students were able to verbalize at least some of the phonics rule. These results suggest that many students had some explicit knowledge of the rules. Therefore, the dissociation is not as definite as previously thought. However, there was a significant difference between groups on these scores. Few learning disabled students were able to partially verbalize the rules. Only 25% of these students had partial explicit knowledge. These results suggest learning disabled students exhibited a larger dissociation between implicit and explicit functions. Partial verbalization scores lend strength to the hypothesis that, when comparing learning disabled and non learning disabled students, the learning disabled students show a stronger dissociation between implicit and explicit functions.

The dissociation for learning disabled students is strengthened when examining the no verbalization scores. Sixty-six point seven percent of the learning disabled students could not verbalize any of the phonics rules. Only 25.0% of the non learning disabled students fell into this category. A significant

difference between groups was found when measuring no verbalization scores. Although the majority of non learning disabled students could at least partially verbalize implicitly learned knowledge, less than 34% of learning disabled students could verbalize any of the rule. Therefore, these results suggest that learning disabled students show a stronger dissociation between implicit and explicit functions.

Implicit Versus Explicit Knowledge

Both the learning disabled students and the non learning disabled students who executed the verbalization phase were moderately successful in acquiring implicit knowledge. Approximately 60% of learning disabled students successfully acquired knowledge implicitly. Over 80% of non learning disabled students were successful in this acquisition. When comparing both groups there was no significant difference on passing implicit knowledge scores. However, a significant difference did occur when examining explicit knowledge scores. 41.7% of non learning disabled students could fully verbalize the rule, and 33% could partially verbalize the rule. Only 8.3% of learning disabled students could fully verbalize the rule, and only 25% could partially verbalize the rule. Furthermore, 66.7% of the learning disabled students could not verbalize the rule, while only 25% of the non learning disabled students were in this category. These results are in accordance with the hypothesis stating that when examining learning disabled and non learning disabled students, there will be a greater difference between explicit knowledge scores than between implicit knowledge scores.

Metacognition

All three groups were given a pre test of implicit knowledge in order to measure how much acquired knowledge could be transferred to memory. All groups did well on the pre test of implicit knowledge. Although there was a significant difference between the three groups. The difference occurred between the non learning disabled group and both of the learning disabled groups. Results indicate that the mean scores on the pretest were almost identical for both learning disabled groups (8.25, 8.33), while the scores were significantly higher for the non learning disabled group (9.38).

Two of the three groups were then exposed to the verbalization phase of the experiment. In this phase students used a role reversed teaching technique in order to verbalize their implicitly acquired knowledge. Only one learning disabled group was given the opportunity to use this technique. This was done in order to compare the learning disabled group which used the technique to the other which did not. This activity was defined as a metacognitive technique, because in order to execute such a technique, students had to experience a particular set of cognitive activities and gradually come to perform these functions by themselves. This activity has two major features. The first is instruction and practice of strategies including self question generating, prediction and clarification. The second consists of the use of the role reversed teaching dialogue as a vehicle for both verbalizing and consolidating knowledge. It was expected that the use of this technique would increase scores on a posttest of implicit knowledge.

All three groups were administered the posttest of implicit knowledge. The second learning disabled groups was administered the posttest although these students did not participate in the verbalization phase. This was done in order to eliminate the bias that would be created through number of test exposures. Hence, the number of test exposures was constant for each group. Results indicate that the execution of the role reversed teaching technique increased posttest scores. The learning disabled group not participating in the verbalization phase had an increase of 0.75%. However, the non learning disabled group executing the verbalization phase had an increase of 4.50%. This increase was significantly different to the increase of the learning disabled group not executing the verbalization phase. The non learning disabled group which participated in the verbalization phase had an increase of 2.42%.

Results indicate that a significant difference still occurs between groups on the post test of implicit knowledge but the difference only occurs between the non learning disabled group and the learning disabled group not executing the verbalization phase. There was no longer a difference between the non learning disabled group and the learning disabled group which executed the verbalization phase. These results suggest that the use of this technique, not only increased the implicit knowledge scores of the learning disabled group, but did so to such an extent that there was no longer a significant difference between this learning disabled group and the non learning disabled group. Furthermore, the non learning disabled group which did execute the verbalization phase, did not benefit as much from the use of this technique as did the learning disabled group. An increase in

posttest score did occur within the non learning disabled group, but it was not as significant was the increase in score within the learning disabled group. This result is not surprising, in that research (Mean & Knapp, 1991; Wong, 1991) has shown that non learning disabled students are explicitly taught to use metacognitive techniques. Learning disabled students are not often given the opportunity to use metacognitive techniques. This does not necessarily mean that this population does not have the capacity to use such techniques (Mean & Knapp, 1991; Wong, 1991). Evidence for such a statement is illustrated in the results of this experiment. The use of such a technique had some effect on the learning disabled students' scores. The learning disabled students given the opportunity to use the role reversed teaching technique benefited to such an extent that their post test scores were no longer significantly different to the non learning disabled students.

An interesting question arises from these results. Both the learning disabled and the non learning disabled executed the verbalization phase, yet the impact of this phase was significantly greater for the learning disabled group. Why doesn't the use of this phase have such a great impact on the non learning disabled group? This question is difficult to answer. There could be many reasons for this difference, including type I or sampling error.

Metacognition has been defined as our knowledge about what we know. It includes the capacity to monitor, question, and control our own cognitive capacity. Metacognitive capacity increases developmentally. It is also a function of instruction. As pointed out in Chapter 2, metacognitive techniques are often

explicitly taught in classrooms as students become cognitively mature. This maturity is domain specific. Learning disabilities are also often domain specific. Educators may neglect learning disabled students, believing that these students lack the cognitive capacity to use metacognitive techniques. In some academic domains this may be true, yet often enough it is not.

As non learning disabled students become cognitively mature, they are explicitly taught how to use metacognitive techniques. The students benefit from the use of these techniques and eventually the execution of this type of thinking becomes automatized. As this occurs, the students begin to monitor, question and regulate their cognitive capacity when encountering all learning activities. In other words, this type of thinking becomes a regular part of a student's life. Therefore, in this experiment, the non learning disabled students would use this type of thinking from the beginning of the experiment. Through the acquisition and pre test phase, the non learning disabled students would be thinking in a metacognitive manner. This type of thinking could increase students' acquisition scores as well as their pretest implicit knowledge scores. Because the non learning disabled students have previously been taught how to use metacognitive techniques, they would employ this type of thinking during all phases of the experiment, therefore increasing their pretest scores. These students would continue to use this type of thinking during the role reversed teaching phase. The use of this technique increased their posttest scores. Yet, the student's type of thinking did not change. Hence, there would be an increase in posttest scores but

the difference between pre and posttest scores would not reflect a different type of thinking.

On the other hand, learning disabled students may not be explicitly taught to use metacognitive techniques. Therefore, monitoring, questioning, and regulating thinking would not become a part of these students' lives. This type of thinking would not be employed in this experiment and would not affect the pretest implicit knowledge scores. The use of the role reversed teaching technique would allow students to use this type of thinking, and would have a great affect on the posttest scores. The difference between pre and posttest scores would reflect a different type of thinking.

In the case of the non learning disabled students, metacognitive thinking may have affected both pre and posttest scores. In the case of the learning disabled students metacognitive thinking affected only posttest scores. Although the scores were lower for the learning disabled students, the difference between pre and posttest scores reflected a change in thinking and therefore was greater.

Theoretical Implications

Research has examined implicit and explicit learning, as well as implicit and explicit knowledge. Some of this research describes a dissociation between implicit and explicit functions (Berry and Broadbent, 1984; Broadbent, FitzGerald and Broadbent, 1986; Lewicki, 1986; Lewicki et al., 1988; Lewicki et al., 1987; Mathews et al., 1988; Sanderson, 1989; Schmidt, 1994; Stanley et al., 1989). This dissociation is usually found in a discrepancy between task performance and the

ability to verbalize what has been done. In other words, students may be successful in acquiring knowledge, but may not be conscious of what exactly they have done to acquire this knowledge.

Some research has pointed out that this dissociation may have been present because of errors in methodology (Berry, 1994; Berry and Broadbent, 1984; Ryan, 1970; Stanley et al., 1989). This study uses a methodology which has been shown to elicit a proper measure of explicit knowledge. A role reversed teaching technique allows students to verbalize their acquired knowledge to a naive partner. This has been shown to allow a representative measure of explicit knowledge (Berry and Broadbent, 1984; Mathews et al., 1989; Palincsar and Brown, 1984; Stanley et al., 1989).

One element of this research was the examination of the dissociation between implicit and explicit knowledge. Students were exposed to information and given the opportunity to implicitly learn this information. Many students were successful in doing this. Students were then measured on their explicit ability to verbalize what they had learned. Only a few students were able to fully verbalize the information. This result suggests that a dissociation does exist. However, many students were able to verbalize about part of their learned information. This suggest that the dissociation may not be absolute but rather one of degree.

Previous research on implicit and explicit functions did not focus a great deal on learning disabilities. Learning disabled students were efficient when implicitly acquiring knowledge. Results of this study concur with previous research of Winter and Reber (1994) who suggest that implicit functions should

be robust in the face of disorders and should show less individual difference. However, results of this study do suggest that learning disabled students were much less able to verbalize about their implicitly acquired knowledge. In fact, when examining this population the dissociation between implicit and explicit knowledge is strong.

This study also examined the effects of metacognition on learning disabilities. The results suggest that, although the benefits of metacognitive techniques may be limited due to domain specific deficits, learning disabled students do not necessarily lack the cognitive capacity to benefit from such techniques. Research must take into account the nature of learning disabilities. Much of the time the disabilities are domain specific. Therefore unaffected domains may be functioning at a normal level. Thus, when working with unaffected domains, learning disabled students can benefit from the use of metacognitive thinking. Further use of these techniques within the learning disabled population must be examined. The results of this study suggest that metacognitive techniques can be powerful learning tools with this population.

In order to correctly measure verbalization scores, correct methodological techniques were adapted. The choice of these techniques was based on previous research as well as reflection about the nature of explicit knowledge.

The rule that was used governed the pronunciation of two pseudowords. The variables in this rule were designed to be salient. Salience has been defined as the obvious nature of the variables needed to solve a problem or situation (Berry & Broadbent, 1988; Reber, 1967; Reber et al., 1980). In previous explicit

knowledge experiments, the variables which needed to be solved were overly complex. Here, the variables were salient enough to create a normal distribution of sample means. An experimental design containing non salient variables may create a skewed distribution of sample means, therefore creating unrepresentative verbalization scores.

Stanley et al. (1989) suggest that declarative knowledge develops after procedural knowledge. In this respect, a dissociation may be found with young, beginning learners, while more advanced learners may show less of a dissociation. In this research, the students were matched for chronological age at approximately 11 years old. The reading grade scores of the learning disabled students was approximately a Grade 4 level. The sentences, words and pseudowords were designed to be above a Grade 4 reading level. This was done in order to control for unknown words or sentences. All of the words used in this experiment were in the procedural realm of all of the students. Therefore, a true measure of declarative knowledge could be obtained.

Prior knowledge can be a useful tool when solving problems or when faced with a new situation (Stanley et al., 1989). It was difficult to control for the presence of prior knowledge within each student. Prior knowledge for solving this type of problem could have been present in some students, while absent in others. Again, I believe that the presence of the understanding of the use of prior knowledge is linked to the very nature of learning. Students explicitly taught how to control, monitor and regulate their thinking will soon come to understand the benefits of using prior knowledge to solve problems and situations. It has

previously been pointed out that learning disabled students may not be explicitly taught how to do these things. Therefore, it is likely that many learning disabled students may not appreciate the benefits of the use of prior knowledge. This is a factor that is difficult to control for and may have confounded this data.

Implicit and explicit functions are difficult concepts to examine. There are many different theoretical views on definitions, the dissociation between functions and correct methodologies. This research has taken into account these issues and has attempted to address each one. It is important for research to continue the examination of these functions. Learning disabled students need to be included in this research. These students are a comprehensive part of our classrooms and their learning abilities must be understood.

Learning disabled students need to be included in this research. These students are a comprehensive part of our classrooms and their learning abilities must be understood. This study points out some of the similarities and differences between disabled and non disabled readers. However, only a small amount of research has focused on implicit and explicit functions within this population. Hence, further examination of implicit and explicit functions within the learning disabled population is needed.

Educational Implications

Although implicit and explicit functions are difficult to examine, they are critical elements to our education systems. Students come to school everyday and are given the opportunity to learn. Learning can take place in different ways and at

different paces, and in some cases, not at all. The learning process becomes even more confounding when examining learning disabled students. Does the learning process change for these students? If so, how does it change? This research attempts to answer these questions. This section of the research is perhaps the most important, or at least the most relevant to education. I will attempt to link the findings of this research to the classroom.

During the acquisition phase of this experiment, all students were exposed to information. Students were measured on their acquisition rate and their ability to transfer this knowledge to memory. The non learning disabled students were successful in this acquisition and transfer process. More than 91% of these students were able to transfer at least two thirds of this knowledge to memory. Therefore implicit learning is a process that educators need to understand. These findings are in accordance with the finding of Mathews et al., (1989); Stanley et al., (1988); Reber, (1976); Dulany et al., (1984) and Berry and Broadbent, (1988). At times these researchers have found that implicit learning may be more successful than explicit learning. When engaged in implicit learning, students test hypotheses, become inundated by the surrounding stimuli and are more capable of detecting more subtle and complex relationships within the information. Although explicit instruction is needed in the classroom, students must be given the opportunity to engage in implicit learning as well.

The previous findings also include learning disabled students. During the acquisition phase, learning disabled students took significantly more trials to reach criterion, and made significantly more errors when reaching criterion. However,

all of these students did reach criterion. In fact, more than 65% of these students were able to transfer at least two thirds of the implicitly acquired knowledge to memory. These findings suggest that learning disabled students were successful in the implicit acquisition of knowledge. They were also successful in the transfer of this knowledge to memory. This is important for educators to understand. Learning disabled students have the capacity to succeed in this type of learning. Success of this nature can foster a healthy self esteem which is certainly important within the learning disabled population.

The results of the verbalization phase holds some interesting implications for education. Neither learning disabled nor non learning disabled students were able to fully verbalize their implicitly acquired knowledge. This means that although implicit knowledge about the phonics rules was present, it was not fully realized in the verbalization of the students. Thus, some dissociation between implicit and explicit functions exists. This means that educators must be careful when assessing knowledge attainment through conscious verbalization techniques. In other words, students may not be successful in fully verbalizing the information to which they were exposed. However, this does not necessarily mean that they were unsuccessful in learning this information.

Non learning disabled students were successful in partially verbalizing about the information they implicitly learned. This suggests that within the non learning disabled population the dissociation between implicit and explicit functions is not definite. Many students are able to partially verbalize about

information which has been implicitly acquired. Partial verbalization ability should be an indicator that knowledge acquisition may have taken place.

On the other hand, learning disabled students were not as successful in partially verbalizing about their implicitly acquired knowledge. In fact, over 65% of learning disabled students were not able to verbalize about their acquired knowledge. These results suggest that there is a stronger dissociation between implicit and explicit functions for learning disabled students. Therefore, although learning disabled students may not be able to verbalize about information, it does not necessarily follow that knowledge attainment did not take place. In some cases, the exact opposite may be true. A lack of verbalization ability may be present although knowledge acquisition has taken place. This finding holds an important educational implication. Educators must be aware that measuring knowledge acquisition by asking a student to verbalize about the knowledge may be an unrepresentative measure of the acquisition. An alternative method of measuring knowledge attainment should be considered.

The second focus of this research examined metacognition. The role reversed teaching technique was used to elicit verbalization. As previously pointed out, this technique was viewed as a proper technique to measure explicit knowledge. This technique was also defined as metacognitive. In using such a technique, students had to monitor, question and regulate their own cognitive capacity. In essence, these functions are metacognitive. The effect of the use of this strategy was measured. The non learning disabled group employed this technique during the verbalization phase. However, only one learning disabled

group was given the opportunity to use this technique. The other learning disabled group did not have the opportunity to employ the role reversed teaching technique. All three groups were then given a posttest of implicit knowledge. This test was administered in order to measure the effect of the verbalization technique. Results showed that the learning disabled group, employing the technique, improved their posttest scores. The increase was large enough that there was no longer a significant difference between the learning disabled and non learning disabled students. This suggests that the employment of this strategy was beneficial for the learning disabled students.

The specific role reversed teaching technique incorporates many elements which deserve attention. When employing this technique, students take the position of the teacher. This alone can make students feel that their input is important. They are given responsibility and this itself can foster self-confidence. Also, when employing this technique, students must test hypothesis and generate self-questions. This type of thinking is independent, therefore allowing students to recognize that their thought processes are worthwhile and important.

Concluding Statement

Results of this research suggest that implicit functions show few effects of individual difference. These functions were intact within both the learning disabled and non learning disabled samples. On the other hand, when examining explicit functions, a significant difference was found between groups. There was

evidence of a dissociation between implicit learning and explicit knowledge, but this dissociation was not absolute.

The non learning disabled sample was quite efficient in partially verbalizing the acquired information. However, the learning disabled sample was less successful in partial verbalization ability, and in fact showed a high percentage of students with no verbalization ability. Hence, when examining learning disabled and non learning disabled students, the dissociation between implicit and explicit functions is stronger for the learning disabled group.

The use of the role reversed teaching technique was beneficial for learning disabled students. After employing this technique, the learning disabled students' pre test scores dramatically increased. Hence, learning disabled children, given the opportunity to employ this metacognitive technique, increased their implicit knowledge.

In closing, the relationships between implicit and explicit functions are deserving of further research. Educators must be aware of the benefits of allowing implicit learning to take place in the classroom. However, educators must also be aware that verbal ability may not be a representative measure of this learning. This is especially true with the learning disabled population.

Although the learning disabled students were not overly successful in verbalizing implicitly acquired knowledge, the employment of this technique fostered individual thought and self confidence. The use of this metacognitive technique was beneficial to this population. Therefore explicit instruction in the

use of metacognitive techniques should be a regular occurrence for learning disabled students in our classrooms.

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Appendix A: Instrumentation

Intro, trial 3, trial 6, trial 9

Mr. Taither likes to play baseball.

Mrs. Caisher rides her bike.

I saw Mr. Saitar cutting the grass.

My teacher's name is Mrs. Baidar.

Mr. Saipher watches the Blue Jays.

There goes Mrs. Daitar.

Mr. Taither has a small dog.

Mr. Caisar drives a blue car.

I play hockey with Mrs. Baivar.

I went shopping with Mrs.Vaisher.

Mrs. Haitar likes to swim.

Mr. Paither is my friend.

Trial 1, trial 4, trial 7, trial 10

My mother's friend is Mrs. Daikar.

Mr. Caither drives a new car.

I am going to school with Mrs. Taipher.

Mr. Caitar is my coach

Mrs. Baither has a big cat.

I just saw Mr. Haitar in his house.

My dad plays cards with Mr. Caimar.

Mrs. Saither teaches me to play the piano.

Mr. Baidar has a large swimming pool.

I am friends with Mrs. Taisher.

Mrs. Kaipar is a doctor.

Mr. Jaipher is a dentist.

Trial 2, trial 5, trial 8

Mr. Baicher is the principal of my school.

I ride to school with Mrs. Naidar.

Mr. Caither works for the police.

Mrs. Maivar has a dog who bites.

My brother's coach is Mr. Taikar.

Yesterday, I saw Mrs. Taipher at the mall.

Mr. Baipher drives a red car.

Mr. Saikar plays on a basketball team.

My mother swims with Mrs. Daither.

Mr. Naivar drives our school bus.

Mr. Laisar runs very fast.

Mrs. Kaither has a black cat.

Continue through trials 1, 2, 3, etc.

Test of Implicit knowledge - isolated word

Say each word on your own

	Correct	*Incorrect*
1. Baitar		
2. Naipher		
3. Saither		
4. Caidar		
5. Taivar		
6. Maicher		
7. Caither		
8. Laikar		
9. Taipher		
10. Baidar		
11. Taither		
12. Saitar		

1. Baitar 2. Naipher 3. Saither

4. Caidar 5. Taivar 6. Maicher

7. Caither 8. Laikar 9. Taipher

10. Baidar 11. Taither 12. Saitar

Test of Implicit knowledge - sentences

say each sentence on your own

	Correct	*Incorrect*
1. Mr. Haidar likes to play football.		
2. I can see Mrs. Laipher cutting her grass.		
3. My dad is friends with Mr. Daikar.		
4. Mrs. Taither is my teacher.		
5. Mr. Maicher is a bus driver.		
6. The best player is Mrs. Caifar		
7. Mr. Taipher has a brown dog.		
8. Mrs. Daisar has a cat that bites.		
9. I like to play with Mrs. Naivar.		
10. Mr. Daisher is a hockey player.		
11. Mrs. Maivar likes to play tennis.		
12. The dog ran to Mr. Jaither.		

1. Mr. Haidar likes to play football. **2.** I can see Mrs. Laipher cutting her grass.

3. My dad is friends with Mr. Daikar. **4.** Mrs. Taither is my teacher.

5. Mr. Maicher is a bus driver. **6.** The best player is Mrs. Caifar

7. Mr. Taipher has a brown dog. **8.** Mrs. Daisar has a cat that bites.

9. I like to play with Mrs. Naivar. **10.** Mr. Daisher is a hockey player.

11. Mrs. Maivar likes to play tennis. **12.** The dog ran to Mr. Jaither.

Appendix B: Procedure Worksheet

Rule

- consonants may change in the pseudoword.
- the first vowel digraph in the word is always an 'ai'.
- the second vowel is either an 'a' or an 'education', eg. Taither or Taitar, Baicher or Baidar.
- if the second vowel is an 'a' (Taitar) the first vowel (ai) is pronounced as a short 'ai' (eg. said).
- if the second vowel is an 'e' (Taither) the first vowel (ai) is pronounced as a long 'ai' (eg. rain).
- the pseudoword is always found in the form of a proper name, eg. Mr or Mrs Caisar.

Procedure

Step 1

Subjects will listen to a set of twelve sentences which will be labeled as 'Intro.' They will be asked to repeat each sentence as it is read to them. They will be shown the sentence on a card as it is read to them and when they read the sentence on their own. This introductory set contains twelve sentences each of which contains one pseudoword conforming the previously stated rule. The pseudoword in each sentence will conform to the rule but will contain different consonants. The exact pseudoword will never be repeated in each sentence within the introductory set.

Step 2

Subjects will then be asked to look at a set of 12 sentences labeled 'trial 1'. The subject will be asked to read each sentence on their own. After reading each sentence they will be given feedback. They will be told that their pronunciation of the pseudoword is correct or incorrect. If the pronunciation is correct they will be told to continue. On the other hand, if they pronounce the pseudoword incorrectly, they will be told the correct pronunciation. The subjects will then continue with the next sentence. At no time during this exercise will the subjects be given the pronunciation rule. This trial set will contain twelve sentences containing a pseudoword which conforms to the same rule, but differ in consonant configuration. The pseudowords found in trial 1 will differ from those found in the introductory set.

Step 3

Subjects will follow the exact instructions as they did in Step 2 for a set of twelve sentences labeled 'trial 2.' Again, this set will contain sentences each containing a

pseudoword which follows the same rule. The pseudowords used in this set differ from those used in the Intro set as well as trial 1.

Step 4

Subjects will follow the instructions given in Step 3 for a set of twelve sentences labeled 'trial 3.' This trial set is the same set of sentences used in the intro. set. The sentences will be presented to the subject in a different order, but nonetheless the sentences will be the same.

Step 5

Subjects will continue to follow the sequence of trials 1 through 8. This sequence is a cycle through three sets of twelve sentences. Each time a subject encounters a trial, the sentences will be presented in a different, random order. This procedure will stop once a child reaches trial 8 or once they reach criterion. Reaching criterion occurs when a child continuously pronounces the pseudoword correctly.

Step 6

Once subjects have completed this phase they will complete the Test of Implicit Knowledge - sentences. Here, each subject will be asked to read one set of 12 sentences. The structure of this set will be similar to the sets used in the first phase. Each sentence contains a pseudoword conforming to the rule. Once the subject reads the sentence, I will simply note whether the pronunciation of the pseudoword is correct or incorrect. No feedback will be given during this test. Each of the pseudowords used will be taken from one of the thirty-six pseudowords used during phase 1.

Step 7

Subjects will then be given the Test of Implicit Knowledge - isolated word. Each subject will be asked to read a set containing twelve pseudowords in isolation. Each pseudoword will conform to the same rule and is taken from one of the thirty-six pseudowords used during phase 1. Although, they will be different than those used in Step 6. I will record whether the pronunciation of these words in correct or incorrect.

Step 8 *

Subjects will be given a brief time to rest, after which they will be asked to teach the researcher how to pronounce pseudowords found in a sentence similar to the one they experienced in earlier phases. This will be titled the 'Explicit Knowledge Test.' Subjects will be shown one set of twelve sentences each containing one pseudoword conforming to the rule. They will be asked to teach the pronunciation of each pseudoword. For each subject, the researcher will once state that he/she does not understand the subject's instructions, and ask that they repeat their instructions. The researcher will also purposely

Pronounce six of the twelve pseudowords incorrectly. Of interest will be the subjects instructions for pronunciation as well as the feedback they give when the researcher pronounces the word incorrectly. Once the subject has completed this phase, testing will stop.

Test Groups

Group A Twelve learning disabled children

Group B - Twelve learning disabled children

Group C - Twelve non learning disabled children

* *All groups will complete steps 1 through 7. Only groups A and C will continue through step 8.*

- - - - - Kruskal-Wallis 1-Way Anova

IMPLICIT KNOWLEDGE
by ABILITY

Mean Rank	Cases	
14.00	12	ABILITY = 1
11.00	12	ABILITY = 2
	--	
	24	Total

			Corrected for ties		
Chi-Square	D.F.	Significance	Chi-Square	D.F.	Significance
1.0800	1	.2987	2.1789	1	.1399

- - - - - Kruskal-Wallis 1-Way Anova

FULL RULE
by ABILITY

Mean Rank	Cases	
14.50	12	ABILITY = 1
10.50	12	ABILITY = 2
	--	
	24	Total

			Corrected for ties		
Chi-Square	D.F.	Significance	Chi-Square	D.F.	Significance
1.9200	1	.1659	3.4074	1	.0649

PART RULE
by ABILITY

Mean Rank	Cases	
15.00	12	ABILITY = 1
10.00	12	ABILITY = 2
	--	
	24	Total

			Corrected for ties		
Chi-Square	D.F.	Significance	Chi-Square	D.F.	Significance
3.0000	1	.0833	4.0210	1	.0449

- - - - - Kruskal-Wallis 1-Way Anova

NO
by ABILITY

Mean Rank	Cases	
10.00	12	ABILITY = 1
15.00	12	ABILITY = 2
	--	
	24	Total

			Corrected for ties		
Chi-Square	D.F.	Significance	Chi-Square	D.F.	Significance
3.0000	1	.0833	4.0210	1	.0449

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