UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

The Application of the Self-Generation Effect to the learning of Blissymbols by persons presenting with Severe Aphasia

Priya Rajaram

Submitted in partial fulfilment of the requirements for the degree

Philosophiae Doctor in Augmentative and Alternative Communication

In the Centre for Augmentative and Alternative Communication
Faculty of Humanities

University of Pretoria

Pretoria

August 2008

Dedicated in loving memory to

my late father

Mr Arnand Rajaram Gopee

and my late grandfather

Mr Rajaram Gopee

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

ACKNOWLEDGEMENTS

One of the most important things I have learned during this journey is that one's dreams and ambitions cannot be realised without the help of others. Therefore I pay special tribute and convey my deepest thanks to the following individuals:

- Professor Erna Alant, my supervisor and guide through this process. Thank you for leading me through this journey. This study is a reflection of your innovative ideas and commitment to scientific research in our field.
- Dr Shakila Dada, my second supervisor, thank you for your input into my work. I have appreciated your dedicated contribution.
- To Mike Isaacson, Purdue University, West Lafayette, USA for starting the work on the self-generation effect in the field of AAC and for inspiring this study.
- Mrs Rina Owen, Department of Statistics, University of Pretoria, thank you for your skilful handling of my statistics. All the very best on your retirement.
- To my friends in my PhD class. Thank you for all your contributions to my work. I will miss our contact. I will remember all our times together during our onsites with fondness. All the very best as you too near the completion of your studies.
- To the PhD students at Purdue University, West Lafayette, USA who at various stages of my work assisted me with ideas and references.
- My husband, Mr Mergandaran Velayudan, who I love most dearly, thank you for your unconditionally support in completing my work. You inspire me to be the very best person I can be. I met you when I started this Phd journey, I married you in the middle of this Phd road and now at the end of this Phd trip, I will be most content spending my time being your wife.
- My wonderful mother, Mrs Amitha Rajaram, for always believing in me and making feel that anything is achievable. I acknowledge the personal sacrifices made and hardships endured in bringing me up. I am so grateful.
- My only sibling, my brother Mr Prineal Arnand Rajaram who is so special to me. Thank you for all your support, love and caring. I look forward to the wonderful journey of life ahead of us as you build your own family and I mine. We are first brother and sister for life.

- To the individuals with aphasia I meet and work with, thank you for allowing me into your lives. Thank you for allowing me to develop my skills so that I can best serve you. Special mention to my first and most long-term patient, Mr Veramuthu and his family, you have inspired me.
- Finally, the culmination of this study will mean that I will soon think about becoming a mother. To the child I will welcome into this world one day, you have suddenly become the unseen motivator in all my endeavours. I have strived to do my very best in this piece of work so that one day you will be proud of your mother and you too will be motivated to continue in this journey of learning.

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

ABSTRACT

The Application of the Self-Generation Effect to the learning of Blissymbols by persons presenting with Severe Aphasia.

A severe aphasia following a cerebral vascular accident is characterised by generalised deficits in most speech-language domains. The clinical dilemma remains focused on the extensive verbal speech impairment and in most cases little possibility of regaining verbal speech production. Many individuals living with severe aphasia use augmentative and alternative communication strategies to assist them in getting their communication needs met in their everyday lives. The Blissymbol system is one of the graphic symbol systems that can be used to supplement existing communication and speech strategies of the individual with little or no speech.

Although the use of AAC strategies is gaining momentum in its application to severe aphasia, however, there still remain questions on how best to help these individuals learn and retain such strategies. Not only are individuals with severe aphasia faced with a memory task when learning AAC strategies such as Blissymbols, additional complexity to AAC interventions is derived from clinical presentation of severe aphasia. The presence of extensive damage to the neural centers responsible for linguistic processing and semantic retrieval makes learning of new AAC strategies all the more complicated.

Research studies have looked at whether individuals with severe aphasia can learn to recognise and retain Blissymbols. Although these studies have successfully shown that individuals with severe aphasia can learn Blissymbols, there is little information available regarding how these symbols can best be taught and retained over time individuals with severe aphasia. Recently the research that has looked at the application of symbol learning with persons presenting with severe aphasia using computer technology and sophisticated application software has highlighted the importance of therapeutic methods that may enhance the learning of such software.

This study looks at the application of the self-generation effect as a viable method for enhancing the recognition of Blissymbols in persons presenting with severe aphasia. The self-generation effect is the finding of superior retention and recall for stimuli constructed or generated by an individual. Memory for stimuli such as words, numbers and pictures were found to be enhanced by the extent to which the individual was involved in its construction. Using a 2X2X3 factorial design, this study compared the recognition levels for Blissymbols taught using two treatment approaches which was the self-generation condition and the non self-generation condition. During three experimental sessions which included two withdrawal periods participants were taught using both treatments to recognise a set of Blissymbols. Recognition levels were tested during recognition probes and retention probes. The results from these probes were compared in order to identify which treatment produced superior recognition levels.

The data analysis conducted showed that although there was no recognition advantage for the self-generation effect seen during the three recognition probes some advantage for the self-generation effect was seen during the retention probes conducted. The self-generation effect began to emerge by the final retention probe following a withdrawal period of seven days. The self-generation treatment showed better retention of symbol recognition over time. Previous studies have shown that the self-generation effect failed to emerge with stimuli that were new or unfamiliar. This trend was also seen in this study. The results provide support for a semantic-association theory for the self-generation effect.

Key terms: severe aphasia, self-generation effect, Blissymbols, augmentative and alternative communication (AAC), symbol learning in aphasia, factorial design, symbol translucency and complexity, symbol recognition.

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

CHAPTER 1
ORIENTATION

1.1 Introduction

The presence of severe aphasia following a cerebral vascular accident (CVA) is described as a loss of language functioning with the change in verbal speech production and speech comprehension being the foremost diagnostic criteria. In the case of the individual presenting with a severe aphasia the clinical dilemma remains focused on the extensive verbal speech impairment and, in most cases, the limited possibility of regaining verbal speech production. However when working with severe aphasia clinicians are becoming more aware that it is not the ability to speak but the loss of the ability to make needs known and met that leads to the greatest frustration. Hence clinicians try to find the best configuration of treatment approaches that would allow the individual with aphasia to best meet their everyday communication goals.

The field of augmentative and alternative communication (AAC) is showing promise in improving the communication skills of non-verbal adults with severe aphasia. Many individuals living with severe aphasia use alternate & augmentative forms of communication in order to help them function better in their everyday lives. Several studies highlight the efficacy of developing alternative communication strategies in patients presenting with severe aphasia. (Beck & Fritz, 1998; Koul & Harding, 1998; Koul & Lloyd, 1998; Weinrich, McCall, Weber, Thomas & Thornburg, 1995) Many of these studies point to the fact that AAC may provide the only available treatment option as it presents the individual with severe aphasia with the opportunity to access the world around him or her by facilitating the learning of non-verbal skills ranging from the use of manual signs to the use of symbols to a level which is significantly greater than their verbal communication.

Blissymbols have been used extensively as a means of augmenting or providing an alternative to the natural speech of individuals with severe aphasia. Blissymbols are a graphic symbol system which includes a small number of elements which combine in different ways to convey conceptual information. There have been studies which have shown that individuals with severe aphasia can learn to recognise and retain Blissymbols (Funnell & Allport, 1989; Koul & Lloyd, 1998; Lane & Samples (1981). The application of graphic symbols like Bliss to persons with severe aphasia has evolved even further into software applications which combine with synthetic voice to augment and supplement speech (Beck & Fritz, 1998; Koul, Corwin & Hayes, 2004; Koul & Harding, 1998; McCall, Shelton, Weinrich & Cox, 2000; Shelton, Weinrich, McCall & Cox, 1996; Weinrich, Shelton, McCall & Cox, 1997). However, most of these researchers agree that the application of graphic symbols to this population remains elusive until we are able to identify the methods and procedures which allow these individuals to recognise and retain these graphic symbols.

Although persons with severe aphasia have been shown to benefit from AAC approaches, the very nature of the aphasia itself also causes clinicians to consider how best to teach such approaches. The extensive damage to the linguistic processing centres of the brain caused by aphasia makes the learning of new AAC strategies all the more difficult. Hence studies that have focussed on the application of AAC to this population have recognised the importance of reducing the linguistic load for these individuals during the learning of new AAC systems.

This research study aims to investigate if the self-generation effect is in fact one such viable strategy for facilitating symbol recognition in persons presenting with little or no functional speech due to a severe aphasia. Hence if research is able to push forward the thinking in this field about how persons with severe aphasia learn to recognise and retain AAC strategies, we become better placed to offer more effective services to these individuals.

1.2 Chapter Outlines

This study is presented in five chapters. Chapter one provides an orientation to the study by describing the key terminology and abbreviations used in the study.

Chapter two is the literature review. This chapter reviews the body of literature related to the self-generation effect, Blissymbol learning and severe aphasia. It presents the concept of the self-generation effect and describes its characteristics by presenting some of the pertinent research in this area. Theories for the underlying causes of the self-generation effect will be discussed with supporting argumentation. The application of the self-generation effect in relation to picture stimuli will be explored as this study aimed to investigate the relationship between the self-generation effect and the learning of symbols. The chapter finally explores the possible application of the self-generation effect to persons presenting with severe aphasia.

Chapter three outlines the methods and procedures used in this study in order to determine if the self-generation approach is a viable method for training severe aphasics to learn to recognise Blissymbols. This description of methods includes a presentation of the research design selected, a description of the study participants, an outline of the stimulus material used in the study and a description of the data collection and analysis procedures.

Chapter four presents the results and discussion of the study. The relevant results are presented and its implications are explored. It focuses on answering the research question and achieving the main aim and the sub-aims of the study. The dependant variable under study was the number of symbols recognized following training using each treatment approach. The discussion will present the interactions between the three factors or independent variables of the study with each other but mainly their resultant effect on the dependant variable.

Chapter five presents the conclusions, recommendations and critical appraisal of the study.

1.3 List of Terminology

The following is a list of terminology used frequently in the study. These terms are explained in order to clarify the manner in which they are used in the study.

1.3.1 Self – generation effect

The self-generation effect is the finding of superior retention and recall for stimuli constructed or generated by an individual. Memory for stimuli such as words, numbers and pictures is enhanced by the extent to which the individual is involved in its construction.

1.3.2 Non self-generation condition

The non self-generation condition describes an approach for teaching new stimuli which does not involve any construction or generation by the individual.

1.3.3 Self-generation treatment

This is the training procedure used in the study to illicit the self-generation effect. The individual was taught the Blissymbols by using connect-the-dot drawings. These drawings were used to allow the individual to construct the to-be-learnt Blissymbols hence establishing the self-generation component.

1.3.4 Non self-generation treatment

This is the contrasting non self-generation approach which did not involve any construction by the individual. To-be-learnt Blissymbols were taught by matching the Blissymbol with its referent.

1.3.5 Severe aphasia

For the purposes of augmentative and alternative interventions, a severe aphasia is seen as resulting from a cerebral vascular accident which causes extensive damage to the language centres of the brain. This damage results in severe speech-language deficits which do not show any signs of significant recovery even following the period of spontaneous recovery (Garrett & Beukelman, 1992). The most common types of severe aphasia syndromes are Broca's aphasia and Global aphasia.

1.3.6 Augmentative and alternative communication

Augmentative and alternative communication methods attempts to supplement or replace either temporarily or permanently the natural language of individuals with severe and expressive communication disorders using symbols. (Beukelman & Mirenda, 1992)

1.3.7 Blissymbols

Blissymbols are a graphic symbol system developed by Charles K. Bliss in the 1940s. The system is based on a small number of basic elements that are combined in various orientations to represent an infinite number of concepts (Fuller, 1997).

1.3.8 Probe measures

Probe measures were conducted after each training block. These probe measures tested for the number of symbols recognised following training. The scores from the probe measures were analysed to ascertain which treatment approach produced the best recognition outcomes.

1.3.9 Connect-the-dot illustrations

These were drawings which represented the Blissymbols used in this study in a manner which allowed the participant to construct and learn the Blissymbol. Each Blissymbol was represented by a collection of dots. The participant connected the dots using a pen in a particular sequence in order to construct the Blissymbol. These drawings established the self-generation condition.

1.3.10 Withdrawal periods

This refers to the time between experimental sessions. The second experimental session was conducted two days after the first experimental session. The third experimental session was conducted seven days after the second experimental session.

1.4 Abbreviations

The following is a list of abbreviations commonly used in the study.

SGE	-	self-generation effect
SG	-	self-generation
NSG	-	non self-generation
RP	-	recognition probe
RTP	-	retention probe
E1	-	experimental session 1
E2	-	experimental session 2
E3	-	experimental session 3
RPE1	-	recognition probe for experimental session 1
RPE2	-	recognition probe for experimental session 2
RPE3	-	recognition probe for experimental session 3
RTPE2	-	retention probe conducted before experimental session E2
RTPE3	-	retention probe conducted before experimental session E3

1.5 Summary

This chapter provided a background to the study. It orientates the reader by presenting an introduction to the chapters which follow. In order to ease understanding, a list of terminology as well as a list of abbreviations is provided.

CHAPTER TWO

THE SELF-GENERATION EFFECT, AAC AND SEVERE APHASIA

2.1 Introduction

2.1.1 Scope of the chapter

As presented graphically in figure 2.1, this chapter starts by providing a definition for the self-generation effect and describes its characteristics by presenting some of the pertinent research in this area. Theories for the underlying causes of the self-generation effect are critically evaluated. The application of the self-generation effect in relation to picture stimuli is explored, as this study aims to investigate the relationship between self-generation and the learning of symbols. Since the self-generation effect was used with persons presenting with severe aphasia in this study, the case of severe aphasia is discussed. Finally, the chapter looks at the possible application of the self-generation effect to the learning of symbols by persons presenting with a severe aphasia.

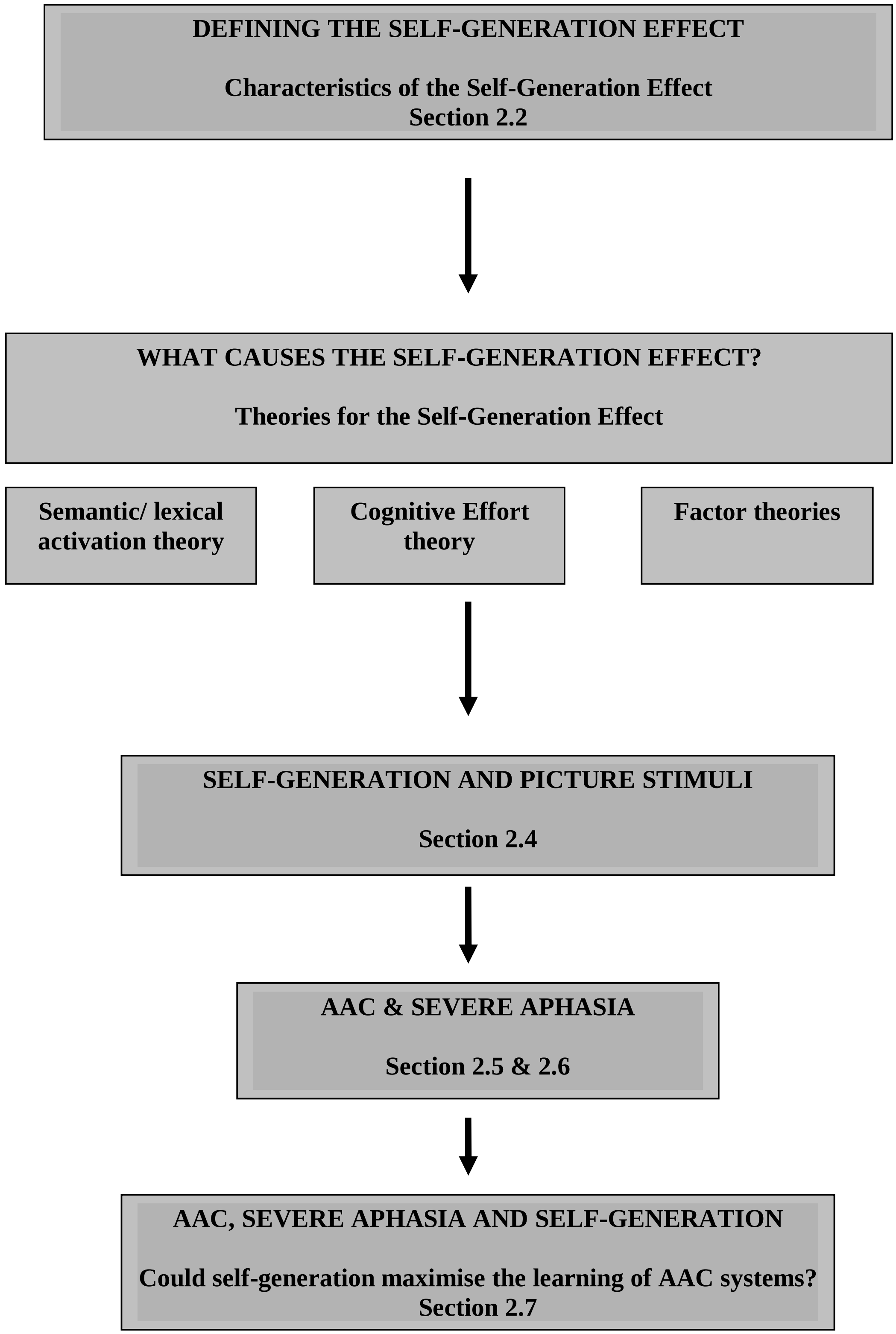


Figure 2.1 Scope of the literature review chapter

2.2 Defining the Self-Generation Effect

The SGE is gaining momentum as a possible strategy for maximising learning in brain-damaged individuals (Dick & Kean, 1989; Mitchell, Hunt & Schmitt, 1986; Multhaup & Balota, 1997; Souliez, Pasquier, Lebert, Leconte & Petit, 1996). The SGE refers to the finding of superior retention and recall for stimuli constructed or generated by an individual. Memory for stimuli such as words, numbers and pictures were found to be enhanced by the extent to which the individual was involved in its construction (Ghatala, 1981; Jacoby, 1978; Peynircioglu, 1989; Slamecka & Graf, 1978). Research into the SGE has found it to be a robust phenomenon of memory that has been shown to exist under a number of different condition types (Slamecka & Graf, 1978). The SGE has been shown to increase the recognition and recall of items that involve some kind of generation or construction by the individual. The memory advantages derived by the full involvement of the individual in constructing, deriving or generating items have been shown to be superior.

Slamecka & Graf (1978) were the first in the field of psychology to test for the SGE and to prove the memorial advantages of having the individual construct or generate to-be-remembered items. During four experiments, they investigated the SGE under a variety of conditions ranging from recognition to free recall in normal adults. Their empirical study reported on a “robust phenomenon of memory” (Slamecka & Graf, 1978, p.593), namely the SGE. These researchers were able to show that to-be-remembered words which were generated by the participants were better remembered than words which were simply read by the participants. Slamecka & Graf (1978) established the SGE as an important memory-enhancing tool and were also able to define the characteristics of the SGE. These characteristics have become fundamental to understanding the SGE and have been the focus of much of the subsequent research in this field.

Slamecka & Graf (1978) proposed that some of the early studies on memory (Abra, 1968; Scwartz & Walsh, 1974) failed to show a SGE because the participants’ use of their own methods for generating responses produced a bias which influenced the recall of the responses. They felt that in order to prove the true influence of the SGE, the participant's generated responses needed to be derived in a manner that allowed for predictable responses, thus eliminating any bias in response generation. In their first experiment, Slamecka & Graf (1978, p. 593) tried to avoid the "idiosyncratic item selection habits" of participants by constraining the participants' responses and making responses predictable. They thus introduced the concept of the all-important generation rule when testing for the SGE. This initial experiment also showed that the magnitude of the SGE did not seem to be affected by the type or category of the self-generation rule applied. Slamecka & Graf (1978) successfully elicited the SGE when using a variety of generation rules ranging from opposites, synonyms, rhyming words, categorisation and association.

In their second experiment Slamecka & Graf (1978) were able to show that the SGE was not influenced by the intentional learning required from participants. They supposed that since the participants were informed that they would be tested following the generation tasks, it may have heightened their awareness of the task items, therefore directly influencing their recall of items. Therefore the superior recall found could not be reliably attributed to the SGE. In the second experiment, one group of participants was informed of the test procedure to be followed and the other group were not informed. The results showed no meaningful discrepancies between the groups with each group showing superior recall for the generated items.

Additionally, experiment two looked at another important defining characteristic of self-generation. This experiment investigated whether the SGE may still be elicited if it were directly contrasted with the to-be-read condition. There was no difference in results between the group with the contrasting condition and the group without the contrast of conditions. However, the generated items were recalled better than the non-generated items in both instances. This further extended "the range of circumstances" under which the SGE could be elicited (Slamecka & Graf, 1978, p. 596).

The SGE's influence on the recall of the actual stimulus word was investigated in experiment three. The researchers argued that if the SGE produced a heightened awareness of the generated items then it may also have extended this awareness to the stimulus item. However, if this was so, the effect of generation on recall of items may be nullified since the stimulus item did not involve any generation at all. Here the participants' recall for the generated items and the stimulus items were tested and compared. The results confirm the existence of a large SGE for the generated responses but none for the stimulus items. Slamecka & Graf (1978) concluded from these findings that they found no support for the notion that self-generation actually enhanced memory of all the elements involved in the testing process. No memorial benefits were found for the stimulus item at all, and the effect was restricted to the generated item only. This further supported the role of self-generation in the memorial benefits observed.

In experiment four and five, Slamecka & Graf (1978) tested whether the SGE was still present if the test format was changed to a more difficult format such as free recall. All the previous experiments used a recognition type test to measure memorial gain for the generated items. However, in this experiment the test procedure was altered from cued recognition to a written free recall test. Participants were now required to write down all the items they were exposed to during the test procedure as they had in experiment one. Again, superior recall was obtained for generated items when using free recall.

Interestingly, Slamecka & Graf (1978) analysed the order of the written responses to see if the generated items were recorded earlier, investigating the suggestion that whatever caused the increased accessibility of generated items may have also caused these items to be recorded earlier. However, results did not support such a trend. Slameck & Graf (1978, p. 602) interpreted this finding as reflecting the generated items' "great intrinsic accessibility" due to the participant's involvement in the generation of these items.

Since the rigorous experimental testing by Slamecka & Graf (1978) confirmed the robustness of the SGE, other researchers have also gone on to establish the existence of the SGE. Jacoby (1978) tested the effect of solving a problem versus remembering a solution. Although labelled as "discovery learning", Jacoby (1978, p.649) tested the memorial consequences for word stimuli that involved some sort of problem solving. In his first experiment, 18 subjects were required to read or construct member pairs of related words. The construction involved a cue word with the subject having to construct the related word using the letters provided. There were different conditions ranging from reading and generating in various combinations as a function of time.

The results of Jacoby's (1978) experiments supported Slamecka & Graf's (1978) defining characteristics of the SGE. Jacoby (1978) supported the important role of the generation rule concept. In fact, in Jacoby's (1978) first experiment, he analysed the effect on recall of the words that were incorrectly constructed when compared to correctly constructed words. He found that the incorrectly constructed items showed superior recall when compared to correctly constructed words. He attributed this to idiosyncratic item selection of the subject, which increased retention, hence substantiating the need for predictable responses if a true SGE is to be measured. Jacoby (1978) supported another important characteristic of the SGE initially identified by Slamecka & Graf (1978) when he showed that increasing the difficulty of the generation rule did not increase the retention benefit.

Tyler, Hertel, McCallum & Ellis (1979) investigated cognitive effort and its role in memory. Their research was actually prompted by the debates at the time on levels-of-processing research (Craik & Lockhart, 1972), which was then the most accepted theory for memory enhancement.

The levels-of-processing theory suggests that the greater the depth to which an item is processed, the greater the ability to recall that item. The ongoing debate on the levels-of-processing theory centred on there being no reasonable measure of the actual 'depth' of processing that a task may involve. In order to provide a quantifiable measure of levels or depth of processing, Tyler et al. (1979, p. 607) investigated the role of "cognitive effort" as a "causal factor in word recall". In four experiments using anagrams and sentence completion as stimuli, Tyler et al. (1979) were able to show greater recall for items involving greater cognitive effort. Here the researchers distinguished between levels of processing versus cognitive effort. Self-generation appeared synonymous with cognitive effort as it involved construction of the target words (anagrams), while levels of processing referred to tasks that did not involve any active, engaged construction of the target item (sentence completion).

Tyler et al. (1979) were able to show a recall benefit for words that involved cognitive effort in the form of solving an anagram as opposed to words that did not involve any engagement on the part of the subject (sentence completion). Tyler et al. (1979) were confident that their experiments showed that effort can be varied within tasks that require different levels of processing. Although some tasks involve construction or engagement while some tasks do not, Tyler et al. (1979) agree that recall is directly influenced by the extent of the cognitive effort involved.

McFarland, Frey & Rhodes (1980) were also able to show that the self-generation factor increases the recall for word stimuli. Here recall for word stimuli which were internally generated were compared with those that were externally generated or experimenter-generated. In five experiments, subjects were involved in phonemic based tasks and semantic based tasks. During the phonemic tasks, subjects were required either to generate a word that rhymed with a presented word (internally generated condition) or to determine whether a pair of words presented rhymed (externally generated condition). During the semantic based tasks, subjects were required either to generate a word that could fit into an incomplete sentence (internally generated condition) or to determine whether words provided fitted into the incomplete sentence (externally generated). Here again a strong SGE was elicited for internally generated items as opposed to externally generated items.

This study asked crucial questions regarding the actual nature of the SGE. They argued that Jacoby's (1978) and Slamecka & Graf's (1978) studies merely showed the effect to be a function of the "subjects' processing of stimuli in an elaborate fashion in one situation and in an unelaborated, non-distinctive manner in the other" (McFarland et al., 1980, p. 211) . They proposed that their study reported on a SGE that far exceeded the effect described by the two initial studies of that time, as it established the SGE as a "memorable function of the mind independent of such factors as meaning or sound" (McFarland et al., 1980, p. 215) .

From their experiments, McFarland et al. (1980, p.215) suggested that the equalisation of the processing levels between tasks involving generation and non-generation provided sufficient evidence that the SGE was a memory phenomenon with "special mnemonic value" which was distinct from the generally accepted levels of processing theory (Craig & Lockhart, 1972). Since the self-generation condition showed superior retention to the judgment condition, the very act of generating was seen as creating the memory benefits. This supported the notion that self-generation in itself was a special memory-enhancing function of the mind. Hence, McFarland et al. (1980) started to ask questions about what contributed to the SGE. Their study proposed that SGE emerged because it was in itself a memory-enhancing function of the mind. However, Slamecka & Graf 's (1978) and Jacoby's (1979) studies suggested that the SGE-increased semantic associations encouraged deeper levels of processing, thus producing the enhanced memory for the self-generated items. So began the debates around which was a more plausible explanation for the SGE.

2.3 Theoretical Interpretations: What causes the Self-Generation Effect?

When Slamecka & Graf (1978) introduced the concept of the SGE, the most accepted theory on memory at that time was the levels-of-processing or depths-of-processing framework (Craig & Lockhart, 1972). This framework evaluated the adequacy of the "multi-store" approach to memory (Craig & Lockhart, 1972, p. 673). The multi-store approach classified memory into three levels: the sensory memory store or registers, the short-term memory (STM) store and the long-term memory (LTM) store. Here information was seen to flow between the different stages. Craig & Lockhart (1972) argued that this modal model of memory was inadequate because the descriptive components for the stages of memory did not provide sufficient grounds for differentiating between the three memory stores.

They argued that there were too many conflicting components attributed as characteristics of each memory store. There were differing views regarding the capacity limits of each store, the type of information coding in each store and the processes for forgetting information in each store. Craig & Lockhart (1972, p. 675) thought that a word could be encoded into its "visual, phonemic or semantic features, its verbal associates or an image". They felt that differing memory capacities for each one of these encoding formats was plausible, that is, one encoding strategy could produce better memory capacity than another. Hence, memory capacity was seen as a function of the type and depth of encoding. In this way, the depths-of-processing framework was founded.

Depths of processing related to the various hierarchical stages of perceptual processing. This began with the analysis of physical and sensory features, while during later stages meaning was derived from the stimuli by matching it with stored concepts gained from previous learning. Hence greater depth of processing was linked to the greater degree of "semantic or cognitive analysis" (Craig & Lockhart, 1972, p. 675). One of the products of this perceptual processing was the memory trace. Longer lasting memory traces were associated with deeper perceptual processing. Studies then began to look at what type of perceptual processing increased this memory trace. Hence, work into the SGE came to the forefront.

Once research began to test the robustness of the SGE and to confirm its influence on memory, it was inevitable that researchers in this field started to question the actual processes underlying the SGE. The question remained centred on what was actually causing the memory benefit seen during increased involvement of the individual. Although the depths-of-processing framework acknowledged that deeper processing improved memory, it did not actually pinpoint the actual mechanisms that contributed to this phenomenon.

The first group of hypotheses resulting from the SGE studies was the semantic-lexical activation theory. This focused on the role of semantic or lexical associations derived during self- generation. Semantic memory refers to an individual's "pre-existing knowledge about verbal information, including in particular, words and their corresponding definitions" (Nairne, Pusen & Widner, 1985, p. 183). The second group of hypotheses was the cognitive effort theory. This referred to the effortful cognitive operations involved in the generating process itself which produces the memory advantage (McFarland et al., 1980). Here the very act of generation creates both increased arousal and increased depth of processing, thus producing the memory benefit. The last group of hypotheses related to the multi-factorial theories around the SGE. The multi-factorial theories included a combination of factors such as semantic-activation and cognitive effort, which are seen to influence the emergence of the SGE.

2.3.1 Semantic/lexical activation theory versus cognitive effort theory

Graf's (1980, p. 316) study was prompted by a lack of any "well-founded theoretical interpretation" for the SGE's influence on recall. Hence he compared the SGE in meaningful sentences with anomalous sentences in order to clarify Slamecka & Graf's (1978) and Jacoby's (1978) intuitive hypothesis regarding the role of semantic memory or meaning activation in the SGE. In his experiments Graf (1980) contrasted the generate condition, where the participants were required to generate both meaningful and anomalous sentences from lists of words using a specific grammatical format, with a read-only condition, where participants were asked to read anomalous and meaningful sentences. Graf (1980) found a significant memorial benefit for the generated, meaningful sentences but not for the generated anomalous sentences. In addition, the generated meaningless sentences did not show a memorial benefit when compared to the read-only anomalous sentence condition.

Graf (1980) suggested that since the results indicated an SGE for the meaningful sentences only, it was plausible that a semantic base contributed to the increased recall for the generated items. He also accepted that these findings could also be placed within the levels-of-processing framework (Craik & Lockhart, 1972), as the results suggested that the deeper semantic processing caused during the generation of meaningful sentences resulted in the memorial superiority for these stimuli when compared to meaningless sentence and read-only sentence stimuli. Hence Graf's (1980) study did not definitively place the role of semantic processing at the forefront of explanations for the SGE.

In an attempt to further understand the workings of the SGE, Ghatala (1981) questioned whether the SGE was related to semantic activation or whether it was the result of increased cognitive effort because it was in fact a specialised function of the brain. He explored the role of "inter-word organization" proposed by Graf (1980, p. 322), and the "special mnemonic value" of the SGE proposed by McFarland et al. (1980, p. 215). Three contrasting conditions were used. These included generating the last word of a sentence, reading a sentence and then judging whether the last word correctly completed the sentence, and finally, reading the sentences only. Ghatala

(1981) felt that if retention in the judgment condition was better than the read-only condition then it would support the intra-word organisation theory. However, if there was an SGE advantage present in the generate condition when compared to the judgment condition, the SGE may have mnemonic value.

The results indicated superior retention for the generate condition and judgment condition when compared to the read-only condition. However, there was no significant difference between the retention levels in the generate condition and judgment condition, as was previously shown by McFarland et al. (1980). Ghatala (1981) contended that these results refuted the assumption that the SGE has some intrinsic mnemonic value as proposed by McFarland et al. (1980), because it did not produce better retention levels than the judgment condition. Ghatala (1981) explained the differences in his findings from the McFarland et al. (1980) study as being methodological. Since McFarland et al. (1980) did not constrain their subjects' selection of words and allowed them to generate freely, he argued that the subjects' idiosyncratic item selection habits may have contributed to McFarland et al.'s (1980) finding of superior retention for generate items when compared to judgment items. As presented earlier, Slamecka & Graf (1978) also supported the contribution of idiosyncratic item selection in masking a true SGE. Ghatala (1981, p. 449) concluded that the SGE does not produce any superior memorial benefits during tasks which require the individual to exert more cognitive effort or "to process the material in an optimal fashion". Ghatala (1981) successfully refuted the cognitive effort possibly as an explanation for the SGE.

Thereafter, McElroy & Slamecka (1982) used non-words to investigate the validity of the semantic-memory hypothesis for the SGE. It became one of the seminal studies that identified the role of semantic or lexical activation as a contributory factor in the SGE. These researchers assumed that an SGE would only be found if there was an increased involvement of semantic memory for the generated stimuli rather than non-generated stimuli. In furthering the semantic memory hypothesis, they argued that since non-words contained no semantic entry, one should not be able to obtain an SGE for these words. In three experiments, they were successfully able to show an SGE for meaningful words and none for the non-meaningful words, thus highlighting the role of semantic memory. McElroy & Slamecka (1982) felt that this was evidence that the SGE was not merely caused by the increased cognitive effort used during generation. Rather, the consistent presence of the SGE when using meaningful stimuli like words and sentences implicated the role of semantic memory as a "necessary, although perhaps not sufficient" prerequisite for the effect to emerge (McElroy & Slamecka, 1982, p. 258).

Interestingly, these researchers also introduced the concept of "lexical activation" into the debate on what actually contributed to the SGE (McElroy & Slamecka, 1982, p. 258). They argued that the inability of the SGE to emerge when using non-words was explained by this concept. The lexical activation concept suggested that the act of generating activated more of the word's attributes in semantic memory than would be activated by a task not involving generation. Since the non-words were not part of the participant's semantic memory these lexical attributes could not be activated; hence the SGE could not emerge.

Graf's (1980) study also supported McElroy & Slamecka's (1982) lexical activation hypothesis because he failed to find an SGE for anomalous sentences. Graf's (1980) findings showed that the lack of meaningful relations between the words did not allow for an integration of the words pairs in the sentence; thus no memorial benefit was gained from generating these types of sentences.

Nairne et al. (1985) attempted to extend McElroy & Slamecka's (1982) work into the lexical activation hypothesis. They too found no SGE for non-words and supported McElroy & Slamecka's (1982) lexical hypothesis by stating that "generation, perhaps because it is more effortful, activates an items location in the lexical network …enhancing the items episodic retrieval network" (Nairne et al., 1985, p. 190). When Payne, Neely & Burns (1986) tested McElroy and Slamecka's (1982) lexical activation hypothesis, they too produced data which were consistent with their findings.

However, other studies tested McElroy & Slamecka's (1983) position regarding the lexical activation hypothesis and were able to show an SGE for non-words, thus possibly negating the role of lexical activation (Gardiner & Hampton, 1985; Gardiner

& Rowley, 1984; Glisky & Rabinowitz,1985; Johns & Swanson,1988; Nairne & Widner, 1987).

Gardiner & Hampton's (1985) experiments appeared to suggest that the SGE may not be merely influenced by the presence or absence of meaning. In three experiments, these researchers were able to show that the SGE was present for meaningful bigrams but not for meaningless bigrams. Further, SGE was present for unitised numbers (i.e., twenty-eight but not two, eight) but not non-unitized (i.e., two, eight but not twentyeight) and finally, the SGE was present for familiar compound words but not for unfamiliar compound words (e.g., tomato cake). They argued that this was evidence that supported the hypothesis of semantic memory because their findings suggested that for the SGE to occur, the to-be-remembered item must be a functional unit of semantic memory like the bigrams and unitised numbers. The emergence of the SGE with numbers tended to discredit the lexical activation hypothesis because numbers are generally not seen as a lexical unit; lexical entries are restricted to words only. Gardiner & Hampton (1985, p. 739) felt that their results were more in keeping with the view that self-generation enhances "conceptual processing" during recall.

Glisky & Rabinowitz's (1985) study also refuted the semantic activation theory. They argued that since studies of that time (e.g., Donaldson & Bass, 1980; Graf, 1980) suggested that the self-generation phenomenon depended on the "enriched semantic relation between the generated word and its context" (Glisky & Rabinowitz, 1985, p. 194) then it may be expected that without this accompanying context, that is, the stimulus cue, no memorial benefits may be expected when a word is generated. These researchers tested this possibility by applying the SGE for single words using simple generation of a word from a word fragment. The results showed a strong SGE for the single words in the absence of a semantic-based stimulus cue. This confirmed the possibility that the semantic interpretations for the SGE that have focused on the role of inter-relational meaning between the stimulus cue and the generated target may represent a heretofore missing explanation for the effect.

Glisky & Rabinowitz (1985) argued that their findings went against the general semantic interpretations of the SGE. They suggested that the self-generation process itself could influence the emergence of the phenomenon, thus supporting more of a cognitive effort theory for the SGE. However, they did not completely rule out McElroy & Slamecka's (1983) lexical activation hypothesis, stating that the self-generation process does indeed interact with the individual's knowledge system, creating a stronger memory trace which enhances the stimulus's later retrieval. However, they acknowledged that the precise interplay between the self-generation process and lexical/semantic knowledge remains unspecified.

Gardiner & Rowley (1984) were able to show an SGE for numbers. Nairne & Widner's (1987, p. 170) study appeared to show that "under the right test conditions" an SGE can be elicited for non-words. Johns & Swanson (1988, p.187) argued that the reason that McElroy & Slamecka (1983) did not find an SGE for non-words could lie in the "semantic status of the cue and not the semantic status of the to-be-remembered target". Since McElroy & Slamecka (1983) used non-word cues to generate the non-word to-be-recalled stimulus, Johns and Swanson (1988) altered their testing procedure by using a meaningful cue word that required the generation of a meaningless non-word. Using a letter transposition rule, word-word pairs, non-word-word pairs and non-word–non-word pairs were tested. They were able to show that the SGE does appear when non-words are used as cues for generation of real words and when non-word cues are used to generate non-words. Interestingly, no SGE was seen when word cues were used to generate non-words. In contrast to the findings by McElroy & Slamecka (1982), Nairne et al. (1985) and Payne et al. (1985), Johns & Swanson (1988) claimed that the SGE can occur with non-words, thus negating the semantic-activation hypothesis. They stated that the generation process itself requires more testing to reveal its true influence on memory.

Since the largest body of work in the field of the SGE tended to support the semantic basis for the phenomenon, more recent work into the semantic activation hypothesis began to organise the different elements of this view in a more coherent fashion. The factor theories began to formalise and organise the role of semantic activation into neat steps.

2.3.2 The factor theories

Hirshman and Bjork (1988) proposed a two factor theory to explain the SGE. Here the SGE is seen to be derived from the influences of both item-specific factors and relational factors. The act of self-generation is seen to activate the features or semantic attributes of the response items and also to strengthen the relationship between the stimulus cue used and the stimulus response generated.

McDaniel, Riegler & Waddill's (1990) three factor theory was reported to be the most comprehensive theory of the SGE (Kinjo & Snodgrass, 2000). Factor 1 is the item-specific factor relating to the increased activation of an item's semantic attributes; Factor 2 is the relational factor which refers to the activation of the relationship between the stimulus and the response; and Factor 3 is the contextual information that individuals become more aware of when they are required to construct stimuli.

Hence the debate in the literature remains inconclusive. However, with the three factor theory, all the relevant viewpoints are married for further experimentation.

2.4 Self-Generation and Picture Stimuli

Since the main purpose of the present study was to expand the application of the SGE to the learning of symbols, the SGE's role in enhancing memory for picture stimuli requires further consideration. Although the studies on the SGE and pictures are few (Kinjo & Snodgrass, 2000; Peynircioglu, 1989; Pring, Freestone & Katan, 1990), they do provide some direct insight into how the SGE may work with symbols. Table 2.1 provides a summary of studies on SGE and pictures. These studies rely on the characteristics of the SGE found with words.

Table 2.1 Description of studies related to SGE and pictures

Authors	Participants	Study Design	Procedures	Stimuli	Significant Findings
Peynircioglu (1989)	College students	Factorial group design	Three different experiments were conducted. A group design was used. There were two groups for each experiment: one received the SG condition and the other received the NSG condition.	Pictures and drawings	The SG was elicited for pictures. The semantic activation theory was questioned because the SGE was found for nonsense pictures that lacked any semantic associations.
Pring, Freestone & Katan (1990)	Blind and sighted children	Factorial group design	Three different experiments were conducted. A group design was used. There were two groups for each experiment: one received the SG condition and the other received the NSG condition.	Pictures and drawings	The SG was found for pictures.
Kinjo and Snodgrass (2000)	24 psychology students	Factorial group design	A computer was used. Participants were exposed to the fragmented and complete pictures and asked to provide the word that the picture represented. The fragmented picture labelling represented the generate condition and the complete picture labelling represented the non-generate condition.	Complete pictures and fragmented pictures	A strong SGE was found for pictures on free recall. Findings showed that pictures may have the combined influence of initiating extra cognitive effort, semantic activation and extra sensory or conceptual activation.

Peynircioglu (1989) was the first to report an SGE for pictures. She found that memory for pictures and figures were certainly enhanced by the degree to which the participants were involved in their construction. In her first experiment, participants were required to draw objects following a written cue (generated condition) and were asked to assess the artistic merit of other given pictures (non-generated condition). Recall was tested 15 minutes later by asking the participants to draw all the pictures they had been exposed to, both generated and rated. Results indicated that participants recalled more of the pictures that they generated than the pictures they had merely rated.

However, Peynircioglu (1989) argued that the very act of drawing in itself could have led to better memory for the pictures. Hence, in Experiment 2, a copy versus draw condition was introduced to test this bias of drawing. Peynircioglu (1989, p. 156) felt only if the draw condition proved to show better memory effects than the copy condition then the "generation explanation would be appropriate". The participants drew pictures according to a written cue, copied a picture or merely just rated a picture. The SGE was in fact elicited for both the draw and the copy condition, with both showing better recall than the non-generate condition (rating). However, the recall benefit was better for the draw condition than the copy condition, showing that the SGE did occur for pictures.

In Experiment 3, Peynircioglu (1989) wanted to directly test the semantic activation hypothesis. Using nonsense figures which did not hold any related meaning, she was able to elicit an SGE. However, since in Experiment 3 the written instruction to draw the nonsense figures was quite detailed, Peynircioglu (1989) argued that this may have caused some semantic activation anyway. In order to rule this out the nonsense pictures in Experiment 4 were now generated using a connect-the-dot format where joining consecutive numbered dots completed the picture. The dot drawing format negated the use of detailed instructions to generate the nonsense pictures. Not only did the data reveal that the generated pictures showed better recall than the copy or rate conditions, but the experiment also introduced an innovative way for generating pictures without using written or verbal cueing. Peynircioglu (1989) concluded that these results cast some doubt on semantic activation theory, since the SGE was elicited for the picture stimuli in the absence of any semantic associations.

The nature of the SGE when using pictures was also investigated by Pring, Freestone & Katan (1990). They tested the SGE with blind and sighted children. The generated condition was established by asking participants to touch and then name a raised shape picture according to a cue to constrain generated responses. The non-generated condition was established by providing a word and then allowing the participants to touch the raised shape picture representation of that word. The sighted children wore blindfolds in order to cut off visual information. A SGE was shown for pictures with the sighted children and a reverse SGE for the blind.

These authors suggested that for the blind children, generating pictures may have directed “the subject’s attention to the distinctive perceptual features of the picture” and enhanced “the sensory representation” of the picture (Pring et al., 1990, p. 41). However, for the sighted children the self-generation of pictures may have highlighted more conceptual information (Pring et al., 1990). Since the recall test in these experiments required a more conceptual response because the children were asked to verbally recall the names of pictures they had been exposed to, it was not unexpected for the reverse SGE to emerge for the blind children.

Kinjo & Snodgrass (2000) also studied the SGE in relation to pictures. These researchers were interested in testing the cognitive effort theory, which they felt may be a more plausible explanation for an SGE with pictures. If an SGE was found pictures it could be due to the increased number of cognitive operations required to name incomplete pictures over completed pictures. They stated that the semantic activation theory cannot be completely ruled out as generating, as it may also activate the semantic or sensory characteristics of the item. To decide which of these theories could be implicated, these researchers used “two kinds of novel source monitoring” (Kinjo & Snodgrass, 2000, p. 99). Source monitoring is the process by which participants identify the source of test items. Source monitoring was seen as “a more sensitive measure of cognitive performance…than a recognition task” because it was a more “elaborate” process of memory than recognition (Kinjo & Snodgrass, 2000, p. 99). Therefore source monitoring provides more information on factors that contribute to the SGE with pictures.

In these experiments, the picture stimuli were presented in two ways, as complete pictures and as fragmented, incomplete pictures. Naming the fragmented pictures established the generated condition and naming the complete pictures established the non-generate condition. The testing phase included a recall test for all pictures and incorporated two source monitoring tasks. In the first source monitoring test task, subjects were presented with a list of pictures and the subjects judged if the picture was generated, named or not seen before during the experimental phase. Kinjo & Snodgrass (2000) felt that this source monitoring task drew the participant's attention more to the sensory features of the generated item. The second source monitoring task was called a success/failure task. Subjects were presented with the list of pictures and evaluated according to whether they had successfully or unsuccessfully recalled the picture during the recall test. The success/failure source monitoring task drew more attention to the cognitive operations involved in generating.

The results provided some important conclusions regarding the SGE for pictures. As expected, a robust SGE for pictures was found during the free recall test. The participants showed a stronger SGE for the complete/incomplete source monitoring task than for the success/failure task, supporting the notion that the extra sensory activation for generated pictures may have contributed to the emergence of the SGE in the complete/incomplete source monitoring task. This differed from words stimuli where semantic activation has been implicated. The researchers concluded from these findings that the SGE for pictures may have the "combined effect of extra sensory activation, extra semantic activation and additional cognitive operations" (Kinjo & Snodgrass, 2000, p. 118).

2.5 Application of the Self-Generation Effect to Individuals with Brain Damage

Recently, researchers have been attempting to transpose the work on the SGE to treatment strategies for individuals with brain damage (Barrett, Crucian, Schwartz, & Heilman, 2000; Chiaravalloti & DeLuca, 2002; Chiaravalloti, DeLuca, Moore & Ricker, 2005; Dick & Kean, 1989; Goverover, Chiaravalloti, Johnston & DeLuca, 2005; Lengenfelder, Chiaravalloti & DeLuca, 2003; Lipinska, Backman, Mantyla &

Viitanen, 1994; Michell, Hunt & Schmitt, 1986; Multhaup & Balota 1997; O'Brien, Chiaravalloti, Arango-Lasprilla, Lengenfelder & DeLuca, 2007; Souliez, Pasquier, Lebert, Leconte & Petit, 1996.

Multhaup & Balota (1997) studied the SGE with three groups: healthy elderly adults, participants with mild dementia of the Alzheimer type and participants with very mild dementia of the Alzheimer type. The study stimuli were complete and incomplete sentences. The generate condition was established by asking the participant to complete a sentence by generating a missing word. The read-only condition contained a complete sentence which was read to the participant by the examiner. A forced choice recognition test and a source monitoring test (Kinjo & Snodgrass, 2000) were used to test for the SGE. The source monitoring test required the participant to judge whether the words presented were self-generated or examiner-generated. The results indicated an SGE ; however, the source monitoring task performance was impaired in the participants with dementia. Similar results were replicated with persons with mild to moderate dementia by Souliez et al. (1996), Lipenska et al. (1994) and Barrett et al. (2000).

Dick & Kean (1989) also investigated the SGE in patients with mild to moderate dementia of the Alzheimer type and a control group of adults without dementia. Here again sentences were used as stimuli. In the generate condition, participants were required to generate the last word in the sentence. Some letters of the word were provided in order to constrain responses. In the non-generate condition the last word was typed in larger letters with the participate having to read only. The stimuli presentation was repeated three times. The test procedures included a free recall test and a source monitoring test, which included word stem completion. Results showed an SGE for the healthy control group but no SGE for the participants with dementia. Mitchell, Hunt & Scmitt (1986) found similar results. They argued that given the role of semantic activation in the SGE, and since semantic memory is disrupted in dementia of the Alzheimer's type, they did not expect to find an SGE in these participants. Such results provide further support for a semantic activation theory for the SGE.

However, Souliez et al. (1996) found an SGE for subjects with dementia when using sentences as stimuli. They argued that the SGE was not found by the above studies due to the type of dementia reported by the study participants, and due to the methodological differences in testing long-term memory in these patients, as opposed to their study where short-term memory was tested. They felt that the patients included in these two studies may have failed to benefit from the SGE because the dementia had progressed too far compared to their patients, who were in the first stage of the disease.

Chiaravalloti & DeLucca (2002) looked at self-generation as a means of maximising learning in multiple sclerosis, a condition where memory appears to be the most consistently identified cognitive dysfunction. Since persons with multiple sclerosis show a deficit in acquiring new information, it was expected that the SGE may provide a method for these patients to generate their own to-be-remembered stimuli. A sample population of 31 was selected in which 14 comprised the multiple sclerosis group and 17 comprised healthy controls who were matched for age and education. In this study participants were presented with 32 sentences, each on a separate page. For the generated condition 16 of the 32 sentences had a blank line which the subject had to construct the correct missing word. Recall and recognition of the words were then tested. Results show that the SGE may exist in individuals with multiple sclerosis as the generated words were recalled and recognised better than non-generated words.

Most recently, O'Brien et al. (2007) investigated the SGE for persons presenting with traumatic brain injury (TBI) and multiple sclerosis (MS). The researchers also aimed to describe the benefits of the SGE in participants presenting with different types of cognitive impairment. Their results showed a strong SGE for words in both the TBI and the MS groups. The results also showed that individuals with cognitive deficits in multiple cognitive domains may also benefit from the SGE.

Although the literature on the application of the SGE to populations with aphasias is scant, the current available literature on the application of the SGE to populations with other types of brain damage does seem to suggest that the nature of cognitive deficits in different types of neurological diseases may play a role in eliciting the SGE. The cases with dementia where the SGE was not elicited suggest that the SGE may also be dependent on the progression of the disease as well as access to factors that appear to influence self-generation itself (semantic activation, semantic memory, sensory activation, cognitive effort). However, in cases such as multiple sclerosis, where the SGE was elicited to the same magnitude as in normal healthy adults, a correlation between semantic activation and performance of the SGE cannot be assumed. The exact critical factors that influence the elicitation of SGE in neurological populations remain unclear. However, what is clear is that once the SGE is generated within these populations it may contribute to an improved understanding of the SGE and its workings. The nature of the SGE elicited in these populations suggests grounds for its application to the severe aphasias.

2.6 AAC and Severe Aphasia

The present study formulates hypotheses on the potential practical application of the SGE as a viable method for facilitating the recognition of Blissymbols in individuals with severe aphasia. Hence, this discussion now moves to a discussion of severe aphasia and the role of AAC in its treatment.

2.6.1 Defining severe aphasia

Aphasia is caused by damage to the language centres of the brain usually following a cerebral vascular accident (CVA). Depending on the extent of the damage and the site of the lesion, a CVA can produce an aphasia with a range of deficits across the speech-language domains.

A severe aphasia is associated with extensive language deficits. Although in most patients spontaneous recovery is expected within the first three to six months following the CVA, there remain variations between patients in the pattern or type of the recovery that is seen (Koul & Corwin, 2003). Some individuals do achieve complete recovery of natural language while others do not go on to achieve any spoken language. This latter group, who display chronic, severe speech-language deficits and do not show any signs of significant recovery following the period of spontaneous recovery, can be defined as presenting with a severe aphasia (Garrett &

Beukelman, 1992; Koul & Corwin, 2003) These individuals present with an aphasia with such severity that their natural language skills are "permanently impaired" (Koul & Corwin, 2003, p. 450).

The most common types of aphasia syndromes which lead to a severe aphasia include Brocas aphasia and global aphasia (Koul & Corwin, 2003). According to Nicholas & Helm-Estabrooks (1990), traditional speech-language therapy, which involved training patients to achieve expressive speech recovery, has shown little success in individuals with global or chronic severe Broca's aphasia. Hence, this study focused on these two types of severe aphasia.

Broca's aphasia is caused by lesions to the anterior language zone, which is responsible for performing expressive language actions such as speech, writing and gestures (Brookshire, 2003). Broca's area, also called the motor speech cortex, is responsible for planning and organising speech movements that to be executed by the primary motor cortex of the brain (Brookshire, 2003). Hence, damage to Broca's area caused by a CVA produces a non-fluent aphasia, the characteristics of which include:

- awkward articulation: words come slowly, laboriously and haltingly
- limited vocabulary
- restricted grammar: utterances are short and consist of mostly content words with few function words
- preserved auditory comprehension: understanding of speech and written language is much better than the ability to speak or write
- mild reading deficits
- severe writing deficits

When describing the neural basis of a global aphasia, Damasio (2001) states that it is usually caused by an occlusion of the middle cerebral artery, which results in extensive damage throughout the perisylvian region of the brain. This diffuse damage of the brain results in a severe language disorder with deficits in both the production and comprehension of language leading. The characteristic signs of severe global aphasia include:

- no or little speech output, with only a few stereotypical utterances
- severe auditory comprehension deficits
- severe reading deficits
- severe writing deficits

2.7 AAC Intervention for Persons with Severe Aphasia

There are several AAC symbol sets or systems that may be used with individuals with little or no functional speech. These are generally categorised into aided and unaided symbols. Aided symbol systems usually require some form of external modality like symbols or gestures to display them. This study focuses on the use of aided symbols, specifically, Blissymbols. Koul & Corwin (2003, p. 464) label this type of aided technique as "no-technology AAC intervention approaches". This is where individuals with severe, chronic Broca's aphasia and global aphasia are trained to use graphics symbols such as Blissymbols with the aid of technology.

Blissymbols is a graphic symbol system developed by Charles K. Bliss in the 1940s. The system is based on a small number of basic elements that are combined in various orientations to represent an infinite number of concepts (Fuller, 1997). Blissymbols are categorised into pictographs, which are graphically highly representative of the referent; ideographs are pictured representations of abstract ideas and arbitrary symbols in which the graphic symbol does not readily depict the referent. An integral part of the system is that an English word or gloss appears with each symbol thus allowing a person unfamiliar with the system to understand users of the system. Additionally, Blissymbols are created by combining various basic elements according to a set of rules. Hence, as more elements are added the more complex the symbol becomes. Several studies have looked at training individuals with severe aphasia to acquire graphic symbol systems like Blissymbols. These studies are presented in table 2.2. Thereafter, the most relevant studies are discussed further.

Table 2.2 List of Relevant AAC and Severe Aphasia Studies

Authors	**Aphasia Severity**	**Type of Symbols**	**Aims of the Study or Research Questions**	**Description of the Training**	**Findings**
Koul, Corwin & Hayes (2004)	Severe Broca's aphasia	Picture Communication Symbols (PCS) using the Gus software programme	Examined the ability of persons with severe aphasia to produce graphic symbol sentences of varying syntactic complexity, ranging from level I to level IV.	A single subject multiple baseline design was used. Participants were first trained to locate and identify pictures using the Gus software. In phase II, participants were trained to produce sentences with the pictures learnt. Baseline probes were conducted during phase I. Generalisation probes were conducted during the phase II.	Participants were able to combine graphic symbols to produce sentences and phrases. Five of the nine participants produced from level I through to level III sentences, eight of nine participants producing level II sentences and only three were able to produce level IV sentences.
McCall, Shelton, Weinrich & Cox (2000)	Global aphasia	C-VIC	Used a case study to examine the utility of a computerised visual communication system (C-VIC) as a diagnostic and therapeutic tool to identify propositional language changes.	The C-VIC training involves learning iconic vocabulary and simple syntactic rules. Training is directed to the conceptual, semantic and syntactic aspects of sentence production. Participants were trained to produce simple sentences to describe actions and to describe pictures.	Participants showed increased ability to represent sentences using syntactic rules by manipulating iconic symbols representing nouns and verbs. All improvements were specific to training only. No changes were noted on natural language or generalisation to production of multiple sentences using C-VIC.

Authors	Aphasia Severity	Type of Symbols	Aims of the Study or Research Questions	Description of the Training	Findings
Koul & Lloyd (1998)	Global aphasia Moderate aphasia	Blissymbols	Compared the performance on the recognition of Blissymbols by persons with aphasia, right hemisphere damage and normal controls. The effects of symbol complexity and translucency on learning were explored.	A factorial design was used. The three groups' ability to recognise symbols was compared. Participants were trained using paired-association to recognise symbol-referent pairs. Their recognition skills were tested after training.	Persons with aphasia were able to recognise the Blissymbols taught at similar levels to the normal controls and better than the subjects with right hemisphere damage. Persons with severe aphasia were found to learn and retain graphic symbols. Translucency was found to influence learning of the symbols.
Koul & Harding (1998)	Severe or global aphasia	TS software using PCS symbols	Evaluated the ability of persons with severe aphasia to identify and produce graphic symbols using a software programme on a laptop computer. These results were compared with past results using C-VIC.	A single subject multiple baseline design was used. During the first phase, participants were trained to identify single symbols and two-symbol combinations. During phase two, participants were trained to produce simple sentences.	Participants were found to learn the basic skills required to manipulate the software with ease. They could also identify noun symbols better than verb symbols, showing that iconicity plays a facilitating role in symbol acquisition. Subject-verb combinations were recognised beyond the baseline scores.

Authors	Aphasia Severity	Type of Symbols	Aims of the Study or Research Questions	Description of the Training	Findings
Beck & Fritz (1998)	Anterior aphasia Posterior aphasia	Prentke Romich Company Minspeak icons	Evaluated the ability of persons with aphasia to learn iconic codes.	Three groups were used: anterior aphasia (high comprehension), posterior aphasia (low comprehension) and normal group. There was one introduction session, three learning sessions and one testing session. Participants were trained to locate a iconic code for a verbal message chosen from a selection of 32 messages provided by the overlay from the "IntroTalker" devise. A factorial design was used to analyse main effects between group, level of abstraction of the message and length of iconic sequence.	Persons with aphasia were shown to have learnt the iconic codes in a controlled recall task. Participants were able to learn concrete messages better than abstract messages. As the length of the iconic codes increased, learning levels decreased. Participants with aphasia who had higher comprehension scores learnt more messages than participants with lower comprehension scores.
Weinrich, Shelton, McCall & Cox (1997)	Severe nonfluent Broca's aphasia	C-VIC	Evaluated the generalisation to multi-sentence production following training on single sentence production using a computerised language production programme (C-VIC).	Participants were trained to the locate the 32 nouns on the C-VIC software interface. Then they were trained on a small set of verbs and sentences. Participants were seen for individual therapy for 3 hours per week. Participants were in training from 7 to 11 months. Participants were tested after training using static pictures to elicit the target verbs and video descriptions to elicit the target verbs.	The 3 participants were able to successfully produce single sentences. Generalisation to multi-sentences was poor and did not approximate production levels of the single sentences. However, all participants demonstrated more productions in C-VIC than on the expressive video description task.

Authors	Aphasia Severity	Type of Symbols	Aims of the Study or Research Questions	Description of the Training	Findings
Shelton, Weinrich, McCall & Cox (1996)	Global aphasia	C-VIC	A computer-based language production training programme (C-VIC) was used as a diagnostic tool to describe and differentiate between the linguistic performances of 6 globally aphasic subjects.	A series of pre-training assessments were conducted to ensure participants could cope with the C-VIC training. The C-VIC training programme involved teaching the participants the meaning of a set of verbs and the syntactic structure required for each one. Participants were expected to learn how to produce a sentence of the verb at a criterion level. Results from the training data were analysed.	Using the iconic based C-VIC programme, participants were able to pick up the residual language skills in comprehension and production of nouns and verbs that were not seen on regular in-depth language assessments. These skills were usually thought to be absent in global aphasics. This supported the usefulness of such an augmentative communication system because the demands of English comprehension and production was removed and replaced by iconic symbols.
Bertoni, Stoffel & Weniger (1991)	Global aphasia	Pictographs	Examined the expressive and receptive use of pictographs in six communication domains.	Participants were trained to convey messages using pictographs. The programme started by training participants to use common pictographs expressively and receptively,and proceeded to the production of line drawings in response to question.	Participants were able to understand and express themselves using pictographs. Transparency of pictographs were found to help participants infer meaning.

The studies summarised in table 2.2 can be divided into two groups. Koul & Corwin (2003) label these groups as the technology based AAC intervention studies and the no-technology AAC intervention studies.

Koul & Lloyd (1998) compared the learning of Blissymbols in individuals with severe aphasia to individuals with right hemisphere damage. This is a good example of a study into the efficacy of a no-technology AAC intervention. Like earlier no-technology studies which had success in using Blissymbols with aphasics (e.g., Funnell & Allport, 1989; Sawyer-Woods, 1987; Johannsen-Horbach, Cegla, Mager, Schempp & Wallesch, 1987; Lane & Samples, 1981), Koul & Lloyd (1998, p. 412) were able to show that individuals with aphasia "did not differ significantly in the recognition of graphic symbols" from the neurologically undamaged adults. A total of 28 participants were included in the study. Of these, eighteen were neurologically normal adults, eight had right hemisphere damage and the remaining ten had aphasia due to left hemisphere damage. The aphasia severity was split between severe-global aphasia and moderate aphasia as determined by the referring speech-language pathologist's assessment on standard aphasia batteries. These participants were required to learn 40 Blissymbols which were balanced for the learning variables of translucency and complexity. A paired-associate paradigm was used to teach the Blissymbol's relationship to its referent. The same recognition based paradigm was used to measure the participants' rate of learning of the Blissymbols.

During the first experimental session the Blissymbols were taught to the participants in four blocks of trials. During each block the participant was presented with five 4X2 grids containing eight of the target Blissymbols. The participant was asked to point to the drawing that matches the word called out. If participants were correct, they were notified and if incorrect, the correct symbol was pointed out by the examiner. For scoring purposes, the first block was regarded as the guessability trial and the remaining three blocks were the learning trials. Following a one week pull-out period, the participants returned for experimental session two. In this round, the same procedure was repeated, where the first block was now the retention trial and the remaining three the learning trials.

The results indicated that the aphasic group showed an increase in the number of Blissymbols recognised from the first to the last block of trials in experimental session one. Following the one week pull-out period, the aphasic group recognised the same number of Blissymbols as the control group and their performance was superior to that of the right hemisphere group. The right hemisphere group's comparatively poorer overall performance led these researchers to suggest the possibility that ideographic Blissymbols may be processed by the right hemisphere of the brain. Additionally, it was found that translucency appeared to be an important variable in promoting the recognition of Blissymbols, with high translucency symbols being recognised better than low translucency variables. The researchers concluded that due to the nature of their findings, AAC symbols do have a "significant role in aphasia therapy;" however, they added that its success depends on further research to uncover "the variables that affect acquisition, retention and communicative use of symbols" (Koul & Lloyd, 1998, p. 415).

More recently, research into severe aphasia and AAC began to explore combining the use of graphic symbols and the computer as a means of alternate communication. Many recent studies dealing with graphic symbols and aphasia look at using graphic symbol software programmes together with dedicated communication aids that produce synthesised speech (Beck & Fritz, 1998; Koul, Corwin & Hayes, 2004; Koul & Harding, 1998; McCall, Shelton, Weinrich & Cox, 2000; Shelton, Weinrich, McCall & Cox, 1996; Weinrich, Shelton, McCall & Cox, 1997).

Such technology-based AAC intervention relies on the severe aphasic's ability to identify, combine and manipulate graphic symbols in an optimal fashion. Koul, Corwin & Hayes (2004) evaluated the efficacy of computer-based AAC interventions which relied on the severe aphasic's ability to acquire and also combine graphic symbols in order to produce graphic symbol sentences of varying levels of syntactic complexity. Their results indicated that eight out of nine participants were able to produce sentences using graphic symbols.

Other computer applications using graphic symbols have been used as both diagnostic tools and as therapeutic devices. Shelton, Weinrich, McCall & Cox (1996) were able to use a computer-based language production training programme (C-VIC) to differentiate between the various levels of linguistic performances in persons presenting with global aphasia. The researchers stated that because the iconic, graphic symbols utilised in C-VIC removes some of the semantic, syntactic and morphologic difficulties associated with expressive English, they were better able to describe what the global aphasic can and cannot do when describing the residual language functions. Not only were these individuals able to access and manipulate the graphic symbols they were exposed too, they also showed levels of language performance otherwise not expected from this population.

Although this particular study did caution that the application of C-VIC to functional communication still remains questionable, other studies in this area were able to support the finding that training on an iconic, graphic-based communication system using technology may even help improve natural language production in severe aphasia (Weinrich, McCall, Weber, Thomas & Thornburg, 1995). Two patients presenting with chronic Broca's aphasia were trained in the production of locative prepositional phrases and subject-verb-object (S-V-O) type sentences using C-VIC. Their results indicated that not only were the participants able to learn to produce S-V-O type sentences by manipulating the graphic symbols used by C-VIC, they also showed an improvement in verbal production of simple S-V-O sentences following the C-VIC training.

However, when similar testing was conducted more recently on globally aphasic individuals, McCall, Shelton, Weinrich & Cox (2000) were unable to show a similar improvement of natural language following training on sentences using the graphic symbols in C-VIC. However, this study was able to demonstrate that persons with severe global aphasia may retain the ability to perform several linguistic functions otherwise thought not to be available to these patients. McCall et al. (2000, p. 822) conclude that AAC treatment for global aphasia needs to be focused on "providing innovative and appropriate techniques" for treating severe linguistic deficits associated with this disorder.

The current research into the use of graphic symbols as a form of alternate or augmentative communication in severe aphasia is promising. Although studies have shown that severe aphasics can learn to use graphic symbols successfully, clinicians are still left without the actual techniques for helping patients with severe aphasia to successfully acquire such AAC methodologies. McCall et al. (2000) suggest that using treatments that use linguistically driven rules may not be the answer, even with the help of graphic symbols. For the severe aphasic, innovative techniques that reduce or remove the linguistic load may prove to be a more viable methodology for allowing these persons access to AAC and hence communication. Self-generation may be established in the absence of linguistic load, especially when using pictures and drawing. Hence, it could be a viable method for enhancing AAC learning. However, no research is available on integrating the benefits of self-generation and AAC learning.

2.8 Why Would Self-Generation Work With Severe Aphasia?

The acquisition of Blissymbols presents a major learning task for the individual presenting with aphasia. When the individual can recognise and recall the Blissymbols taught, then learning of the symbols has taken place. Recognition and recall are components of working memory.

Memory is seen as a product of the perceptual processing of stimuli. In order for learning to occur, individuals are required to process the to-be-learnt stimuli in an optimal fashion. This processing occurs at a perceptual level where stimuli are encoding into their phonemic, semantic, visual or auditory elements. Meaning is then extracted from this encoded information when it is compared to the individual's store of meaning representations from past experiences (Craig & Lockhart, 1972). Hence, meaning is attached to the new to-be-learnt stimuli. The memory trace is a by-product of this perceptual processing. For optimal recognition and recall to occur, the level at which stimuli, like Blissymbols, were processed will determine the strength of the memory trace. Self-generation may be a methodology of increasing the depth of perceptual processing of the to-be-learnt Blissymbols, thus enhancing the recognition and recall of these new stimuli (Jacoby, 1979; Slamecka & Graf, 1978).

Lane & Samples (1981) described the use of Blissymbols with four adult patients with severe aphasia who also exhibited severe verbal apraxia. The study intended to determine the patients' ability to learn Blissymbols in a group setting and use Blissymbols as a facilitating technique for communication. Interestingly, the participant who acquired the symbols by using the learning strategies of first drawing the symbol and then writing down its gloss was the most successful of the four participants in using Blissymbols. Results show that she pointed in response to a verbal stimulus 100% of the time, she was found to recall all 80 symbols included in the study upon repeated testing, she could combine three symbols and often spontaneously used the symbols in the group. Another participant also learnt the symbols by writing the gloss first then drawing the symbol. This patient scored the second highest from the four participants, obtaining 40% for pointing in response to a verbal stimulus, and could combine three symbols together.

The remaining two patients in the study learnt the symbols without drawing or writing, but rather used a paired association technique which linked the symbol with a verbally produced referent. Interestingly, these two participants did not retain the symbols taught from session to session and reported that they found it difficult to recall the symbol in response to a verbal stimulus. The researchers attributed this difference in the retention levels of the symbols to the superior auditory comprehension skills and motivation levels of the two more successful participants. However, upon further analysis it is plausible that the two participants retained the Blissymbols better because they were involved in the construction of the to-be-learnt symbols using drawing and writing. At some basic level, these two participants were self-generating and this may have enhanced the recall and hence use of the symbols.

Similarly, Funnell & Allport's (1989) case study with two severe aphasics also suggests that the patient's level of involvement in the construction of the stimulus improves naming and recall of the item itself. Here the researchers investigated whether Blissymbols did indeed provide "a superior medium relative to residual natural language skills" (Funnell & Allport, 1989, p. 279). They found that the participant's learning of Blissymbols mirrored the patient's natural language performance. Interestingly, this study used drawing as a means of establishing the learning and transfer of symbols to spontaneous speech. In the visual training condition the two participants were expected to draw from memory the Blissymbols they were introduced to previously after being presented with either the written gloss of the symbol referent or just the verbal referent. Upon further recall testing, the participants showed 100% acquisition of the symbols taught.

Current theories exploring the factors contributing to the SGE give promising motivation for why the phenomenon may be an effective teaching tool in individuals presenting with severe aphasia. There are several explanations for the SGE provided in the literature; however, McDaniel, Riegler & Waddill's (1990) three-factor theory provides the most compelling and comprehensive explanation for the SGE. Their factor theory suggests that the SGE is stimulated by the semantic activation of the features of stimulus item, the activation of the context within which the stimuli item is presented, and the activation of the relationship between the stimulus item and the desired response.

The semantic component of language reception and expression is usually severely impaired in severe aphasia (Naeser, Palumbo, Baker, & Nicholas, 1994). The self-generation theory suggests that the SGE may provide a three-pronged route for activating these absent semantic links in severe aphasia by focusing on the item, its context and the linking of the item with the desired response. This makes the SGE a possible technique for stimulating deep semantic processing of symbols, thereby enhancing their acquisition and retention.

Symbol systems provide a method for tapping into the cognitive processes which are no longer available to the surface forms of language like speaking and writing in individuals with severe aphasia. However, the learning of symbol systems presents the person presenting with severe aphasia with an immense learning task. If the SGE does in fact exist in these individuals, this field could be presented with a new method for enhancing the learning of symbols and ultimately improving retention levels for the symbols. The effect may provide a viable method for activating deeper semantic and relational attributes of the symbols and tapping into the residual language skills of the patient following severe brain damage. Hence, further investigation into these hypotheses is required.

2.9 Summary

This chapter reviewed the literature relevant to understanding this research area. It provided a summary of the experimental data that confirm the presence of the self-SGE for stimuli such as words, numbers and pictures. The chapter also helped expand the role that self-generation could play in the rehabilitation of persons with brain damage. Finally, ACC intervention with severe aphasia was discussed with specific implications for the incorporation of the SGE into such an approach.

CHAPTER 3
METHODOLOGY

3.1 Introduction

The objective of this study was to determine if the self-generation effect (SGE) would influence the recognition of Blissymbols in individuals with severe aphasia. This chapter outlines the methods and procedures used to meet this objective. It provides a concise yet detailed description of all the factors that contributed to investigating the research hypothesis. This description of methods includes a presentation of the selected research design, a description of the study participants, an outline of the stimulus material used in the study and a description of the data collection and analysis procedures. Figure 3.1 is a flow diagram that summarises the methodology used in this study.

3.2 Research Question

Does the self-generation effect enhance the recognition of Blissymbols in severe aphasic individuals when it is used as a treatment approach to teach these symbols?

3.2.1 Sub-questions

(i) What are the recognition levels for the Blissymbols taught when using the self-generation treatment approach?

(ii) What are the recognition levels for the Blissymbols taught when using a non-generation treatment approach?

(iii) To what extent do the recognition levels for the Blissymbols differ between the two treatment approaches?

(iv) Which treatment approach produces the best recognition levels for the Blissymbols taught over the different time intervals or withdrawal periods?

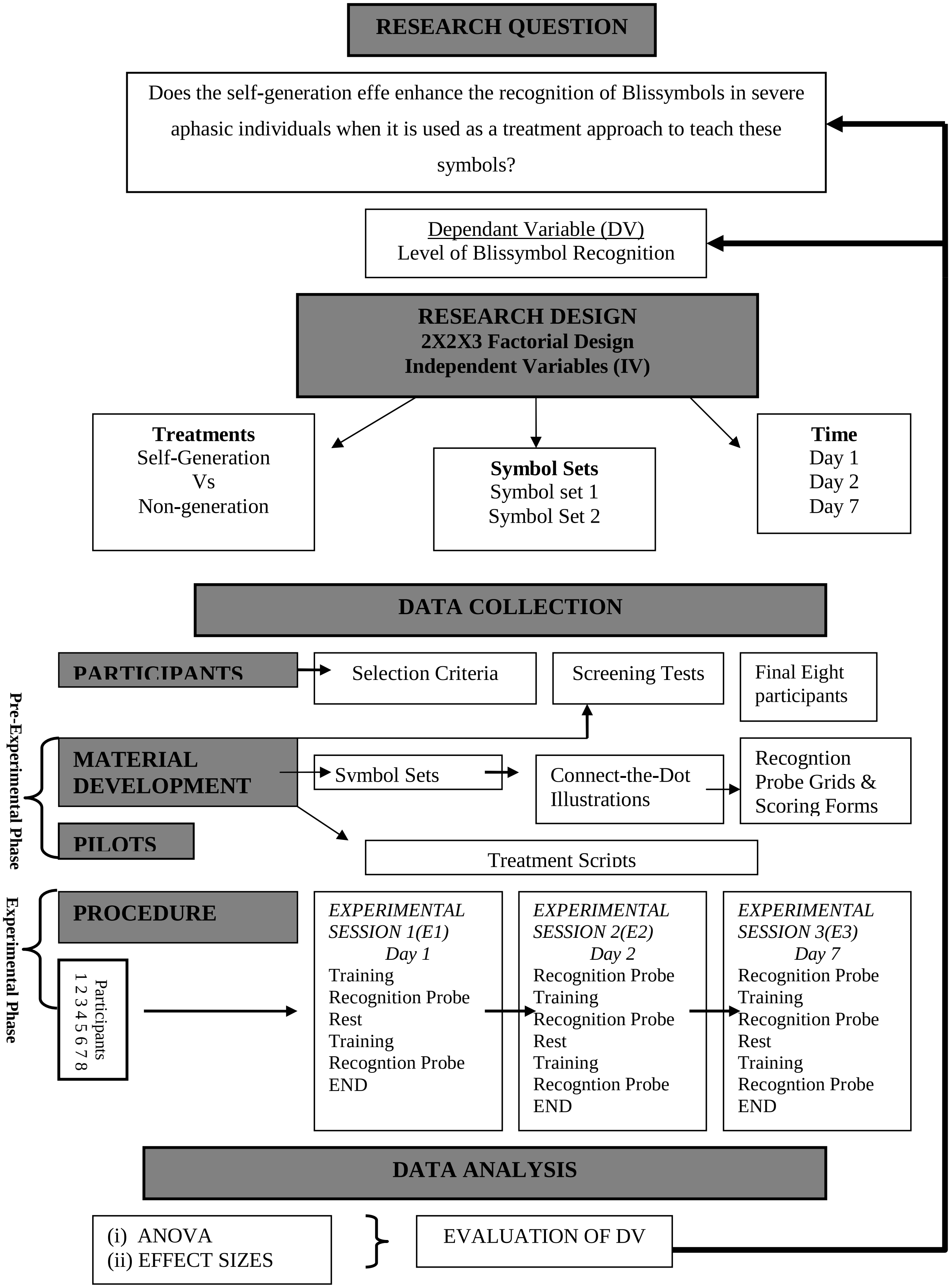


Figure 3.1 Flow diagram of the methodology

3.2.2 Steps towards answering the main research question

This research study aimed to:

(i) compare the recognition levels for the Blissymbols taught between the two treatment approaches namely self-generation and non-generation,

(ii) describe the effect of time on the recognition levels for the Blissymbols taught by using two withdrawal periods of two days and seven days,

(iii) carefully select research participants presenting with severe aphasia who strictly met the participant selection criteria,

(iv) develop two equivalent Blissymbol sets that were alternated between the two treatment approaches in order to prevent an exposure/adaptation bias,

(v) develop a set of stimulus materials that were specific to the two treatment approaches being compared,

(vi) teach the Blissymbols according to a set of pre-determined procedures specific to each treatment approach in order to prevent instructional bias.

3.3 Research Design

A 2X2X3 factorial design was utilised with a within-subject alternation of the treatments and symbol sets. This is essentially a true experimental group design which Hegde (2003) states allow for the simultaneous analysis of outcomes when two or more independent variables are used. The dependant variable in this study was the recognition level for each set of Blissymbols taught. The independent variables used in factor designs should have a minimum of two different levels. This study made use of three independent variables or factors with each including the prescribed minimum levels within each factor. This included the two treatment conditions, the two symbol sets and the three time intervals for the administration of the treatments. Hence this study made use of a 2X2X3 factorial design which had the two treatment types (self-generation and non-generation), the two symbol sets (S1, S2) and time (day 1, day 2, day 7) counter-balanced as within-subject factors. Hegde (2003) adds that the active independent variables or factors in factorial designs can be manipulated by the experimenter in order to analyse the effect and interactions of two or more such variables. A description of the active independent variables or factors included in this study now follows.

(i) Factor 1: The two treatments

In this study the two treatments types were the self-generation condition and the non-generation condition. The self-generation condition was established by the participant completing a connect-the-dot picture representation of the symbols included in the to-be-learnt set of Blissymbols. Hence by connecting the dots to form the complete symbol the participant became involved in the construction or generation of the to-be learnt symbol. The non-generation condition was established by pairing the symbol with its referent which was provided verbally. Hence in the non-generation condition the participant was not in anyway involved in deriving or constructing the to-be-learnt Blissymbol but was required to associate the verbal referent with the Blissymbol.

(ii) Factor 2: The symbol sets

In order to prevent an exposure bias, two different symbols sets were required for the training. The administration of the two treatment conditions were carefully counter-balanced within each subject for the two different but compositionally equivalent Blissymbol sets (for a list of the symbols in set 1 and set 2 see appendices 2a and 2b). These two equivalent symbol sets comprised of a total of 28 Blissymbols which were taught to each participant using either one of the treatment approaches. Each symbol set was allocated 14 Blissymbols each. The Blissymbols that were selected for inclusion into these to-be-learnt sets were obtained from a preliminary set of forty Blissymbols (Appendix 1) which were used by Koul & Lloyd (1998) to investigate whether persons with severe aphasia could learn Blissymbols (see section 3.5.1 for details on how the symbol sets were developed).

(iii) Factor 3: Time

Two withdrawal periods were applied in order to identify which treatment produced superior recognition levels over time. This was critical to answering of the main research question as the results determined which treatment approach emerged as being more robust over an extended period of time. Hence the withdrawal periods introduced the time factor. Training occurred over three different time intervals, namely, Day 1 (experimental session E1), Day 2 – two days after day 1 training (experimental session E2) and Day 7- seven days after day 1 training (experimental session E3). Table 3.1 shows the two withdrawal periods.

In order to measure the effect of these time lines on the two treatment approaches probe measures were conducted after each training block. Table 3.1 shows when the probe measures were conducted and also specifies what the probe measured. There were two types of probes:

- Recognition probes conducted directly after training tested recognition for the particular symbol set when using the specified treatment condition,
- Retention probes conducted before training recommenced on Day 2 and Day 7. This retention probe measured recognition levels retained for both symbol sets taught during the previous experimental session.

These two types of probe measures allowed for the comparison of recognition and retention levels between treatments as a function of the time intervals.

3.3.1 Within-subject counter-balancing of symbol sets and treatment

The presentation of the same symbol set using the same treatment condition over the three experimental sessions would have led to a learning adaptation and an exposure bias. To prevent this, it was important to ensure that each participant was trained on a different symbol set and a different treatment condition during each experimental session. Table 3.1 shows how the treatments and the symbol sets were counter-balanced for each participant so as to prevent a participant receiving the same treatment and symbol set within the same experimental session (see section 3.6.2.1 for details on the training procedure used). Each participant was taught symbol set 1(S1) or symbol set 2(S2) using either the self-generation strategy (Treatment 1 - T1) or the non-generated strategy (Treatment 2 - T2). Counter-balancing also controlled for order effects in the presentation of symbol sets and the presentation of the treatment types. A set of criteria was used in order to guide the counter-balancing of the sets and treatments. The criteria stipulated the following:

- The participant was exposed to both treatments during each experimental session.
- The participant was exposed to a different symbol set per treatment. The same symbol set could not be used for the two different treatments during the same experimental session. This prevented exposure bias.
- Symbols sets and treatments were alternated within each subject over the three experimental sessions in a random fashion which ensured that order of exposure did not produce any bias. However, due to random ordering, a between-subject analysis shows that S2T2 did not appear in session E1 as an initial combination (see Table 3.1). This was not seen to compromise order effects as S2T2 did appear in session E2 for participant 3 and participant 7 as an initial training combination. Additionally, the main purpose of the counter-balancing was to ensure that each participant received a different symbol set and treatment condition over the three experimental sessions and not to ensure counter-balancing within the entire group of participants.

Hence, the research design included the following defining elements:

- Dependant variable: the level of recognition for Blissymbols taught
- Independent variables or factors: treatments (T1, T2), symbol sets (S1, S2) and time (day 1 - E1, day 2 - E2, day 7 - E3)
- Participants: Eight participants presenting with severe aphasia were included in the study
- Equivalent symbol sets: The study design required the use of two different groups of symbols (symbol set 1 and symbol set 2). Their equivalency was established by strictly matching the descriptive characteristics of the symbols for each symbol set. These two groups or sets of symbols were alternated between the two treatment approaches to prevent participants from becoming over-exposed to any one set as well as to prevent presentation or order bias.

Table 3.1 Counter-balancing of symbol sets (S1, S2), Treatments (T1, T2) and Time (Day 1, Day 2, Day 7)

Participant	Experimental Session (E1) Day 1	Experimental Session (E2) Day 2(two day withdrawal period)	Experimental Session (E3) Day 7 (seven day withdrawal period)
1	Training S1T1 Recognition Probe for S1T1 Rest Training S2T2 Recognition Probe for S2T2 End Session	Retention Probe for S1T1 and S2T2 Training S1T2 Recognition Probe for S1T2 Rest Training S2T1 Recognition Probe for S2T1 End Session	Retention Probe for S1T2 and S2T1 Training S1T1 Recognition Probe for S1T1 Rest Training S2T2 Recognition Probe for S2T2 End Session
2	Training S1T2 Recognition Probe for S1T2 Rest Training S2T1 Recognition Probe for S2T1 End Session	Retention Probe for S1T2 and S2T1 Training S1T1 Recognition Probe for S1T1 Rest Training S2T2 Recognition Probe for S2T2 End Session	Retention Probe for S1T1 and S2T2 Training S2T1 Recognition Probe for S2T1 Rest Training S1T2 Recognition Probe for S1T2 End Session
3	Training S2T1 Recognition Probe for S2T1 Rest Training S1T2 Recognition Probe for S1T2 End Session	Retention Probe for S1T2 and S2T1 Training S2T2 Recognition Probe for S2T2 Rest Training S1T1 Recognition Probe for S1T1 End Session	Retention Probe for S1T1 and S2T2 Training S2T1 Recognition Probe for S2T1 Rest Training S1T2 Recognition Probe for S1T2 End Session
4	Training S1T2 Recognition Probe for S1T2 Rest Training S2T1 Recognition Probe for S2T1 End Session	Recognition Probe for S1T2 and S2T1 Training S1T1 Recognition Probe for S1T1 Rest Training S2T2 Recognition Probe for S2T2 End Session	Recognition Probe for S1T1 and S2T2 Training S2T1 Recognition Probe for S2T1 Rest Training S1T2 Recognition Probe for S1T2 End Session
5	Training S1T1 Recognition Probe for S1T1 Rest Training S2T2 Recognition Probe for S2T2 End Session	Retention Probe for S1T1 and S2T2 Training S1T2 Recognition Probe for S1T2 Rest Training S2T1 Recognition Probe for S2T1 End Session	Retention Probe for S1T2 and S2T1 Training S1T1 Recognition Probe for S1T1 Rest Training S2T2 Recognition Probe for S2T2 End Session

Participant	Experimental Session 1(E1)	Experimental Session 2(E2)	Experimental Session 3 (E3)
6	Training S1T2 Recognition Probe for S1T2 Rest Training S2T1 Recognition Probe for S2T1 End Session	Retention Probe for S1T2 and S2T1 Training S1T1 Recognition Probe for S1T1 Rest Training S2T2 Recognition Probe for S2T2 End Session	Retention Probe for S1T1 and S2T2 Training S2T1 Recognition Probe for S2T1 Rest Training S1T2 Recognition Probe for S1T2 End Session
7	Training S2T1 Recognition Probe for S2T1 Rest Training S1T2 Recognition Probe for S1T2 End Session	Retention Probe for S1T2 and S2T1 Training S2T2 Recognition Probe for S2T2 Rest Training S1T1 Recognition Probe for S1T1 End Session	Retention Probe for S1T1 and S2T2 Training S2T1 Recognition Probe for S2T1 Rest Training S1T2 Recognition Probe for S1T2 End Session
8	Training S1T2 Recognition Probe for S1T2 Rest Training S2T1 Recognition Probe for S2T1 End Session	Recognition Probe for S1T2 and S2T1 Training S1T1 Recognition Probe for S1T1 Rest Training S2T2 Recognition Probe for S2T2 End Session	Recognition Probe for S1T1 and S2T2 Training S2T1 Recognition Probe for S2T1 Rest Training S1T2 Recognition Probe for S1T2 End Session

3.4 Study Phases

This study included two major phases. The first was the pre-experimental phase which included material development and the pilot studies, while the second, the experimental phase included the pre-experimental participant screening and the experimental sessions. Table 3.2 summarises these phases by providing a description and purpose of each phase of the study. This table also shows which section in the chapter discusses a particular phase in greater detail.

Table 3.2 The study phases

Study Phase	Purpose	Description
A. PRE-EXPERIMENTAL PHASE		
1. Material Development	During this phase all materials used in the study were developed and tested.	This included the development of the equivalent symbol sets (section 3.5.1), the connect-the-dot illustrations (section 3.5.2, Appendix 3a), the recognition probe grids (section 3.5.5, Appendix 6a, 6b), and the recognition probe scoring forms (section 3.5.5, Appendix 7a, 7b).
2. Pilot Studies (section 3.5.6)	The outcomes of the pilot studies allowed for the refinement of the research methodology.	The complete data collection protocol was tested on two participants who met the participant selection criteria.
B. EXPERIMENTAL PHASE		
1. Participant Selection Screening Tests (section 3.5.3)	Prospective participants underwent a preliminary screening procedure to determine whether they would meet the participant selection criteria (see section 3.6.1.2). Participants who passed this screening phase were included in the study.	Pre-experimental tests administered included: Boston Diagnostic Aphasia Examination (Goodglass and Kaplan, 1983), Pointing Skills/ Receptive Language (see Appendix 5a),Visual Discrimination Test (Appendix 5b)and Connect-the-Dot execution test (Appendix 5c).
2. The Experimental Sessions (section 3.6)		
Experimental Session E1	This was the initial training session using each treatment condition followed by recognition probes. There were rest periods between treatments.	The two symbol sets were alternated between the two treatment strategies. A recognition probe measure was conducted after training on each set.
Experimental Session E2	This was the second training following a withdrawal period of two days.	Participants' recognition levels for symbols taught in E1 were tested. Participants' recognition levels for all symbols taught in E2 were tested.
Experimental Session E3	This was the third and final training following a withdrawal period of seven days.	Participants' recognition levels after E1 & E2 were tested. Participants' recognition levels for all symbols taught in E3 were tested.

3.5 The Pre-Experimental Phase

The pre-experimental phase began with the development of the study materials followed by the pilot studies. A list of the five main study materials or stimuli which were developed is presented in Table 3.3. The process for developing each of these stimuli is described in detail in the sections to follow (see section 3.5.1 to 3.5.5). Thereafter the pilot study process and outcomes are presented (see section 3.5.6).

Table 3.3 List of developed material

Stimulus	Stimulus Description	Purpose	Methods
(i) Symbol Set 1 and Symbol Set 2 (section 3.5.1, Appendix 2a, 2b)	Two functionally equivalent symbol sets that were counter-balanced between the treatments were developed. Fuller's (1997) forty symbols with their four descriptive groups were used for the initial selection. Section 3.5.1 describes the selection process in detail.	Symbol set 1 and symbol set 2 were balanced using four equivalency variables namely: translucency, complexity, familiarity and frequency of use.	Fuller & Lloyd's (1987) complexity values were used to objectively rate the complexity of each symbol selected. Likert ratings were conducted with under-graduate students for the remaining three equivalency variables. Statistical analysis was used to analyse ratings and reject symbols falling outside of the rating. (see section 3.5.1)
(ii) Connect-the-Dot Picture Illustrations (section 3.5.2, Appendix 3a)	The final 28 Blissymbols were converted into a connect-the-dot format by a professional illustrator.	To establish the self-generation condition.	The illustrator made professional judgements on the number of dots required per category of symbols. As symbol complexity increased, the number of dots increased. The number of dots used per drawing was in proportion to its complexity value. Section 3.5.2 describes the development of these illustrations.
(iii) Treatment Scripts (section 3.6.2.3)	The two treatment conditions were scripted in order to strictly match teaching strategies in both treatment conditions.	To define a strict treatment administration script for the non-generation and the self-generation approaches.	A script for the non-generated condition was developed and tested for equivalency to the self-generation condition during piloting.

(iv) Participant screening tests (see Section 3.5.3 for full description)	Development of the Pointing Skills/ Receptive language Test (Appendix 5a), Informal Visual Discrimination Test (Appendix 5b) , Connect-the-dot execution test (Appendix 5c)	To ensure that all participant selection criteria were adequately met.	Test were developed and tested for reliability during piloting.
(v) Scoring Forms (Section 3.5.4, Appendix 6a, 6b, 7a & 7b)	Developed to determine and record recognition levels during recognition probes.	To ensure that all recognition scores were recorded in an accurate manner for data analysis.	2X4 scoring grids were used as recognition probes. Scoring forms were tables which included columns for the symbol and the gloss. The numbering corresponded with the stimuli numbering. There was a scoring column for ticking or crossing correct /incorrect responses.

3.5.1 Development of the equivalent symbol sets

3.5.1.1 Defining the equivalency variables

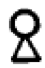
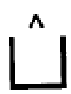
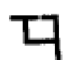
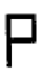
Two equivalent Blissymbol sets were required for counter-balancing between the two treatment approaches. The selection of the Blissymbols included in the two symbol sets was based on Fuller's(1997) study on the effects of translucency and complexity on the learning of Blissymbols by normal children and adults. This study used 40 Blissymbols which were randomly selected from the 910 Blissymbol set for which Lloyd & Karlan, 1986 (in Fuller, 1997) allocated translucency values. Fuller's (1997) set of 40 symbols was also used by Koul & Lloyd's (1998) study which investigated the acquisition of Blissymbols by individuals with severe aphasia. These 40 Blissymbols were divided into four groups of 10 symbols each (Table 3.4 and Appendix 1). The four groupings were: high translucency-high complexity (HTHC), high translucency low complexity (HTLC), low translucency-high complexity (LTHC), low translucency-low complexity (LTLC).

Table 3.4 Forty blissymbols within four groupings (Fuller, 1997)
Adapted from Koul & Lloyd (1998)

High Translucency–High Complexity Symbols

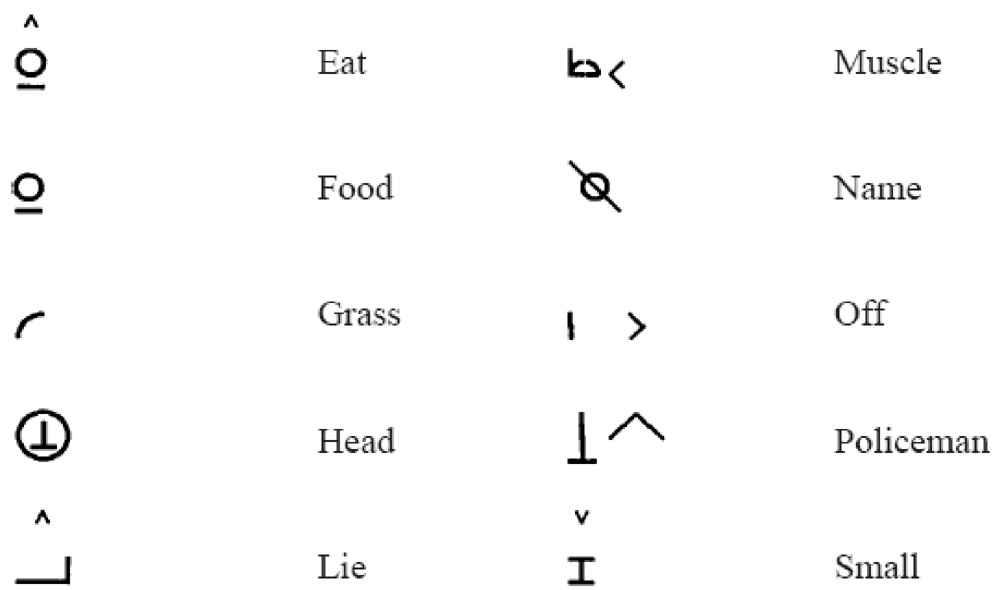
	Brick		Love
	Bus		Pizza
	Car		Push
	Chin		Surprise
	Jail		Train

High Translucency–Low Complexity Symbols

	Apple		Girl
	Banana		Jump
	Bowl		Open
	Dish		Stamp
	Flag		Teeth

Low Translucency–High Complexity Symbols

Low Translucency–Low Complexity Symbols



The equivalency of the two symbols sets used in the present study were based on the following equivalency variables:

- Translucency: Each set included the same number of high and low translucency symbols. Translucency has been shown to influence the learning of Blissymbols by adults and children (Koul & Lloyd, 1998; Fuller & Lloyd, 1992; Luftig & Bersani, 1985). Fuller's (1997) four groups of symbols were derived using Lloyd & Karlan's (citied in Fuller, 1998) translucency ratings. These translucency ratings were obtained by asking university students to rate the symbol's translucency on a Likert scale. Since the ratings of translucency in Lloyd & Karlan's (citied in Koul & Lloyd, 1998) study were based on the perceptions of a group of American students, it was important to determine whether the symbols translucency ratings would remain the same if they were re-rated by South African participants. Replication of this simple rating test with a group of South African undergraduate university students helped to confirm whether the translucency ratings remained unchanged.

- Complexity: Each symbol set was balanced for the number of high and low complexity symbols included. Complexity values were not subjected to a rating procedure. Instead Fuller & Lloyd's (1987) definition of complexity was used. These authors determined a symbol's complexity by the number of strokes required to construct the symbol. Symbols which had between one and five strokes were defined as being low in complexity and symbols which had eight or more strokes were defined as being high in complexity. Table 3.5 shows the complexity values which were used in this study as determined by Fuller & Lloyd (1987).

Table 3.5 Complexity values (adapted from Koul & Lloyd, 1998)

Symbol	Complexity Value	Group
Brick	14	HTHC
Bus	15	
Car	9	
Chin	8	
Jail	13	
Love	8	
Pizza	8	
Push	9	
Surprise	8	
Train	11	
Apple	4	HTLC
Banana	3	
Bowl	1	
Dish	3	
Flag	4	
Girl	5	
Jump	5	
Open	5	
Stamp	4	
Teeth	5	
Birthday	8	LTHC
Coke	10	
Cookie	10	
Pancake	18	
Popcorn	12	
Sister	8	
Sleep	9	
Sock	14	
Thirsty	10	
Toothbrush	9	
Eat	5	LTLC
Food	5	
Grass	1	
Head	4	
Lie	4	
Muscle	5	
Name	3	
Off	3	
Policeman	4	
Small	5	

- Familiarity: Symbols included in each of the symbol sets were required to be equally familiar to the study participants as unfamiliarity could influence recognition of the symbol. A Likert scale was used to rate the familiarity of the symbol referents included in Fuller's (1997) set of 40 Blissymbols. The same group of university students were asked to rate how familiar they were to the list of symbol referents listed.

- Frequency of Use: The two symbol sets were allocated with symbols that were rated as being used frequently in everyday situations. Fuller's (1997) 40 Blissymbols were thus evaluated for their frequency of use in everyday speaking situations in the South African context. Symbols that represented words or concepts that were frequently used by speakers (that is, had a high everyday functional value in communication) were seen as influencing the degree to which participants felt motivated to acquire the symbol. Should one set have been found to be more functionally relevant than the other, it may have provided a serious threat to the internal validity of the research design. The two symbol sets were therefore balanced to include a good distribution of functionally relevant symbols that had an equivalent frequency of use rating.

3.5.1.2 Procedure for rating the equivalency variables

In order to obtain the ratings for translucency, familiarity and frequency of use, the original 40 symbols (Fuller, 1997) were re-rated by 18 South African undergraduate students who had had no previous exposure to Blissymbols. These students comprised a mix of 13 first-language English speakers who were Indian South Africans and five second-language English speakers who were Black South Africans. All participants, both first- and second-language English speakers, rated their English proficiency in speaking, understanding, reading and writing as high. These students were enrolled for their third year of their undergraduate studies in which all tuition is offered in English. This further supports their English proficiency. Participants were in the age range of 20 to 23 years. Likert scales were used in order to obtain ratings for translucency, familiarity and frequency of use. Three different booklets were used which clearly described the required type of rating. All three booklets were presented separately. A booklet was handed out, the instructions read out loud and then the rating was completed. Then the next two variables were presented in the same manner one after the other. The procedure was completed in 30 minutes. Appendix 4a shows the instructions presented to the participants in each of the booklets.

For the translucency rating (Appendix 4), the participants were asked to judge how closely related they perceived a symbol and its referent to be. They were instructed to rate the symbol with the digit 1 if they were strongly related and with a 7 if they were perceived to be highly unrelated. The numbers in between were to be used to rate various degrees of perceived translucency. Hence, highly translucent symbols' ratings should ideally approach 1 and low translucency symbols' ratings should approach 7. For the translucency booklet, the symbols and referents were presented in a table with columns for the symbol and referent pair. The rater selected a rating by ticking the corresponding column allocated with a 1 through to 7.

For the familiarity rating (Appendix 4), the participants were to evaluate each symbol's referent for how familiar the word was to them. If they knew the word well and were very familiar with it, they were instructed to allocate the symbol a 1 and if the word was unfamiliar and unknown to them, they were to allocate the word with a 7. The numbers in between were to be used to rate various degrees of perceived familiarity. Hence, ideally, the ratings of highly familiar words should approach 1. A table with only the referents (listed from 1 to 40) and corresponding columns to tick the selected rating from 1 through to 7 was used.

For the frequency of use rating (Appendix 4), participants were instructed to make a judgment about how often they used a word. If the word was used often, they were instructed to allocate it a 1 and if it was not used often, it should be allocated a 7. The numbers in between represented the various degrees of use of the word. Hence words with a high frequency of use should have a mean rating approaching 1. The table used was the same as the familiarity rating.

Once the student rating procedure was complete, the results were analysed using descriptive statistics to identify the mean ratings and standard deviation for each of the four groupings of symbols. In order to compare the ratings of symbols within each category, the Friedman two-way Analysis of Variance Test was performed.

3.5.1.3 Results of the rating procedure

(i) Translucency Ratings

- High-translucency symbol ratings

There were two groups of symbols that fell into the high translucency category (as determined by Fuller, 1997). These were the high translucency – low complexity (HTLC) group and the high translucency – high complexity (HTHC) group. The latter group was analysed first.

The statistical analysis of the high translucency – high complexity symbol group showed a statistically significant difference in the student's ratings of high translucency ($p< 0.001$). This implies that although this group of symbols was described by Lloyd & Fuller (citied in Koul & Lloyd, 1998) as being highly translucent, the students did not rate some symbols in the group as such. In trying to isolate which symbols contributed to the overall difference, the symbol means were ranked and analysed. In addition, the symbol means were compared pair-wise using the Friedman test.

Table 3.6 shows the ranked means (most favourable to the least favourable) and standard deviations obtained in the HTHC group. The cutoff mean level was determined by using Lloyd & Karlan's (cited in Koul & Lloyd, 1998) high translucency mean rating value (called translucency value in the study) which scored between 4.5 and 7.0. However, in the present study, the rating instructions of the Likert scale were somewhat different from Lloyd & Karlan's translucency study. Their study used the 7 rating to indicate high translucency while the present study used the opposite end of the scale (ie. 1) to indicate high translucency. Hence, in this present study, symbols with a mean above 3.5 (conversion of 4.5 to 7.0 rating used by Lloyd & Karlan, 1986, cited in Koul & Lloyd, 1998) were rejected. Table 3.6

highlights symbols (5-jail, 9-surprise, 10-train) unfavourable means. Table 3.6 also includes the results of the pair-wise comparisons between the symbols in this group. This analysis helped to identify exactly where the overall difference in the ratings existed. In Table 3.6, each of the ten symbols in the group is given its own postscript ranging from *a* to *j*. Symbols whose mean rating did not differ at the 5% level when compared to each other, shared a postscript. Table 3.6 shows how symbol 4, 5, 9 and 10 were differed consistently at a 5% level when compared to the mean rating for high translucency of the other symbols in the group.

Hence, the decision to reject symbol 4, 5, 9 and 10 was based on a combination of their means being above the 3.5 cutoff as well as the pair-wise comparison results. Table 3.6 shows the rejected symbols in this group.

Table 3.6 Results for high translucency-high complexity group

Symbol Number and Referent	Mean	Standard Deviation
6 love [abcdef]	1.7	1.5
1 brick [abcdefghij]	2.4	1.4
7 pizza [abcdefghij]	2.7	2.8
8 push [abcdefghij]	3.0	2.0
3 car [abcdefghij]	3.1	1.8
2 bus [abcdefghij]	3.1	1.7
4 chin [abcdefghij]	3.9	2.4
5 jail [bcdefghij]	3.9	2.0
9 surprise [cdefghij]	4.8	1.9
10 train [cdefghij]	4.9	1.6

In the following section, the analysis of the high translucency – low complexity group is discussed. This category had a significant p-value ($p < 0.001$). Again, in order to investigate which symbols contributed to this difference, the means as well as the pair-wise comparisons between all symbols in the category were reviewed. In Table 3.7, the means and standard deviations of the ratings are presented as well as the pair-wise analysis results. Symbols sharing postscripts (a, b, c) are similar and those not sharing a postscript were rated differently at a 5% level. Within this category symbols with a mean above 3.5 and which did not consistently share the same mean rating level when compared to the other symbols were rejected. Hence, the rejected symbols were 18 (open) and 19 (stamp). The symbols had unfavourable means (above 3.5 cutoff level) and were consistently rated differently at a 5% level from other symbols in the category as indicated by their postscripts.

Table 3.7 Results for high translucency-low complexity group

Symbol Number and Referent	Mean	Standard Deviation
11 apple ^{abcde}	1.1	0.2
12 banana ^{abcde}	1.2	0.9
15 flag ^{abcdefgh}	1.7	1.4
13 bowl ^{abcdefghi}	2.3	1.3
16 girl ^{abcdefgh}i	2.4	1.5
14 dish ^{cdefghi}	3.2	1.8
17 jump ^{defghi}	3.4	1.7
20 teeth ^{defghi}	3.5	1.9
18 open ^{ghi}	4.9	2.1
19 stamp ^{ghi}	5.4	1.9

- Low-translucency symbol ratings

In the low translucency- high complexity (LTHC) instance the p-value was not significant ($p>0.001$). Hence there was no significant difference in the rating of the symbols in this category and all symbols can be accepted as being low in translucency as determined by Lloyd & Karlan (cited in Koul & Lloyd, 1998). Table 3.8 shows the means for this group. It is evident that the mean ratings are above 3.5 confirming their low translucency description.

Table 3.8 Results for low translucency-high complexity group		
Symbol Number and Referent	Mean	Standard Deviation
22 coke	6.4	0.9
23 cookie	6.4	1.1
24 pancake	6.3	1.2
21 birthday	5.9	1.4
28 sock	6.1	1.6
29 thirsty	6.0	1.4
26 sister	5.7	1.6
27 sleep	5.7	1.8
25 popcorn	5.6	1.4
30 toothbrush	4.7	1.7

Similarly, the p-value of the low translucency – low complexity (LTLC) was not significant ($p>0.001$), which indicates that no statistical difference exists between the ratings. This supports the acceptance of all symbols in this category as being low in translucency. Table 3.9 summarises the mean ratings for this group. As can be seen, the mean rating for all symbols are above the 3.5 cutoff mark.

Table 3.9 Results for low translucency-low complexity group		
Symbol Number and Referent	Mean	Standard Deviation
39 policeman	6.3	1.4
37 name	6.0	1.3
32 food	5.7	1.5
31 eat	5.6	1.5
35 lie	5.2	1.9
38 off	5.2	1.8
40 small	5.1	2.2
34 head	4.7	2.4
36 muscle	4.7	1.8
33 grass	3.9	2.3

(ii) Familiarity ratings

The p-value was found to be non-significant for this rating in all groups (p>0.001). This indicates that all of the 40 symbols were rated as being familiar to the participants. Table 3.10 summaries the non-significant p-values for each group of symbols.

Table 3.10 p-Values for familiarity ratings

Group	p- value
HTLC	0.964
HTHC	0.986
LTLC	0.883
LTHC	0.279

(iii) Frequency of use ratings

- High translucency-high complexity group

The overall p-value for this group was significant (p<0.001). This indicates that some of the symbols were rated differently from each other. Table 3.11 summaries the mean ratings for frequency of use which helps identify which symbols were being unfavourably rated. A favourable rating here means that the mean rating approached 1 as this would indicate that the referent was perceived to be used frequently. When deciding on the cutoff point for the means, the values of the means were evaluated collectively. The majority of the mean ratings fell between 1 and 3. Hence, any mean that fell above 3.0 was rejected as it was not seen as being familiar enough. Additionally, the pair-wise comparisons were also used to decide on a rejection. In Table 3.11 similarly rated symbols shared a postscript. Hence, based on the evaluation of means and the pair-wise analysis, the rejected symbols were 9 (surprise), 4 (chin), 1 (brick), 5 (jail).

Table 3.11 Results for high translucency-high complexity group

Symbol Number and Referent	Mean	Standard Deviation
2 bus [bcfh]	1.2	0.4
3 car [bcfhj]	1.2	0.4
6 love [bcdghi]	1.4	1.0
7 pizza [abcdefhij]	1.7	1.1
8 push [abcdefghij]	2.2	1.3
10 train [abcdefhij]	2.4	1.6
9 surprise [adehij]	3.1	1.9
4 chin [adefhi]	3.2	2.1
1 brick [adehij]	3.3	1.9
5 jail [adehij]	3.3	1.7

- High translucency-low complexity group

The overall difference in this group was significant ($p < 0.001$). The cutoff mean was set at 3.2. Symbol 15 (flag) did not meet this criterion. The pair-wise test results (as indicated by the allocated postscripts in Table 3.12) also shows that symbol 15 (flag) was rated significantly differently from other symbols in the group. Hence, symbol 15 (flag) was rejected as its frequency of use was rated as being low.

Table 3.12 Results for high translucency-low complexity group

Symbol Number and Referent	Mean	Standard Deviation
18 open [abcdfghij]	1.4	1.1
13 bowl [abcdfghij]	1.4	0.8
16 girl [abcdfghij]	1.5	1.0
11 apple [abcdfghij]	1.5	0.7
12 banana [abcdfghij]	1.6	1.0
14 dish [abcdfghij]	1.8	1.6
20 teeth [abcdfghij]	2.1	2.8
17 jump [abcdefghij]	2.3	1.5
19 stamp [abcedfghij]	3.2	2.0
15 flag [degi]	4.2	2.2

- Low translucency - high complexity

There was no significant difference in the ratings in this group (p>0.001). Hence, all symbols in this group were accepted as having a high frequency of use rating.

- Low translucency - low complexity

There was no significant difference in the ratings in this group (p>0.001). Hence, all symbols in this group were accepted as having a favourable frequency of use rating.

3.5.1.4 The rejected symbols

The student rating outcomes are summarised in Table 3.13 which shows the symbols that were rejected and their rejection variable.

Table 3.13 Summary of rejected symbols after rating procedure

Rejected Symbol	**Rejection Variable**	
	Translucency	**Frequency of Use**
1 brick		•
4 chin	•	•
5 jail	•	•
9 surprise	•	•
10 train	•	
15 flag		•
18 open	•	
19 stamp	•	•

3.5.1.5 The balanced sets

Once the eight rejected symbols were removed from the original 40 Fuller (1997) symbols, the remaining 32 symbols were randomly allocated to either Symbol Set 1 or Symbol Set 2. However, the rejection of symbols resulted in an unequal split of symbols in each of the four categories. Hence, if a category had an odd number of symbols, a random symbol was removed. In the category HTHC, symbol 6 (love) was removed and in category HTLC, symbol 16 (girl) was removed. This resulted in 30 symbols remaining with a 15 Blissymbols split per set. The random allocation was performed for each of the remaining symbols in the four categories of translucency and complexity. Table 3.14 details the distribution of the symbols within each set.

Table 3.14 The balanced symbol sets after rating procedure

Set 1 Total number of symbols 15	Set 2 Total number of symbols:15
HTHC- total 2 To ensure an equal number of symbols to distribute, 6 (love) was randomly selected for removal. 2 bus 7 pizza	HTHC- total 2 To ensure an equal number of symbols to distribute, 6 (love) was randomly selected for removal. 3 car 8 push
HTLC- Total 3 To ensure an equal number of symbols to distribute, 6 (girl) was randomly selected for removal. 11 apple 13 bowl 20 teeth	HTLC- Total 3 To ensure an equal number of symbols to distribute, 6 (girl) was randomly selected for removal. 12 banana 14 dish 17 jump
LTHC-total 5 25 popcorn 21 birthday 27 sleep 29 thirsty 30 toothbrush	LTHC-total 5 22 coke 24 pancake 26 sister 28 sock 23 cookie
LTLC total 5 39 policeman 31 eat 37 name 33 grass 36 muscle	LTLC total 5 32 food 34 head 35 lie 38 off 40 small

3.5.1.6 Equivalency verification

The equivalency of the symbol sets was tested further using an inter-rater test (Appendix 8a). Eleven PhD(AAC) students were included as participants in this procedure. The purpose of the inter-rater test was to determine how well balanced the symbol sets were in terms of translucency, frequency of use and familiarity. A balanced split of symbols in relation to these three variables was essential for establishing the equivalency of the two symbol sets.

The participants were presented with pairs of symbols (in the translucency instance) or with pairs of referents (in the frequency of use and familiarity instance) (see Appendix 8b, 8c). The pairs were obtained from a direct matching of symbols from symbol set 1 and symbol set 2 (see Table 3.15) Using a seven point Likert scale, the participants were required to rate how well matched the symbol pairs were in relation to each of the equivalency variables. Twenty symbol pairs were presented with fifteen symbol pairs from the balanced set list (Table 3.14) and five symbol pairs acting as foils. The participants were instructed to evaluate each symbol referent pairing for their levels of translucency. If the translucency level for each symbol in the pair was evaluated as similar to each other then they allocated the symbol pair a 7. Symbols pairs who did not share similar translucency levels were allocated a 1. Participants were instructed to use the in-between numbers to rate their perceived level of equivalency of the symbol pairs (see Appendix 8a for instructions given to participants). Similarly, the participants were instructed to rate the equivalency of the frequency of use and familiarity variables (see Appendix 8a for the instructions given to the participants). Thereafter basic descriptive statistics was used to analyse the results.

Table 3.15 shows the mean ratings for the three variables. The symbol pairs (P) of the balanced list and the foils (F) are shown. The results for the translucency test showed that the foils were rated the lowest. Hence, the cutoff mean was set a 4.0 as this was the uppermost limit for the rating of the foils. The assumption here was that the participants should allocate the foils the lowest rating as these were not equally matched symbol pairs. P12 (toothbrush, cookie) fell below the cutoff mean for translucency. This implies that the participants did not agree that these two symbols were equal in terms of their translucency. Hence, these symbols were removed.

Similarly, for the frequency of use rating the lowest foil rating was 5.1. Hence, if any of the symbol pairs fell below this level of rating, it could indicate a poor match of symbols in the pair. However, all symbol pairs fell above the cutoff level. Lastly, for the familiarity rating, the lowest foil rating was 6.4. All the symbol pairs fell above this level indicating a good balance in terms of frequency of use. However foil 14 (F14) scored a high rating of 7.0. One possible reason for this was that the foil selection was poor as both words (toothbrush, jump) were seen as words used equally often in everyday lie.

Overall, the inter-rater test confirmed that the symbols included in symbol set 1 and symbol set 2, required the removal of P12 (toothbrush, cookie) in order to achieve equal balance for translucency, frequency of use and familiarity.

Table 3.15 Inter-rater results: mean rating for translucency

Symbol Pairs(P) Foil Pairs(F)	Mean Rating		
	Translucency	Frequency of Use	Familiarity
P1 bus, car	7.0	6.2	7.0
P2 pizza, push	4.5	5.1	6.8
P3 apple, banana	6.4	7.0	7.0
F4 pizza, pancake	3.0	5.1	6.5
P5 teeth, jump	5.1	6.0	7.0
P6 dish, bowl	6.4	5.8	6.7
F7 eat cookie	4.1	6.3	6.4
P8 coke, popcorn	5.4	6.2	6.9
P9 pancake, birthday	5.7	5.8	6.4
P10 sister, sleep	5.9	6.1	7.0
P11 sock, thirsty	5.4	5.7	6.8
P12 toothbrush, cookie	3.6	5.6	6.5
P13 eat, head	5.7	6.0	6.8
F14 toothbrush, jump	5.7	5.8	7.0
P15 grass, off	4.8	5.8	6.6
F16 sock, dish	3.4	5.8	6.7
P17 lie, name	4.7	4.6	6.2
P18 muscle, small	5.7	4.3	6.1
P19 policeman, food	6.5	5.4	6.8
F20 teeth, cookie	3.1	5.6	6.4

3.5.1.7 The final balanced sets

Following the inter-rater equivalency test, the final balanced sets of symbols were derived. Table 3.16 provides the list of balanced symbol sets. The final list contains a total of 28 symbols with 14 symbols per set.

Table 3.16 The final balanced symbol sets

Set 1 Total number of symbols 14	**Set 2** Total number of symbols:14
<u>HTHC- total 2</u> To ensure an equal number of symbols to distribute, 6 (love) was randomly selected for removal. 2 bus 7 pizza	<u>HTHC- total 2</u> To ensure an equal number of symbols to distribute, 6 (love) was randomly selected for removal. 3 car 8 push
<u>HTLC- Total 3</u> To ensure an equal number of symbols to distribute, 6 (girl) was randomly selected for removal. 11 apple 13 bowl 20 teeth	<u>HTLC- Total 3</u> To ensure an equal number of symbols to distribute, 6 (girl) was randomly selected for removal. 12 banana 14 dish 17 jump
<u>LTHC-total 4</u> To ensure an equal number of symbols to distribute, 23 (cookie) was randomly selected for removal. 24 pancake 22 coke 25 popcorn 26 sister	<u>LTHC-total 4</u> To ensure an equal number of symbols to distribute, 23 (cookie) was randomly selected for removal. 28 sock 29 thirsty 21 birthday 27 sleep
<u>LTLC total 5</u> 39 policeman 31 eat 37 name 33 grass 36 muscle	<u>LTLC total 5</u> 32 food 34 head 35 lie 38 off 40 small

3.5.2 Development of the connect-the-dot illustrations

Appendix 3a shows the connect-the-dot illustrations developed for use in this study which were drawn by a professional illustrator. In order to elicit the SGE, some sort of generation rule had to be put in place. Connect-the dot illustrations were used in order to establish the self-generation condition.

Peynircioglu's (1989) study was the first to establish the SGE for pictures. Peynircioglu (1989) used connect- the-dot drawings in order to show a SGE for pictures. Peynircioglu (1989) used these illustrations not only because she wanted to prove that the SGE could be elicited for picture stimuli, but also to provide evidence against the semantic processing theory, which at that stage was considered to be an underlying factor in the emergence of the SGE. Her initial experiments proved the existence of the SGE for pictures but made use of generation rules which were verbal. Hence, this could have meant that some level of semantic processing was involved. In order to rule out the involvement of semantic processing, the nonverbal format of the connect-the-dot drawings was used. Peynircioglu's (1989) connect- the-dot drawings were constructed using between 15-18 dots depending on the complexity of the pictures. As the picture became more complex, more dots were used.

The connect-the-dot illustrations were considered feasible in the present study for the following reasons:

- Blissymbols could be easily converted into connect-the-dot illustrations.
- Connect-the-dot illustrations excluded the need for a verbal generation rule for the participant to follow, which would have added complexity to the experimental procedure.
- It provided an easy, quick method for establishing the self-generation condition.

In the present study, complexity was also used as the main variable for standardising the number of dots used per symbol. Table 3.17 summaries the complexity value of the symbols and mean number of dots used for that symbol. According to Fuller and

Lloyd's (1987) definition of complexity, symbols which had between one and five strokes were defined as being low in complexity and symbols which had eight or more strokes were defined as being high in complexity. In order to standardise the allocation of dots per symbol, dot allocations were derived depending on the complexity value of the symbol. As the complexity of the symbol increased, the number of dots allocated to the symbol also increased. Hence, high complexity symbols were allocated between 15 and 20 dots while the low complexity symbols were allocated between three and eight dots. Symbols with the same complexity value shared the same number of dots.

Table 3.17 Dot allocations for connect-the-dot illustrations

Symbol	Complexity Value	Group	No. of dots
bus	15	HTHC	20
pizza	8		15
car	9		16
push	9		16
apple	4	HTLC	7
bowl	1		3
teeth	5		8
banana	3		6
dish	3		6
jump	5		8
popcorn	12	LTHC	18
birthday	8		15
sleep	9		16
thirsty	10		17
coke	10		17
pancake	18		22
sister	8		15
sock	14		19
policeman	4	LTLC	7
eat	5		8
name	3		6
grass	1		3
muscle	5		8
food	5		8
head	4		7
lie	4		7
off	3		6
small	5		8

Additionally the illustrator used her professional experience to decide when to include complete lines in suitable positions in order to prevent the participant from going backwards when trying to complete the symbol drawing. A large diameter size of 1mm was selected for each dot. This was kept consistent except for when a symbol itself included dots as part of its construction. These dots had a larger diameter of approximately 1,5mm in order to disassociate them from the connecting dots. Each stimulus card was approximately 8.5cm by 12cm. The stimulus card contained the dot picture together with the written referent.

3.5.3 Development of participant screening tests

Before participants were recruited into the study, they were exposed to a set of pre-experimental screening tests which confirmed that they presented with the skills required to complete the tasks included in the main experimental sessions. Table 3.18 summarises the screening tests used. The main purpose of this screening procedure was to ensure that all participants met the selection criteria as outlined in section 3.6.1.2. Those participants who passed the pre-experimental screening test phase were invited back to the experimental sessions conducted as part of the main study. A participant who failed but who wished to continue with an AAC programme was referred to a speech-language therapist for further therapy outside of the study. A total of 23 prospective participants were screened for suitability for this study. Eight participants were finally selected for inclusion (see section 3.6.1 for a description of the participants).

Table 3.18 Pre-experimental screening tests

Target Skill Assessed	Procedure	Purpose	Criteria
Aphasia Severity Rating Receptive Language Score Expressive Language Score	The Boston Diagnostic Aphasia Examination (BDAE) was administered to confirm the severe aphasia diagnosis and determine the severity of the participant's language reception and expression.	To ensure that the participant presented with a severe aphasia.	Percentile ranks were obtained for expressive and receptive language. The BDAE rates the severity of the aphasia on a scale from 0 to 5 were 0 represents no useable speech. A severity rating of between 0 to 2 was accepted as a severe aphasia rating.
Receptive Language and Pointing Skills Test Appendix 5a	Five grid boards with a 2X3 layout were developed. Each grid board contained six simple picture representations of the 28 symbol referents included in this study. The tester named the referent verbally and the participant was instructed to point to the correct picture on the grid.	This ensured that the participant was able to understand all 28 symbol referents included in the two symbol sets. This test also confirmed that the participant had adequate pointing skills to complete the recognition probes.	Participants who were unable to correctly identify five or more of the symbol referents via pointing were excluded from the study.
Visual Discrimination Appendix 5b	A grid board with a 2X3 configuration containing a Blissymbol in each grid (not included in study symbol sets) was developed. The participant was required to match a set of identical symbols cards to symbols on the board.	To ensure that participant could visually discriminate between symbols.	The participant had to match symbols at 100% accuracy.
Connect-the-dot execution test Appendix 5c	The participants were required to complete a connect-the-dot picture that was in the same format as the experimental stimuli.	To ensure that the participant had enough skill to complete the connect-the-dot drawings. To ensure that a dot drawing could be completed in one minute (the time limit determined during piloting). To ensure that the participant could complete the symbol independently.	Participants who were unable to complete the dot drawing successfully after a maximum of four trials were excluded.

3.5.4 Development of the treatment scripts

A specific treatment script was developed for each treatment approach to ensure that each participant received the same treatment instructions. This prevented any instructional bias. The treatment scripting is presented and discussed in detail in section 3.6.2.3.

3.5.5 Development of the scoring forms

Two types of scoring forms were used during the data collection process. These were the probe grids (see Appendix 6a and 6b) and the probe measure scoring forms (see Appendix 7a and 7b). These forms were used during the recognition probe tests and the retention probe tests to identify the number of symbols correctly recognised by the participant as a result of the different treatments (see section 3.6.2.3 and section 3.7 for a detailed discussion of the types of recognition and retention probes conducted).

Two 2X4 probe grids were used during the recognition probe tests (see Appendix 6a & 6b). The probe grids displayed the symbols specific to the symbol set used during training. The placement of the symbols on the grids was randomly allocated for each recognition probe test. The participants pointed out the symbol on the grid that matched the named referent.

Four 2X4 probe grids were used during the retention probe tests. The probe grids displayed the symbols from both symbol sets. The symbols were randomly placed on the grids during each retention probe but were still presented set by set (that is set 1 was presented first, followed by set 2). The participants pointed out the symbol on the grid that matched the named referent.

The probe measure scoring forms were used to record the recognition levels obtained during each recognition or retention probe (see Appendix 7a and 7b). This was used exclusively by the examiner to record symbols that were correctly recognised. Since many recognition and retention probe tests were conducted over the three experimental sessions, it was important to develop a method for accurate record keeping. This form allowed for the following information to be captured:

- Participant identification and date
- Type of probe measure conducted: recognition probe or retention probe
- The order of the symbols presented
- Symbols correctly identified
- Symbols incorrectly identified

3.5.6 Pilot studies

The purpose of the pilot studies was to confirm the reliability of the study materials and to test the proposed experimental procedures. The piloting phase included two pilot tests. Two individuals who met all the participant selection criteria (see section 3.6.1.2) were included in the pilot study. During pilot test 1, the full experimental procedure was conducted and recommendations were made to refine the methodology further. The purpose, objectives and recommendations of pilot test 1 are described in Table 3.18. The recommendations derived from pilot test 1 were applied and the procedure was re-administered in pilot test 2. Table 3.19 describes the objectives and recommendations emerging from pilot test 2.

Table 3.19 Pilot study 1

Objectives	Purpose	Procedures	Results	Recommendations
1. To determine whether the connect-the-dot pictures were an effective method for establishing the self-generation condition.	Due to the nature of aphasia, the processes involved in completing a connect-the-dot drawing could be unavailable to the participant. The pilot confirmed whether or not the participants were able to complete a connect-the-dot drawing. Hence this helped to ascertain if these drawings were an effective method for establishing the self-generation condition.	The participant was required to complete the connect–the-dot pictures for symbol set 1 and symbol set 2 as per the study procedure over the withdrawal periods.	For the low complexity pictures, participants completed the pictures appropriately. The symbol completed closely resembled a complete symbol drawing. The high complexity symbols were problematic. Participants did not know which direction to start moving in as the picture was complicated. Participants required prompting to complete the drawing of the symbol. A fine tip ball point pen did not allow for a good finished product because the connection between dots was fragmented making the symbol difficult to identify. The participant had a right hand paresis. The participant struggled to stabilise the page and the examiner used a hand to stabilise the page. This did not appear to aid in the completion of the drawing or present any unfair advantage or help.	None In order to a complete dot drawing, it was seen as necessary to provide a complete symbol drawing alongside to act as a reference. Participants would then see what the completed symbol should look like and would not require prompting. A thicker felt tip pen was needed to complete the dot drawings. Examiner/researcher may stabilise page if participant cannot do so.
2. To confirm the time taken to complete each dot picture from each descriptive category.	It was critical to match exposure times to symbols between treatments. Hence time taken to complete the dot symbol and time exposed to symbol must be the same.	The participant was timed using a stop watch for all 14 dot drawings.	For the low complexity symbols the average completion time was 35 seconds. For the high complexity symbols the average completion time was 50 seconds.	An acceptable exposure time in both conditions was levelled to 60 seconds.

Objectives	Purpose	Procedures	Results	Recommendations
3. To determine how many symbols were actually learnt.	This helped to set a teaching criteria level for each procedure.	An average of four blocks of repetitions of symbol presentation was used to test recognition.	The average rate of recognition over the three days was 87% after the 1st repetition block, 82% after the 2nd block, 86% after the 3rd block and 86% after the 4th block. The participant became fatigued after the second block and became bored with repeated presentations by E2-day 2 and E3-day 7. The repeated blocks did not seem to improve recognition levels by day 2 and day 7 but did seem to frustrate the participant.	Two blocks of training for day 1 and one block of training for E2-day 2 and E3-day 7 were selected as a possible teaching criterion. This was tested during pilot test 2.
4. To determine the appropriateness of all stimulus materials used including the pre-experimental screening tests (Appendix 5a, 5b, 5c).	Aided in assessing if the participant responded appropriately to the stimuli used.	A run-through of the all pre-experimental tests and the complete experimental procedure over the withdrawal periods. The appropriateness of the receptive language test was evaluated to determine if the line drawings included in the Pointing Test were accurately representing the referents.	Presentation sizes of the symbols were not reported as problematic. Stimuli were familiar to the participants. Pre-assessment tests were valid. The participant was able to identify all 28 line drawings in response to the verbal presentation of the referent's name.	None
6. To test scoring procedure (scoring sheets and other procedures)	To determine if any administrative improvements could be made to the scoring procedure.	Scoring forms were in the format of a table of columns with the glosses of the 32 symbols and an incorrect /correct recording space.	Scoring forms were not arranged according to symbol sets. Scoring forms had gloss only and not the symbol itself. Scoring forms were not arranged to match probe grids.	To pre-determine symbol layout on the probe grids. Scoring forms to represent these grids with gloss and symbol. Correct and incorrect scores were marked on the grid.

Table 3.20 Pilot study 2

Objectives	Purposes	Procedures	Results	Recommendations
1. To confirm if teaching criterion proposed after pilot test 1 was adequate.	This established if the participant could learn to recognise the symbols after the proposed number of training blocks.	Complete experimental procedure with withdrawal periods.	82-85% recognition of symbols was observed in each treatment across the three time lines.	The following teaching criteria were accepted: E1-day 1 had two training blocks (that is the participant was exposed to the symbol set twice). E2-day 2 had one training block (that is one exposure to the symbol set). E3-day 7 had one training block.
2. To confirm if the use of a complete symbol card helped the participant complete the connect-the-dot picture without prompting from the examiner.	Ascertained if the participant could complete the dot picture without assistance.	Confirmed during completion of complete experimental procedure.	Participant able to complete all dot pictures without assistance.	Complete dot picture to be included during dot picture completion.
3. To confirm that a thicker felt tip pen produced a clearer completed dot drawing that closely resembled the completed target symbol.	To produce a clear, well-defined completed dot drawing.	Confirmed during completion of self-generation treatments.	A good, clear drawing was produced.	A thick, black felt tip pen was used.
4. To confirm if the SGE could be observed.	Ascertained if the research design allowed for the emergence of the SGE.	Analysis of recognition scores over the withdrawal periods.	The SGE was observed.	The study design was appropriate to see the SGE emerge.

In summary, the pilot study helped to refine the procedures utilised in the final study. The two pilot tests helped to determine an appropriate teaching criterion which was used with all participants. Exposure times were also set following the pilot results. The pilots helped confirm that the connect-the-dot procedure was an appropriate method for establishing the self-generation condition. Most importantly, pilot test 2 helped confirm that the research design did support the hypothesis that the SGE was produced superior recognition of the symbols.

3.6 The Experimental Phase: The Main Study

3.6.1 Participants

3.6.1.1 Ethical clearance

The proposal for this study was initially evaluated by the University of Pretoria Ethics committee for ethical clearance and consent to start the experimental phase of this study.

Informed consent was obtained from each referral source namely the referring hospital, the rehabilitation centre and private clinicians (see section 3.6.1.3 for discussion on recruitment procedures). Additionally, each prospective participant provided informed consent. The informed consent letter described the study procedures (see Appendix 10). The form was completed by the prospective participants or their spouse.

3.6.1.2 Participant selection criteria

This study targeted participants presenting with a severe aphasia. It was important to ensure that participants were as homogeneous as possible with respect to the target behaviours and relevant background information. Hence all the participants included in this study met the selection criteria summarised in Table 3.21. This table also provides motivation for the selection of each criterion and the method for how each criterion was confirmed.

Table 3.21 Criteria for the selection of participants

Criteria	Motivation	Method
1. The aetiology of the severe aphasia was confined to a **cerebral vascular accident (CVA)**.	The inclusion of participants who were confirmed to have acquired the aphasia via a CVA ensured that the correct pathology was targeted. The inclusion of participants who were one year post onset of the CVA ensured that spontaneous recovery was complete.	Written confirmation of aetiology and onset of the CVA was provided through a neurological examination which was documented in clinical case notes. This was obtained from the referral source (see section 3.6.1.3 for a discussion of the recruitment procedures used).
2. A unilateral left sided lesion either caused by infarction or an ischemic episode confirmed by a CT scan of the brain.	A unilateral, left sided brain lesion localised to the language areas of the left hemisphere (parietal, temporal, frontal lobes) has been shown to cause various categories of aphasia. Any other type of lesion would suggest a different pathology and hence presentation of the resultant language disorder would be quite different to the target pathology i.e. severe aphasia. Controlling for this type of lesion helped to ensure that all participants presented with the same disorder.	Review of CT scan reports.
3. A minimum of one year post onset of CVA.	Spontaneous recovery is complete by this time. The presence of no significant language recovery following the spontaneous recovery period confirms a severe, chronic aphasia.	Review of clinical records obtained from referral source.
4. Adequate receptive language skills.	The participant had to be able to understand the verbal instructions included in the training procedures in order to complete the tasks required. A poor understanding of the task instructions would have compromised the participant's ability to learn the symbols. Additionally, it had to be ensured that the participant could comprehend all 28 symbol referents included in the study.	Adequate receptive language skills as determined by performance on the Boston Diagnostic Aphasia Examination. A pre-experimental test (The Receptive Lang/Pointing Test) was conducted to confirm that the participant was able to identify line drawings of all 28 symbol referents. If the prospective participant was unable to identify five or more referents, they were excluded from the study.

Criteria	Motivation	Method
5. No uncorrected peripheral vision or visual field deficits or hearing deficits,	Visual deficits would compromise a potential participant's ability to complete the connect-the-dot pictures making it difficult to establish the self-generation condition. A hearing deficit may interfere with the way a participant understood the verbal instructions included in the experimental procedures.	Medical records were reviewed to confirm the lack of visual or hearing deficits. The attending doctor and family also confirmed the above. The presence of either excluded the participant.
6. Ability to sustain attention for 30 minutes.	The inability to sustain attention on a 30 minute task (as determined during piloting) meant that participants may not be able to adequately complete all the tasks included in the experimental phase of the study.	An informal assessment of the participant's attention skills was conducted during the administration of the Boston Diagnostic Aphasia Examination. Participants who failed to complete the test due to inattention or fatigue were excluded from the study.
7. Adequate pointing skills as determined by the pre-experimental screening tests.	During the testing probes participants were required to point to the symbol named by the researcher. The participant must be able to point using either the right or left hand (especially in the instance of a right-sided hemiplegia or hemiparesis)	An informal pointing test (Appendix 5a) was used to test the participant's ability to point to an item requested verbally.
8. No visual discrimination deficits as confirmed during pre-experimental screening tests.	During the testing probes, 2X4 grids with a symbol in each grid block were presented to the participant. The participant must have been able to discriminate adequately between symbols on the 2X4 grid board.	An informal visual discrimination test was developed and used. (Appendix 5b)
9. Ability to complete a connect-the-dot picture of pre-determined number of dots in allotted time frame using either the right hand or the left hand in the presence of a right-sided hemiplegia or hemiparesis.	The connect-the-dot pictures of the symbols were used to establish the self-generated condition. Participants must be able to complete the dot picture in a similar period of time to prevent exposure bias.	Participants were required to complete a connect-the-dot picture matching the size and mean number of dots used in the study during the pre-experimental screening test (Appendix 5c).
10. No previous exposure to AAC training.	Familiarity with any of the Blissymbols utilised in the study would influence the participant's learning of the symbol.	The referral source as well as the participant's spouse, children or caregiver confirmed that the participant had no previous AAC exposure.

3.6.1.3 Recruitment of participants

Twenty-three prospective participants were screened for this study. They were recruited in the following ways:

- Past patients of a private acute-care rehabilitation unit were recruited into the study. Consent was obtained from the rehabilitation unit's management for sourcing patients via their patient records. Prospective patients were then referred by the resident speech-language therapists.
- Local private speech-language therapists specialising in the treatment of aphasia were contacted via letters which detailed the type of participants required for this study. They were asked to refer any suitable participants.
- Suitable participants from the researcher's past private speech therapy client base were contacted for possible participation in the study.
- Consent was sought to screen prospective participants at a government hospital that specialises in neurological rehabilitation. The attending physician referred suitable candidates.

Over approximately three months a total of 23 prospective participants were referred through the above referral sources. These individuals were screened for suitability using the pre-experimental screening tests presented above in table 3.18. When a patient was referred from the above mentioned sources, the prospective participant was contacted to obtain informed consent. Once consent was obtained, suitable times and venues for the screening tests were arranged. The screening tests were conducted at the participant's home, at the referring hospital or at the researcher's clinical rooms according to the participant's convenience. If the participant passed the screening test, he or she was invited back for the main experimental procedures. However, if the participants did not meet the screening test criteria (as presented in table 3.18), they were excluded from the study. Again, the venue options remained the same. It emerged that the experimental sessions were conducted at the clinical rooms of the researcher and the participant's homes. During the home visits, a quiet room was sought with minimal noise and distractions.

3.6.1.4 Description of study participants

Table 3.22 describes the study participants. Of the 23 participants screened, eight participants were selected. Four presented with a severe Broca's (B) aphasia and four with a severe Global (G) aphasia. Table 3.22 shows the participants' performance on the Boston Diagnostic Aphasia Examination (BDAE). The BDAE allowed for the reporting of a cumulative expressive score and a receptive score. These are reported in percentiles. The BDAE severity score rating ranges from 0 to 5, with 0 being no useable speech.

Table 3.22 Description of participants

Participant	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Age	44	42	78	68	57	61	56	48
Months post onset	40	16	19	25	14	16	18	17
Type of Aphasia	G	G	G	G	B	B	B	B
Gender	M	M	M	M	M	M	F	M
BDAE Expressive Score (percentile)	10	0	10	13	23	10	47	37
BDAE Receptive Score (percentile)	13	30	10	10	30	40	57	47
***BDAE Severity Rating**	1	1	1	1	2	2	2	2

***BDAE Severity rating definitions**
1 – All communication is through fragmentary expression, great need for inference, questioning and guessing by the listener. The range of communication is limited and the listener carries burden of conversation
2- Conversation about familiar subjects is possible with help from the listener. Frequent failures to convey ideas, but patient shares burden of communication.

3.6.2 Data collection

3.6.2.1 Procedure

The experimental sessions included in the main study followed the process outline in Table 3.21. Each experimental session included the symbol training on either Symbol Set 1 (S1) or Symbol Set 2 (S2) using one of the two treatment approaches. Three experimental sessions (E1, E2, E3) were conducted over the three withdrawal periods (day 1, day 2, day 7). During E1-day 1, the participant received training, followed by a recognition probe, a rest period of five minutes, training of the next treatment, and the final recognition probe. During E2-day 2 and E3-day 7 the procedure changed by adding a retention probe before any training started.

Table 3.23 Description of experimental sessions

PARTICIPANTS	**Experimental Session E1- Day 1**	**Experimental Session E2-Day 2**	**Experimental Session E3-Day 7**
1,2,3,4,5,6,7,8	Training Recognition Probe REST Training Recognition Probe	Retention Probe Training Recognition Probe REST Training Recognition Probe	

In addition, a within-subject alternation or counter-balancing of treatments and symbol sets was used in order to avoid a presentation bias. The symbol sets (S1, S2) were alternated between the two treatment approaches (T1, T2). These alternations are presented in table 3.1.

3.6.2.2 Materials and equipment

The equipment used in the main study included the following:

- A Sony HandyCam Digital Camera Recorder (DCR-HC21E) was used to video record all experimental sessions.
- The Seiko W073 high-precision timer was used for time-keeping.

- The Artline 70 Fiber Tip permanent, instant dry marker was used for completing the dot drawings.

Materials used in the main study included the following:

- Connect-the-dot drawings, which were printed on 8cm X 12.4cm cards (see Appendix 3a).
- The Blissymbols which were printed on to 8cm X 12.4cm cards (see Appendix 3b).
- The probe grids (see Appendix 6a, 6b).
- The probe measure scoring forms (see Appendix 7a and 7b).

3.6.2.3 General training procedures

(i) Description of setting

The training setting was selected at the convenience of the participant. The experimental sessions were conducted either at the researcher's clinical rooms or the participant's home. The venue was kept the same over the three experimental sessions. The clinical setting provided a quiet room with adequate lighting and minimal distractions. The video camera was placed discretely out of view of the participant. The home visit option was only used if a quiet room with adequate lighting and minimal distractions was available. Again the video camera was placed out of view of the participant.

(ii) Description of general training considerations

The training procedures utilised for each treatment condition were specified in order to prevent instructional bias. This set of general training considerations included basic instructional and procedural conditions that were kept the consistent in both treatment approaches. These included the following:

- The non-generation condition (T2) was established by saying the symbol referent's name together with visual exposure to the symbol. A maximum of three verbal repetitions of the referent was allowed.
- The self-generation condition (T1) was established by having the participant complete a connect-the-dot picture representation of the symbol.
- A trial connect-the-dot drawing was done before training started.
- As will be evident from the training script descriptions that follow, T1 and T2 differed only by the introduction of the self-generated condition which was established by the dot drawing.
- In T1, two stimulus cards of the same size were presented; one with the dot drawing and one with the complete symbol.
- In T2, only one stimulus card of the complete Blissymbol was presented.
- The dot drawing was constructed by referring to the complete symbol card provided.
- No construction cues were allowed while the participant was completing the connect-the-dot picture.
- No comprehension cues were allowed.
- The researcher was allowed to stabilise the page using a finger in presence of a right-sided hemi-paresis.
- Time of exposure to each symbol was kept consistent across strategies. A maximum of one minute exposure to each symbol (as determined by the pilot tests) was used for both approaches. The timer was started upon presentation of the symbol.
- A teaching criterion was set. The teaching criterion specified that only two blocks of training were permitted for the first training session (E1-day 1), and one block of training for the remaining two sessions (E2-day 2 and E3-day 7).
- A training block constituted the complete exposure to an entire symbol set depending on the treatment approach being used. A repeated exposure to the entire symbol set constituted a second training block or repetition.
- The duration of session E1-day 1 was approximately 75 minutes.
- The duration of session E2-day 2 and E3-day 7 was approximately 50 minutes.
- Two types of probes (RP) were used. During E1-day 1, the recognition probes were conducted at the end of each treatment procedure. During E2-day 2 and

E3-day 7, a retention probe was conducted before training began thereafter when each treatment block was completed, a recognition probe was conducted (this is summarised in Table 3.3 and Table 3.21).

(iii) Specific training considerations: The training scripts

The self–generation strategy: establishing the self-generation condition

The training for the self-generated condition (T1) adhered to the following script:

- Initial instructions:

Researcher says: I will be presenting a symbol or picture to you. Each symbol represents or "stands for" a word. To help you learn these symbols and their words you will be drawing the symbols using a connect-the-dot drawing like this one(trial dot drawing and complete symbol cards shown). You must join the dots and make your picture look exactly like this complete picture of the symbol (point to complete symbol picture). Take your time with each picture as there will be a test of how many you can remember later. Let us try this one to practise.

- Trial drawing presented and completed. (two minutes)
- Researcher says: We will be starting with our main task now.
- Present stimulus card of complete symbol and the dot drawing. Researcher says: This is ___*symbol referent*___(maximum of three repetitions of referent allowed). Please join the dots to make ___*symbol referent*____.
- Complete symbol card remains in view for reference.
- Remove card and present new stimuli.
- Continue process for 14 symbols.
- During E1-day 1, this entire process was repeated; in other words, there were two training blocks. During E2-day 2 and E3-day 7, one training block was conducted.
- At the end of the prerequisite symbol exposures for the treatment approach, the recognition probe was conducted to test for the recognition levels following the training.
- The duration was approximately 30 minutes for the training, including the trial, and five minutes for the recognition probe which followed.

Non-generated strategy: Establishing the non-generated condition

The training script for the non-generated condition (T2) was as follows:

- Initial instructions

Researcher says: I will now present a complete picture of the symbol that represents or "stands for" a word. I will show you a symbol like this one and say its word (show complete trial symbol card). You must take a good look at the symbol and listen to the word I say. Take time to look at each symbol and remember its word because there will be a test for how many you can remember later. Let us try this one for practise. Do you understand? Let us start now.

- Present card of complete symbol. Researcher says: This is __*symbol referent*__(maximum of three repetitions).
- Researcher says: Take some time to study this symbol of __*symbol referent*__.
- Card remains in view for a maximum of one minute. Timer started at presentation of symbol.
- Remove card and present next symbol.
- Continue process for 14 symbols.
- During E1-day 1, this entire process was repeated in other words two training blocks were conducted. During E2-day 2 and E3-day 7 there was one training block conducted.
- At the end of the prerequisite symbol exposures for each treatment, the recognition probe was conducted to test for the recognition levels obtained following the training.
- The duration was approximately 30 minutes for the training including the trial and five minutes for the recognition probe which followed.

(iv) The Probes

Two types of recognition probes were conducted. The first type refers to the recognition probes which followed directly after training using a specific treatment.

This probe determined the number of symbols recognised as a result of the treatment used. The script used during this recognition probe was as follows:

- The participant was presented with two 2X4 grids (Appendix 6).
- Each grid was presented separately.
- The grids presented during the recognition probes contained the symbols from the symbol set specific to the treatment used during training (see Table 3.1 for how symbol sets were allocated to the two treatments).
- The first grid contained eight randomly assigned symbols, without their written referent.
- The second grid contained seven randomly assigned symbols, without their written referent.
- The researcher said: "Please show me the symbol that you think matches the word I say. Do you understand? Let's start. Show me ……….".
- The two grids were presented one after the other.

The next type of probe was the retention probe which was conducted before training began during session E2-day 2 and E3-day 7. This probe determined which treatment retained its recognition levels after the withdrawal period. Both symbol sets were presented for testing. The script used during this retention probe was as follows:

- The participant was presented with four 2X4 grids (Appendix 6).
- Each grid was presented separately.
- The first two grids contained symbol set 1 with symbols being placed in random order.
- The second two grids contained symbol set 2 with the symbols placed in random order.
- The researcher said: "We will be testing to see how many symbols you can remember from our last session. Please show me the symbol that you think matches the word I say. Do you understand? Lets start. Show me ……….".
- The grids were presented one after the other. Symbol set 1 was presented followed by symbol set 2.

During the administration of both the recognition probes and the retention probes, the researcher used the probe scoring forms (see Appendix 7a and 7b) to record correct and incorrect responses. Correct responses were marked with a tick and incorrect responses were marked with a circle. A response was accepted as correct if the participant pointed to the correct symbol when the researcher said each symbol referent. Corrections were accepted if the participant self-corrected before the next symbol was named. An incorrect response was allocated when the participant pointed to the wrong symbol when it was named or for no response when the symbol was named.

3.7 Scoring

The recognition (RP) and retention (RTP) probes formed part of the scoring procedure. A recognition probe followed the training using either one of the treatment conditions. In addition, a retention probe was conducted before training during E2-day 2 and E3-day 7 to determine the effect of the withdrawal periods on the recognition levels . A scoring form was used to tally scores (Appendix 7a, 7b). Table 3.24 summarises and labels the probe measures as function of treatments (T1, T2) and time or experimental sessions (E1, E2, E3).

Table 3.24 Probe measures

	E1-day 1	E2-day 2	E3-day 7
Retention Probes (RTP)		RTPE2	RTPE3
Recognition Probes (RT)	RPE1	RPE2	RPE3

Hence, each of the eight participants accumulated six recognition scores from the probes conducted in session E1- day 1, E2 –day 2 and E3-day 7; and two retention of recognition of scores from probes conducted before training in sessions E2-day 2 and E3-day 7. By comparing recognition scores from RPE1, RPE2 and RPE3 the treatment approach which produced the best recognition outcomes was identified. Comparisons between recognition levels obtained during RTPE2 and RTPE3 determined which treatment helped produced better retention of recognition levels following the withdrawal periods of two days and seven days respectively.

3.8 Data Analysis

The 2X2X3 factorial design used for this study allowed for the analysis of the three independent variables and their interactional effects on the dependant variable. Hence the raw data (see Appendix 10) were analysed in order to describe the effects of the two symbols sets, the two treatment approaches and the three time lines on the two treatment approaches. Table 3.25 summarises the statistical measurements performed.

Table 3.25 Summary of statistical measurements

Test	Variable Measured	Statistical Outcomes
Analysis of Variance (ANOVA)	Interactions of Time, Sets and Treatments using recognition scores	p-values, effect sizes
Repeated measures Analysis of Variance (rANOVA)	Interactions of Time with Treatments and Sets using retention probe scores	p-values, effect sizes, mean value for regression of recognition levels

The Analysis of Variance procedure or ANOVA was used to analyse the effects and interactions of the three independent variables on the dependant variables or factors. The recognition probe scores were used for the initial ANOVA analysis. The underlying hypothesis of the ANOVA procedure is that some kind of difference exists in the means of the factors under study, and the ANOVA calculations helped to identify where the variation of the means lay.

The ANOVA analysis yielded a probability value or p-value for each of the interactions measured. According to Maxwell & Satake (2007), the p-value provides an indication of the probability of obtaining a favourable sample test statistic. The following criterion was used to determine the significance of the p-values obtained: if the p-value was less than 0.05 ($p < 0.05$) then the result was highly significant at a 5% level.

Effect sizes were also used to evaluate the variance between the factors under study. According to Maxwell & Satake (2007, p. 355), the effect size is an "index of the degree to which the phenomenon of interest exists in the population". The effect size is the difference between the means divided by the average standard deviation between the groups (Maxwell & Satake, 2007). Cohen's (1977) criterion for evaluating the significance of the effect size was used in the present study. His criteria state that an effect size between 0.01 – 0.05 means that the effect size is small, an effect size between 0.06 – 0.14 is medium and an effect size greater than 0.15 is large (Cohen, 1977).

A repeated measure ANOVA (rANOVA) was performed in order to analyse the significance of the retention probe scores. The rANOVA looked at repeated measurements of the significant variable (i.e. the retention probe scores) over two or more times. Both p-values and effect sizes were obtained.

Hence the interaction between symbols sets, treatments and time were analysed using the ANOVA procedure. This procedure yielded the p-value for each interaction and its significance was evaluated according to a set of criteria. Additionally, the calculation of the effect size allowed for further statistical evaluation of each of the interactions. Based on these statistical procedures the effect of the various factors specifically, the two treatments, on the recognition of the Blissymbols could be recognised.

3.9 Inter-Rater Testing

The treatment protocol was subjected to an inter-rater test. The purpose of the inter-rater test was to assess the treatment integrity of the data collection procedures. Two raters who were qualified, practising speech-language therapists were used.
This test required the rater to view three randomly selected, video-recorded experimental sessions. A checklist (see Appendix 9) was developed to guide the rater on how to assess the integrity of the experimental procedures viewed. The checklist focussed on the rating of the training procedures and the accuracy of the recognition probe measures. The rater was required to tick *yes* or *no* for each rating variable (see

Appendix 9). The scores of the two raters were tallied and an inter-rater agreement percentage was obtained. The results are presented in chapter four.

3.10 Summary

This chapter presented the methods and procedures used for collecting the data in this study. The main research question and sub-questions were presented. This was followed by a discussion of the study design, material development, pilot study and data collection procedures. The data analysis techniques were also presented.

CHAPTER 4
RESULTS AND DISCUSSION

4.1 Introduction

This chapter will present and discuss the results of the experimental procedures conducted. It focuses on answering the research question, the main aim and the sub-aims of the study as presented in Chapter 3 (section 3.2). The dependant variable under study was the number of symbols recognized following training using each treatment approach. Recognition levels were measured during the different probe measures. The independent variables were: the two treatment conditions (T1- self-generation and T2- non self-generation), the two symbol sets (symbol set 1 and symbol set 2) and the different time intervals or experimental sessions (day1 - E1, day 2 - E2, day 7 - E3). The discussion will proceed to present the interactions between these three factors or independent variables with each other but mainly the resultant effect of their interactions on the dependant variable.

4.2 Treatment Integrity and Reliability

Poor implementation or a failure to adhere to planned treatment protocols can pose a serious threat to the reliability and internal validity of a study (Schlosser, 2003). Hence an evaluation of treatment integrity is important as it would ascertain how well the described procedures and protocols have been adhered to. Treatment integrity helps to define the level of treatment reliability. Reliability refers to the consistency with which a method or procedure has been applied (Macmillian & Schumacher, 2001). Specifically, inter-rater reliability was used in this study. It refers to the match between ratings performed by different individuals who are required to evaluate the integrity of the experimental procedures conducted during data collection.

Two independent raters viewed three randomly selected video-recorded sessions (see section 3.9, chapter 3 for a full description of the procedures used). They rated the video recorded sessions according to a checklist (see appendix 9, section 3.9, chapter 3). According to Schlosser (2003), it is important that at least 20%-40% of sessions be reviewed for treatment integrity and more importantly; there should be an equal review of sessions across all study phases. To meet this requirement, the two raters were asked to review sessions E1, E2 and E3 for three randomly selected participants. Table 4.1 below shows the spread of sessions which were rated.

Table 4.1 Sessions rated during inter-rater test

Sessions	Participant (P)
E1 E2 E3	P1 P4 P7

Once the raters completed the checklist, their scores were tallied. Maxwell & Satake (2003) recommend a method based on probability theory for calculating inter-rater reliability. Using their method, the agreement levels were obtained by dividing the number of agreements by the total number of ratings (agreements and disagreements) per training area evaluated. The equation used is presented below. The scores were then converted to a percentage which is presented in table 4.2.

$$\frac{\textit{Agreements}}{\textit{Agreements + Disagreements}} \quad X \;\; 100\% = \textit{Inter-rater agreement value}$$

The agreement levels obtained fell between 80% - 100%. This is above the 70% agreement rate recommended by Macmillian & Schumacher (2001) for good inter-rater reliability. Hence inter-rater reliability was favourable.

Table 4.2 Inter-rater agreement levels

Training Area Evaluated	E1	E2	E3
A. Self-Generation Protocol	86%	86%	100%
B. Non Self-Generation Protocol	83%	83%	100%
C. Probe Measures	100%	100%	100%

4.3 Scores Obtained

Table 4.3 presents a summary of the different scores that were obtained during the three experimental sessions (day 1-E1, day 2-E2 and day 7-E3). Experimental session 2 (day 2-E2) and experimental session 3 (day 7-E3) were derived from the two withdrawal periods imposed during testing. Therefore, the different experimental sessions over the different withdrawal periods represented the time variable in the analyses that were conducted.

As previously presented in Chapter 3 (section 3.7), there were two types of probe measures conducted. These were:

(i) recognition probes (RP) conducted after training on each day (RPE1, RPE2, RPE3) which measured recognition levels for the specific symbol set administered (see table 3.1, chapter 3 for administration of sets and treatments)

(ii) retention probes (RTP) conducted before re-training on day 2 – E2 and day 7 – E3 (RTPE2, RTPE3) which measured retention of recognition levels for both symbol sets.

Table 4.3 Summary of the probe measures

Experimental Sessions TIME	Procedure	Description
Day 1 – E1	Training (treatments and sets allocated as per table 3.1, chapter 3)	This was the first session where the participant was trained to recognise symbols using a specific treatment and set (see table 3.1, chapter 3).
	Recognition probe (RPE1)	This was the first recognition probe conducted directly after the above training was completed. The recognition levels for the specific treatment approach and symbol set used was measured.
	Training (treatments and sets allocated as per table 3.1, chapter 3)	Training using the next treatment and symbol set was conducted.
	Recognition Probe (RPE1)	This recognition probe measured recognition levels for the specific treatment and symbol set used during the above training procedure(see table 3.1, chapter 3).

Experimental Sessions TIME	Procedure	Description
Day 2 – E2	Retention probe (RTPE2),	This retention probe was conducted to determine the level of recognition for the symbols retained following the withdrawal period of one day. This probe measured recognition outcomes for both symbol sets and treatments which were retained from day 1-E1.
	Training	Training began after retention probe (RTPE2) was completed. One specific treatment and symbol set was used.
	Recognition probe (RPE2)	This probe (RPE2) took place directly after the above training procedure was completed. It measured the recognition levels for the specific treatment and symbol set used during training.
	Training	Training on the next symbol set using the next treatment was conducted.
	Recognition probe (RPE2)	Recognition levels were measured for the specific treatment and symbol set used directly after training.
Day 7 – E3	Retention probe (RTPE3)	This retention probe was conducted to determine the level of recognition for the symbols retained following the withdrawal period of seven days. This probe measured recognition outcomes which were retained for both treatments from day 2-E2.
	Training	Training was conducted after the probe (RTPE3) using a specific treatment and symbol set.
	Recognition probe (RPE3)	This probe measured recognition levels for the treatment and symbol set used during the training procedure above.
	Training	Training using the next treatment and symbol set was conducted.
	Recognition probe (RPE3)	This probe measured the recognition levels for the symbol set and treatment used during the training procedure above.

4.4. Statistical Analysis Procedure

The 2X2X3 factorial design used for this study allowed for the analysis of the three independent variables and their interactional effects on the dependant variable using ANOVA. Hence the raw data was analysed in order to describe the effects of the two symbols sets, the two treatment approaches and the three time lines on the recognition levels for the Blissymbols taught (for details on data analysis procedures see section 3.8, chapter 3). The recognition probe scores (RPE1, RPE2 and RPE3) were analysed in the initial ANOVA analysis and the retention probe scores(RTPE2 and RTPE3) were analysed in the repeated ANOVA measure.

The initial ANOVA analysis considered the interactional effects of the three independent variables in the following manner:

(i) Symbol sets: the two symbol sets interactions with the treatments and their resultant effect on the recognition of symbols were analysed. The symbol sets and their interactions with the time variable and its resultant effect on symbol recognition were also analysed. Finally, the symbol sets interactions with both the treatment and the time variable were analysed in order to isolate its influence on the recognition of symbols.

(ii) Treatments: the two treatments interactions with the symbols sets were analysed. The two treatments interaction with the time variable was considered. Then the two treatments interactions with time and symbol sets were analysed.

(iii) Time: the overall influence of the three time lines (day 1-E1, day 2-E2 and day 7-E3) on the recognition of symbols was analysed. Thereafter the interactions of the time variable in combination with the two treatments were analysed for its effect on the recognition of the symbols. The time variable's interactions with the combination of symbol sets and treatments were also looked at.

In order to isolate the significance of the retention probe scores, a repeated ANOVA measure was performed (rANOVA). The following retention probe scores were compared for their interactions with the two treatments and their resultant effect on the recognition of the symbols: (i) comparison of scores for RPE1 and RTPE2 and (ii) comparison of scores for RPE2 and RTP3.

4.5 Presentation of Results

Table 4.4 presents the results of the initial ANOVA analysis which analysed the significance of the recognition probe scores (RPE1, RPE2 and RPE3). The variables included were: the *time* variable which represented the different experimental sessions or day1-E1, day 2-E2 and day 7-E3, the *treatment* variable which included treatment 1 (T1 Self-Generation SGE) and treatment 2 (T2 – Non Self-Generation NSG), and the *set* variable which was symbol set 1(S1) and symbol set 2 (S2). The results presented in table 4.4 and its significance will be discussed in the sections to follow.

Table 4.4 ANOVA analysis results
Interactions of time, treatments and sets on recognition levels

Independent Variable Interactions	p-value*	Effect Size**	Effect Size Rating
Time	0.387	0.051	small
Treatment	0.322	0.027	small
Set	0.709	0.004	small
Time-Treatment	0.556	0.032	small
Time-Set	0.228	0.079	small
Treatment-Set	0.851	0.001	small
Time-Treatment-Set	0.264	0.071	small

* p-value: if $p < 0.05$, then significant at a 5% level
** Effect size: 0.01 – 0.05 small, 0.06 – 0.14 medium, >0.15 large.

4.5.1 Interactions of the symbol sets with recognition levels

An intensive development procedure was followed (as described in section 3.5.1, chapter 3) to provide an argument for the equivalency of the two symbol sets. The present ANOVA analysis ascertained whether the symbol sets produced any bias in how the participants learnt to recognise the symbols taught. The initial ANOVA analysis helped to isolate any significant interaction between the sets, treatments and time on the dependant variable (recognition levels for the symbols as determined by

RPE1, RPE2 and RPE3). Table 4.4 presents the ANOVA results together with the effect sizes. As is evident from table 4.4, a non-significant p-value together with a small effect size, was obtained for the interaction of the symbol sets with treatments, time, and the combination of treatment-time. This indicated that there was no significant interaction between the symbol sets used during training and the level of symbol recognition. Hence the symbol recognition levels were not influenced by any ease of recognisability of any one symbol set over the other.

Table 4.5 shows the mean (M) symbol recognition levels and their standard deviations for symbol set 1 and symbol set 2 across experimental sessions. These similar mean recognition levels for symbol set 1 and symbol set 2 further validated the equivalency procedure conducted during the material development phase of this study.

Table 4.5 Mean recognition levels and standard deviations across symbol sets (n 14)

	Mean (M)	**Standard Deviation**
Set 1	9.04	2.49
Set 2	9.12	2.83

4.5.2 Interaction of treatments with symbol recognition

4.5.2.1 Treatment 1 (self-generation) and treatment 2 (non self-generation)

Table 4.4 shows the non-significant interactions between treatments and the level of symbol recognition determined during the recognition probes. Figure 4.1 shows the mean recognition levels obtained during RPE1, RPE2 and RPE3 when using treatment 1 (self-generation - SG) and treatment 2 (non self-generation – NSG). As is evident from the similar mean recognition levels across recognition probe measures, the self-generation approach was showing no recognition advantage when the recognition probe scores were analysed.

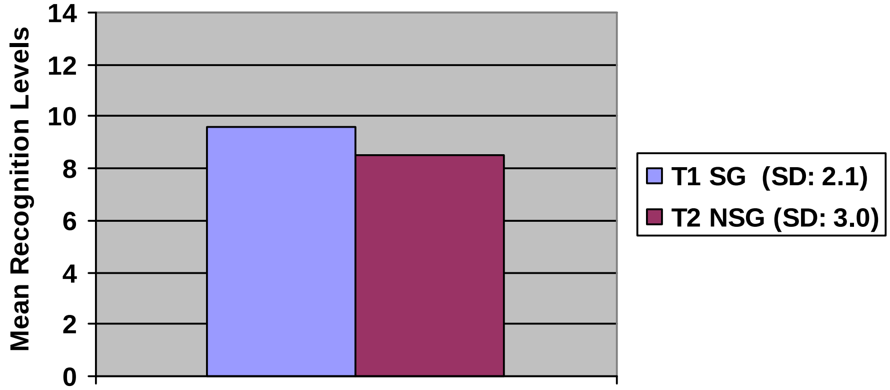


Figure 4.1 Mean recognition levels and standard deviations (SD) for treatment 1 (Self-Generation SG) and treatment 2 (Non Self-Generation NSG)

Figure 4.1 presents the mean recognition level and standard deviations (SD) of both treatment conditions. It provides as overview of the performance across all experimental sessions.

The results do indicate that the participants with severe Global aphasia and severe Broca's aphasia do have the ability to recognise Blissymbols. This is consistent with previous studies which have shown that AAC may be a viable method for establishing communication in these patients (Koul, Corwin & Hayes, 2004; Koul & Harding, 1998; Koul & Lloyd, 1998; McCall, Shelton, Weinrich & Cox, 2000).

However, the results from the recognition probes shown in figure 4.1, do not support the superiority of a self-generation type of approach when trying to teach individuals with severe aphasia to recognise symbols. There seemed to be no obvious, immediate benefit to the patient's increased involvement in the construction of the to-be-recognised symbols. The underlying premise of the SGE is the notion that the more an individual is involved in the construction of the to-be-remembered item, the greater the memorial advantage for that item can be expected. The SGE research has successfully been able to replicate the SGE phenomenon using words, numbers, sentences and pictures with non brain-damaged individuals (Graf, 1980; Gardiner & Hampton, 1985; Peynircioglu, 1989; Slamecka & Graf, 1978,). Studies conducted with individuals with brain-damage have also been able to show a memory advantage for words when using the SGE (Barrett, Crucian, Schwartz, & Heilman, 2000; Chiaravalloti & DeLuca, 2002; Chiaravalloti, DeLuca, Moore & Ricker, 2005; Dick & Kean, 1989; Goverover, Chiaravalloti, Johnston & DeLuca, 2005; Lengenfelder, Chiaravalloti & DeLuca, 2003; Lipinska, Backman, Mantyla & Viitanen, 1994; Michell, Hunt & Schmitt, 1986; Multhaup & Balota 1997; O'Brien, Chiaravalloti, Arango-Lasprilla, Lengenfelder & DeLuca, 2007; Souliez, Pasquier, Lebert, Leconte & Petit, 1996). However the SGE failed to emerge during the recognition probe measures in this study. In comparison to other studies on the SGE, the present study's format differed by the specific deficits associated with the severe aphasia and the type of stimuli used to elicit the SGE. Hence, it is plausible that the reason for the SGE not emerging during the recognition probe tests was influenced by the very nature of the severe aphasia itself and the type of stimuli used to elicit the SGE.

There are many characteristics of a severe aphasia (as presented in section 2.6.1, chapter 2) that could contribute to how these individuals learn to recognise symbols. Deficits in higher level cognitive processes seem to pose the foremost threat to symbol recognition. However, O'Brien et al's (2007) study into the SGE with participants presenting with traumatic brain injury did show that even individuals with multiple deficits in most cognitive domains (i.e. working memory, episodic memory and executive functioning) were still able to benefit from the SGE. Hence ruling out deficits within the cognitive domains that are associated with a severe aphasia, some other possibilities for why the SGE did not enhance the symbol recognition levels needs to be explored.

The most relevant SGE theory points to the process of semantic activation as a contributor to the emergence of the SGE (Graf, 1980; McElroy & Slamecka, 1982; Nairne et al, 1985; Payne et al, 1986). This theory assumes that because self-generation is more effortful it activates the items location in the individual's lexical network and enhances the items retrieval from memory. However, in the instance of this present study, the opposite explanation is proposed. It is possible that the SGE failed to emerge because it was the NSG approach and not the SGE approach which allowed the participant to determine the semantic or meaning association between the symbol and its referent thus influencing its recognition. During the NSG procedure the participant was not required to perform any actions besides studying the symbol carefully and remembering it for the test to follow. Hence, it is possible that the participant merely used the allotted time to examine the symbol and make sense of it. On the other hand, the SGE approach required the participant to draw the dot picture to make the symbol. It is possible that the participant then focused on completing the drawing successfully and failed to focus on determining the semantic link between the symbol and its referent. The drawing activity was distracting and shifted the participants attention away from making the semantic association required. Hence, lexical activation did not occur and the SGE failed to emerge on recognition testing.

Another possibility for SGE not emerging requires evaluation of the stimuli used. Some SGE studies have shown no SGE for non-words or non-meaningful stimuli (Gardiner & Hampton, 1985; Nairne, Pusen and Widner, 1985; Nairne & Widner, 1987). The semantic-association or lexical activation (McElroy & Slamecka, 1982) theories on SGE suggest that in order for the SGE to emerge, meaning must be established. The Blissymbols are in-fact new, non-meaningful picture stimuli presented to the participants for the first time. In fact one of the participant selection criteria was no previous exposure to AAC training (see section 3.3.2, chapter 3). The participants could have failed to attach meaning to the Blissymbols on a single exposure. The drawing of the dot picture could have also further distracted their attention away from forming a meaningful link between the symbol and its referent. Hence, poor SGE recognition scores were obtained for the Blissymbols as the participants did not have a preexisting mental representation of the symbols.

A recent study by Lutz, Briggs, & Cain (2003, p. 171) also showed a “greatly reduced generation effect for new, unfamiliar material”. This study contrasted unfamiliar sentences from textbooks with familiar clichés. They concluded that the SGE can have limited effectiveness on memory for new, unfamiliar stimuli. Since the participants in this study were exposed to the Blissymbols for the first time, the Blissymbols could also be classified as new and unfamiliar stimuli hence producing similar results to the above study.

Dick & Kean (1989) and Mitchell, Hunt & Scmitt (1986) also did not find a SGE when it was tested with a group of subjects presenting with dementia. They also argued that given the role of semantic activation in the SGE and since semantic memory is disrupted in dementia of the Alzheimer's type, a SGE could not be expected. Souliez, Pasquier, Lebert, Leconte & Petit (1996) also supported this contention. They agreed that the participant's lack of access to semantic memory or semantic activation contributed to the SGE not being found.

4.5.3 Interactions of time with symbol recognition

4.5.3.1 Results of the recognition probes

The time variable in the initial ANOVA conducted analysed the scores of the recognition probe measures conducted after training on day 1 – E1 (RPE1), day 2 – E2 (RPE2) and day 7 – E3 (RPE3). Table 4.4 shows that there was no significant interactions between time, symbols sets or treatments. Figure 4.2 shows the mean number of symbol recognised over the three recognition probes (RPE1, RPE2, RPE3).

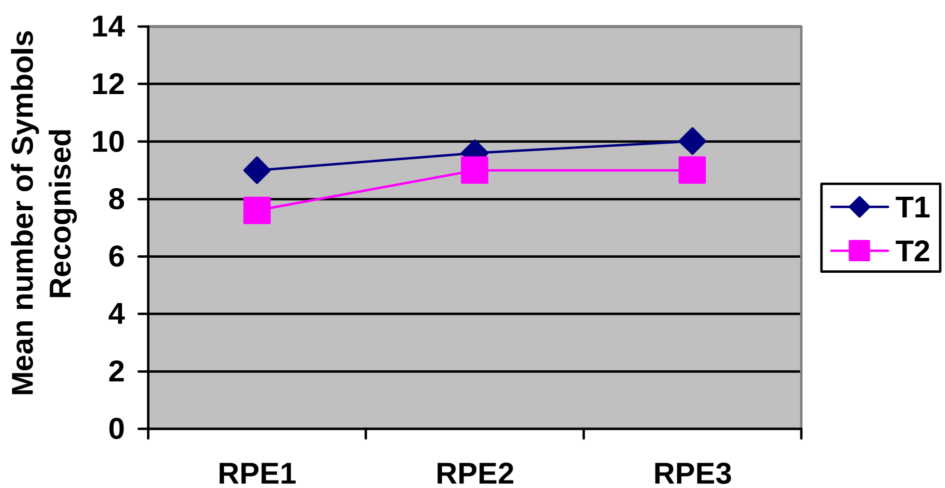


Figure 4.2 Results of the recognition probes

4.5.3.2 Results of the retention probes

A repeated analysis of variance (rANOVA) was performed in order to determine the significance of the retention probe scores. There were two retention probes conducted in order to ascertain how symbol recognition levels were being retained as a function of the two withdrawal periods and the two treatments. Two types of comparisons were made. In order to analyse the retention of recognition levels after the first withdrawal period (one day), recognition scores from recognition probe RPE1 and retention probe RTPE2 were analysed. In order to analyse the effect of the second withdrawal period (seven days) scores from recognition probe RPE2 and retention probe RTPE3 were compared.

Table 4.6 presents the rANOVA results of the comparison between recognition levels for RPE1 and RTPE2. As is evident from table 4.6, the p-values obtained were not significant and the effect sizes were small. Hence no statistically significant difference existed between these experimental sessions. The same number of symbols recognised in RPE1 when using either treatment 1 (self-generation) or treatment 2 (non self-generation) were retained and recognised to the same level during the retention probe (RTPE2).

Although these results do not support the superiority of the SGE, the results could have implications for patients who present with a severe aphasia. It is evident that persons with severe aphasia can learn to recognise Blissymbols when using either a self-generation type of method or a more traditional teaching method. These individuals also appear to retain the ability to recognise these Blissymbols after a one day withdrawal period suggesting the integrity of each treatment approach as a methodology for teaching these Blissymbols to persons presenting with a severe aphasia. It was seen that the level of Blissymbol recognition gained on initial training was carried over to the next training session.

Table 4.6 Comparisons between RPE1 and RTPE2		
Comparison Variable	**P-Value***	**Effect Size****
Treatment	0.840	0.194
Set	0.548	0.162
Treatment and Set	0.112	0.001

* if $p < 0.05$, then significant at a 5% level
** Effect Size: 0.01 – 0.05 small, 0.06 – 0.14 medium, >0.15 large.

The rANOVA results which compared scores obtained during recognition probe RPE2 and retention probe RTPE3 is presented in table 4.7. This helped to ascertain the retention of recognition levels following the second withdrawal period of seven days.

Table 4.7 Comparisons between RPE2 and RTPE3			
Comparison Variable	**P-Value***	**Effect Size****	**Effect size Rating**
Treatment	0.198	0.150	medium
Set	0.100	0.005	small
Treatment and Set	0.002*	0.190**	large

* if $p < 0.05$, then significant at a 5% level
** Effect Size: 0.01 – 0.05 small, 0.06 – 0.14 medium, >0.15 large.

The analysis indicated there was a significant difference between RPE2 and RTPE3 as a function of treatments and sets. This is reflected by the significant p-value (0.002) and the large effect size (0.190). In order to further analyse this significant interaction, a further rANOVA was performed. Table 4.8 below shows the results of this rANOVA which presents the mean difference between recognition levels obtained during RPE2 and RTPE3 as a function of treatments and sets. The mean difference score describes the difference in recognition levels across the two probe measures. The negative mean difference scores indicates that there were less symbols retained and recognised by day 7-E3 when compared to day 2-E2.

Table 4.8 Mean difference and standard deviations (SD) between recognition levels for RPE2 and RTPE3

Treatment	Set	Mean Difference	SD
1	1	0.7	0.9
	2	-1.5	0.7
2	1	-4.0*	1.4
	2	0.5	1.8

*largest difference in the recognition levels between time lines

This analysis indicates that the largest difference in recognition levels between RPE2 and RTPE3 was for treatment 2 (non self-generation) on set 1. This is presented in figure 4.4. This indicates there were less symbols recognised in session E3 compared to E2 when using the treatment 2 (NSG). However, for treatment 1 (SG) there was no large, significant difference in the number of symbols recognised between sessions E2 and E3. This implies that when using the SG treatment, the same number of symbols recognised in session E2 were retained and recognised to the similar level during the retention probe (RTPE3) conducted at the beginning of session E3.

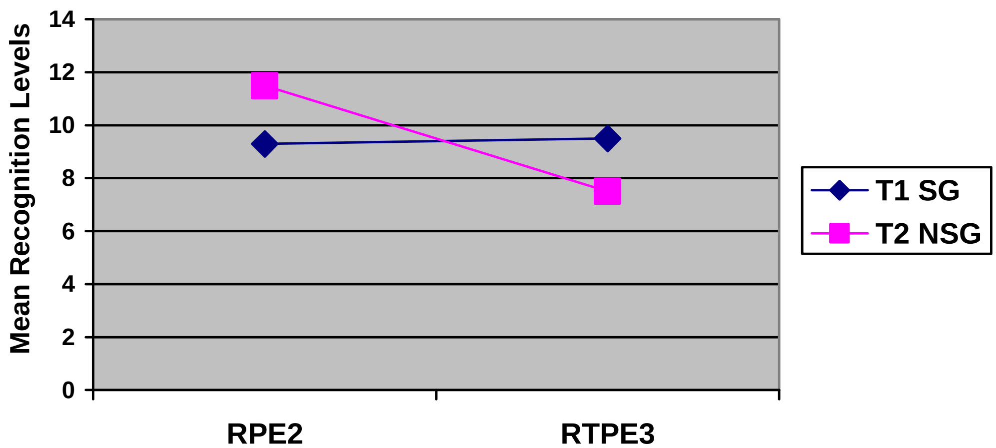


Figure 4.3 Comparison between mean recognition levels for SET 1 during RPE2 and RTPE3

These results point to the possible robustness of the memory enhancing effect caused by the self-generation treatment on the recognition of the symbols. It is possible that the participant's involvement in constructing these symbols in session E2 could have led to the sustained retention of recognition levels following the withdrawal period in session E3. Interestingly, this increased long-term retention benefit for generated stimuli was also reported by Kornell & Terrace (2007) when they studied the SGE in monkeys. These researchers contrasted the SG and NSG conditions using photographs as stimuli. The subjects were presented with a touch screen which included a set of five photographs. They were required to touch the photographs according to a specific sequence. In the NSG condition the subjects performed the sequence with hints provided for the correct photograph sequence required. In the SG condition, the subjects performed the sequence without hints using trial and error. The results showed that the subjects' performance levels were better using the NSG condition during the first three days of training. However, as training continued over time, the SG condition started to show higher performance levels. The researchers concluded that "although the active generation of answers during training may result in low initial performance, it enhances long-term retention and transfer" (Kornell & Terrace, 2007, p. 685). Similar results were seen in the present study because during initial sessions E1 and E2, the SG condition did not show any advantages but as training proceeded the SGE showed some signs of improving retention of recognition levels after the longer withdrawal period.

The difference in the retention of recognition levels between E2 and E3 also provides further support for the semantic-association or lexical activation theories for the SGE. It is possible that during the repeated exposures to the Blissymbols during the two preceding training sessions (E1 and E2), the participants were starting to develop a mental representation for the Blissymbols and were beginning to attach meaning to the symbols. Hence, a SGE was starting to emerge.

Additionally the Blissymbols after repeated exposures during sessions E1 and E2, were now becoming more familiar stimuli. Since the SGE has been shown to be ineffective for non-familiar stimuli, it is probable that the increased exposure during training was also increasing the familiarity levels hence the SGE emerged.

4.6 Summary

This chapter provided a presentation of the research results and discussion. It focused on answering the central research question which determined if the self-generation effect could enhance the recognition of Blissymbols in severe aphasics when it is used as a teaching strategy. The results indicated that there was no statistically relevant difference between the participants' performance on the self-generation or non self-generation approach during recognition probe testing. However, there was a statistically relevant recognition advantage on the SG treatment as seen by the better retention of recognition levels from day 2-E2 to day 7-E3. Hence, the SG treatment showed better retention of symbol recognition over time. Previous studies have shown that the self-generation effect failed to emerge with stimuli that were new or unfamiliar. This trend was also seen in this study. The results provide support for a semantic-association theory for the SGE.

CHAPTER 5

CONCLUSIONS, EVALUATIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter will provide the final conclusions of the study. It provides an evaluation of the strengths and weaknesses of the study and presents some recommendations for future research.

5.2 Conclusions

5.2.1 The symbol sets

The study aimed to construct two equivalent symbol sets that could be counter-balanced between the two treatment approaches. The ANOVA analysis performed showed that there was no statistically significant interaction between the sets and the treatments. Hence the equivalency procedure was successful.

5.2.2 Self-generation (SG) versus non self-generation (NSG)

The results from the recognition probe measures conducted indicated that there was no overall difference between the recognition levels for the Blissymbols using either SG or NSG. This supports other studies which have shown that persons with severe aphasia can be trained to recognise symbols. This is consistent with the SGE research findings which show no SGE for new, non-meaningful and unfamiliar material. The finding of similar recognition levels across treatments during the recognition probes, also provided support for a semantic-association or lexical activation theory of the SGE. Since the Blissymbols were new, non-meaningful stimuli, no semantic association was made initially. The severity of the participants' aphasia may have also hampered the process of establishing a meaning association between symbol and referent pairs.

However, the results did show that there was a statistically significant difference between recognition levels using SG and NSG following the seven day withdrawal period as determined by the retention probe measure. The SG treatment appeared to produce better retention of recognition levels over time. With repeated exposure to the Blissymbols, the stimuli became more familiar to the participants and it is possible that the semantic associations between the symbol and its referent became more apparent. Hence over time, the SG effect began to emerge.

5.3 Evaluation of the Study

The strengths of the study included the following:

- The construction of two equivalent symbol sets was a strength of this study. The statistical analysis showed no bias imposed by the sets. Hence, the sets were shown to be functionally equivalent.

- The factorial design was a strength of the study because it allowed for the analysis of the interactions of all three independent variables and its resultant influence on the dependant variable.

- The use of raters to evaluate the treatment procedures supports the treatment integrity of this study. The positive inter-rater scores also support the equivalency of the training procedures used across participants.

- The inclusion of both recognition and retention probe measures was another strength on this study. If the retention probes were omitted, the emergence of the SGE as a function of time would not have been demonstrated.

- The study included an intensive pre-experimental screening phase which decided if a prospective participant was a suitable candidate for inclusion into the study. More importantly, the Receptive/ Pointing Test conducted during screening confirmed that the participants were able to understand and recognise the target referents. If not, the recognition levels may have been largely influenced by auditory comprehension levels. The Boston Diagnostic Aphasia Examination alone could not have provided any reliable indication of how the participants understood the symbol referents. Hence this study included both test types to ascertain receptive language skills.

- The withdrawal periods helped to isolate the emergence of the self-generation effect. There was also a strong match between the training task and the test (probe measure) tasks. The testing phase called for recognition of symbols which was in-keeping with the level of training conducted. A more difficult test task like free recall would have not been appropriate for the amount of training that occurred.

- The actual format of the probe measures was a strength as it tested recognition levels for the symbols taught in the most basic, straight forward and uncomplicated manner as possible. This was important if the SGE was to emerge as demonstrated by Gardiner (1988), Slamecka & Graf (1978) and Graf (1980).

- The randomisation of symbol presentation on the grids used during the different probe measures was also an important strength. Should the presentation have been kept the same, an exposure bias could have led to better recognition performance as a function of time.

- The customisation of the connect-the-dot pictures by correlating the number of dots used per illustration to the complexity values proposed by Fuller & Lloyd (1987) supported the standardisation of these illustrations. This was a positive aspect of this study's methodology.

The limitations of the study include the following:

- Both Broca's aphasics and Global aphasics were included in the study. Although there was an equal split between these two types of severe aphasias and they were matched across four variables (time of onset, severity, lesion site and education); homogeneity between these groups is limited. However, the inclusion of both aphasia types may also have been a strong point of this study because it may have been possible that a sub-group of aphasic individuals who may learn better using SG could have been identified. The inclusion of both these groups was necessitated by the lack of availability of a sufficient number of participants from either one of the groups.

- The study only investigated one aspect of memory which was recognition. A free recall task could have caused the SGE to emerge earlier as it is a more difficult test of memory and the benefits of generation could have been isolated. For example, in a free recall test format the participant could be presented with symbols cards, which included all the test symbols together with foils, and the participant would be asked to select all the symbols he/she had seen during the training. During such a free recall task, which also reduces the auditory comprehension demands of asking an individual with aphasia to point to the symbol named; the SGE may have had a better chance of emerging.

- The study only investigated the SGE over three training days and a seven day withdrawal period. A longer withdrawal period might have yielded additional insights in understanding the influence of the SGE.

5.4 Recommendations for Future Research

The recommendations for future research are as follows:

- Broca's and Global aphasics were included in this study. The inclusion of participants with different types of aphasia may be important in future studies as this may help to identify sub-groups of aphasic individuals who benefit more from the application of the SGE.

- Since the issue of unfamiliarity of stimuli was discussed and evaluated, it would be interesting to see how severe aphasics who have already been exposed to Blissymbols may perform when using self-generation.

- It would be interesting to see how other types of self-generation strategies apart from the dot drawing used here, could impact on the emergence of the self-generation effect. It was mentioned that the dot drawing could have been very distracting.

- The SGE could be tested with other types of stimuli such as words, numbers and pictures.

- A study which focuses on longer training schedules and longer withdrawal periods might add important insights in relation to when the SGE may emerge during training. Increasing the number of experimental sessions and changing the length of the withdrawal periods could also help to identify the robustness of the SGE over time.

- It would also be interesting to test whether the SGE would emerge when used with other types of populations who present with cognitive deficits. This would help to further delineate the involvement of semantic activation.

- Replication of this study with normal adult learners may help to isolate factors that contribute to the SGE and its effect on the learning and memory.

- The two equivalent symbol sets could be used for further study. Research into the use of these symbol sets with other populations could yield interesting results.

5.5 Summary

The major conclusions and recommendations of the present study are presented in this chapter. The study's strengths and limitations are discussed. There remain certain issues that do merit further investigation via future research.

REFERENCES

Abra, J. C. (1968). Acquisition and retention of consistent associative responses with varied meaningfulness & similarity of stimuli. *Journal of Verbal Learning & Verbal Behaviour*, 7, 647-652.

Barlow, D.H., & Hersen, M. (1984). *Single case experimental designs: Strategies for behaviour change.* 2nd edition. New York: Pergamon Press.

Barrett, A. M., Crucian, G. P., Schwartz, R. L., & Heilman, K. M. (2000). Testing memory for self-generated items in dementia: Method makes a difference. *Neurology*, 54(6), 1258–1264.

Beck, A.R., & Fritz, H. (1998). Can people who have aphasia learn iconic codes? *Journal of Augmentative & Alternative Communication*, 14, 184 -196.

Bertoni, B., Stoffel, A., & Weniger, D. (1991). Communicating with pictographs: A graphic approach to the improvement of communicative interactions. *Aphasiology*, 5, 341-353.

Beukelman, D.R., & Mirenda, P. (1992). *Augmentative and alternate communication: Management of severe communication disorders in children and adults*. 3rd edition. Baltimore: Paul Brookes Publishing.

Brookshire, R.H. (2003). *An introduction to neurogenic communication disorders*. St Louis: Mosby-Tear Book Inc.

Chiaravalloti, N. D., & Deluca, J. (2002). Self-generation as a means of maximizing learning in multiple sclerosis: An application of the generation effect. *Archives of Physical Medicine & Rehabilitation*, 83, 8, 1070-1079.

Chiaravalloti, N. D., DeLuca, J., Moore, N. B., & Ricker, J. H. (2005). Treating learning impairments improves memory performance in multiple sclerosis: A randomized clinical trial. *Multiple Sclerosis*, 11, 1, 58-68.

Crutcher, R.J., & Healy, A.F. (1989). Cognitive operations and the generation effect. *Journal of Experimental Psychology: Memory & Cognition*, 4, 669-675.

Craik, F. I. M., & Lockhart, R.S. (1972). Levels of processing: A framework for memory research. *Journal of Verbal Learning and Verbal Behaviour*, 11. 671-684.

Cohen, J. (1977). *Statistical power analysis for the behavioural sciences*. New York: Academic Press.

Damasio, H. (2001). *Neural basis of language disorders*. In Chapey, R (ed). Language intervention strategies in aphasia & related neurogenic communication disorders, 18-36, (4th edition) Philadelphia: Lippincott Williams & Wilkins.

Dick, M.B., & Kean, M.L. (1989). Memory for internally generated words in Alzheimer-type dementia: Breakdown in encoding & semantic memory. *Brain & Cognition*, 9, 1, 88-108.

Donaldson, W., & Bass, M. (1980). Relational information and memory for problem solutions. *Journal of Verbal Learning and Verbal Behaviour*, 19, 26-35.

Funnel , E., & Allport, A. (1989). Symbolically speaking: communicating with Blissymbols in aphasia. *Aphasiology*, 3, 279-300.

Fuller, D.R. (1997). Initial study into the effects of translucency and complexity on the learning of Blissymbols by children and adults with normal cognitive abilities. *Augmentative & Alternative Communication*, 13, 1, 30-39.

Fuller, D. R., & Lloyd, L. L. (1987). A study of physical and semantic characteristics of a graphic symbol system as predictors of perceived complexity. *Augmentative and Alternative Communication,* 3**,** 26-35.

Fuller, D. R., & Lloyd, L. L. (1992). Effects of physical configuration on the paired-associate learning of Blissymbols by preschool children with normal cognitive abilities. *Journal of Speech and Hearing Research*, 35, 1376 -1383.

Gardiner, J.M. (1988). Generation and priming effects in word-fragment completion. *Journal of Experimental Psychology: Learning, Memory & Cognition,* 14, 3, 495-501.

Gardiner, J.M., & Hampton, J.A. (1985). Semantic memory & the self-generation effect: some tests of the lexical activation hypothesis. *Journal of Experimental Psychology: Learning, Memory & Cognition,* 11, 4, 732-741.

Gardiner, J.M., & Rowley J.M.C. (1984). A generation effect with numbers rather than words. *Memory & Cognition*, 12, 443-445.

Garrett, K., & Beukelman, D. (1992*). Augmentative communication approaches for persons with severe aphasia.* In K. Yorkston (Ed.), Augmentative communication in the medical setting, 245-338. Tucson, AZ: Communication Skill Builders.

Ghatala, E.S. (1981). The effect of internal generation of information on memory performance. *American Journal of Psychology*, 94, 3, 443-450.

Glisky, E.L. & Rabinowitz, J.C. (1985). Enhancing the self generation effect through repetition of operations. *Journal of Experimental Psychology: Learning, Memory & Cognition*, 11, 2, 193-205.

Goodglass, H. (2001). The assessment of aphasia & related disorders. 3rd edition. Lippincott Williams & Wilkins.

Goodglass, H., Kaplan, E., & Barresi, B. (2001). The Boston Diagnostic Aphasia Examination. 3rd edition. Lippincott Williams & Wilkins.

Goverover, Y., Chiaravalloti, N., Johnston, M., & DeLuca, J. (2005). Self-generation to improve learning of everyday functional tasks in multiple sclerosis & traumatic brain injury. *Journal of the International Neuropsychological Society*, 11 (Suppl. 1), 49-59.

Graf, P. (1980). Two consequences of generating: Increased inter & intraword organization of sentences. *Journal of Verbal Learning & Verbal Behaviour*, 19, 316-327.

Hegde, M.N. (2003). *Clinical research in communication disorders. Principles & strategies.* 3rd edition. Texas: Pro-Ed.

Hirshman, E,. & Bjork, R.A. (1988). The generation effect: Support for a two-factor theory. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 14. 484-494.

Jacoby, L.L. (1978). On interpreting the effects of repetition: Solving a problem versus remembering a solution. *Journal of Verbal Learning & Verbal Behaviour*, 17, 649-667.

Johns, E.E., & Swanson, L.G. (1988). The generation effect with nonwords. *Journal of Experimental Psychology: Learning, Memory and Cognition*, 14, 180-190.

Johannsen-Hornbach, H., Cegla, B., Mager, U., & Schempp, B. (1985). Treatment of chronic global aphasia with a nonverbal communication system. *Brain & Language,* 24, 74–82.

Kinjo, H., & Snodgrass, J.G. (2000). Does the generation effect occur for pictures. *American Journal of Psychology*, 113 (1), 95-121.

Kornell, N., & Terrace, H.S. (2007). The generation effect in monkeys. *Psychological Science*, 18 (8), 682-685.

Koul, R.K., & Corwin, M. (2003). *Efficacy of AAC intervention in individuals with chronic severe aphasia*. In Schlosser R.W (ed). The efficacy of augmentative &

alternative communication: Towards evidence- based practise (pp. 449-469). New York, London: Academic Press.

Koul, R.K., Corwin, M., & Hayes, S. (2005). Production of graphic symbol sentences by individuals with aphasia: Efficacy of a computer-based augmentative & alternative communication intervention. *Brain & Language*, 92 (1), 58-77.

Koul, R.K., & Harding, R. (1998). Identification and production of graphic symbols by individuals with aphasia: Efficacy of a software application. *Journal of Augmentative & Alternative Communication*, 14, 11-23.

Koul, R.K., & Lloyd, L.L. (1998). Comparison of graphic symbol learning in individuals with aphasia and right hemisphere brain damage. *Brain & Language*, 62, 394-421.

Lane, V.W., & Samples, J.M. (1981). Facilitating communication skills in adult aphasics: Application of Blissymbolics in a group setting. *Journal of Communication Disorders*, 14, 157–167.

Lengenfelder, J., Chiaravalloti, N. D., & DeLuca J. (2003). Examining the generation effect in individuals with traumatic brain injury. *Journal of the International Neuropsychological Society*, 8, 173-184.

Lipinska, B., Backman, L., Mantyla, T., & Viitanen, M. (1994). Effectiveness of self-generated cues in early Alzheimer's disease. *Journal of Experimental & Clinical Neuropsychology*, 16 (6), 809–819.

Luftig, R. L., & Bersani, H. A. (1985). An initial investigation of the effects of translucency, transparency, & component complexity of Blissymbolics. *Journal of Childhood Communication Disorders*, 8, 191–209.

Lutz, J., Briggs, A & Cain, K. (2007). An examination of the value of the generation effect for learning new material. *Journal of General Psychology*, 130 (2), 171-187.

Maxwell, D.L., & Satake, E. (2006). *Research and statistical methods in communication sciences and disorders*. New York: Thomson Delmar Learning.

McMillan, J. H., & Schumacher, S. (2001). *Research in education: A conceptual introduction* (5th Ed.). New York, NY: Longman.

McCall, D., Shelton, J.R., Weinrich, M., & Cox, D. (2000). The utility of computerized visual communication for improving natural language in chronic global aphasia: Implications for approaches to treatment in global aphasia. *Aphasiology*, 21, 8, 795-826.

McDaniel, M.A., Riegler, G.L. and Waddill, P.J. (1990). Generation effects in free recall: Further support for a three-factor theory. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 16, 789-798.

McElroy, L.A. & Slamecka, N.J. (1982). Memorial consequences for generating nonwords: Implications for semantic-memory interpretations of the self generation effect. *Journal of Verbal Learning & Verbal Behavior*, 21, 249-259.

McFarland C.E., Frey, T.J. & Rhodes, D.D. (1980). Retrieval of internally versus externally generated words in episodic memory. *Journal of Verbal Learning & Verbal Behaviour,* 19, 210-225.

Mitchell, D.B., Hunt, R.R., & Schmitt, F.A. (1986). The generation effect and reality monitoring: Evidence from dementia and normal aging. *Journal of Gerentology*. 41 (1), 79-84.

Multhaup, K. S., & Balota, D. A. (1997). Generation effects & source memory in healthy older adults and in adults with dementia of the Alzheimer type. *Neuropsychology*, 11 (3), 382-391.

Nairne, J.S., Pusen, C., & Widner, R.L. (1985). Representation in the mental lexicon: Implications for theories of the self generation effect. *Memory & Cognition*, 13, 2, 183-191.

Nairne, J.S., & Widner, R.L. (1987). Generation effects with nonwords: the role of test appropriateness. *Journal of Experimental Psychology: Learning, Memory, & Cognitio,*. 13, 1, 164-171.

Nicholos, M., & Helm-Estabrooks, N. (1990). Aphasia: The efficacy of speech-language pathology intervention. *Seminars in Speech and Language*, 11, 135-144.

O'Brien, A., Chiaravalloti, N., Arango-Lasprilla, J.C., Lengenfelder, J., & DeLuca, J. (2007). An investigation of the differential effect of self-generation to improve learning and memory in multiple sclerosis and traumatic brain injury. *Neuropsychological Rehabilitation*, 17 (3), 273-292.

Payne, D.N., Neely, J.H. & Burns, D.J. (1986). The self generation effect: further tests of the lexical activation hypothesis. *Memory & Cognition*, 14 (3), 246-252.

Peynircioglu, Z.F. (1989). The generation effect with pictures and nonsense figures. *Acta Psychologica*, 70, 153-160.

Pring, L., Freestone, S.F., & Katan, S.A. (1990). Recalling pictures and words: Reversing the generation effect. *Current Psychology: Research & Reviews*, 9 (11), 35-45.

Sawyer-Woods, L. (1987). Symbolic function in a severe non-verbal aphasic. *Aphasiology*, 1, 287-290.

Schlosser, R.W. (2003). *The Efficacy of Augmentative & Alternative Communication: Towards evidence- based practise*. California: Elsevier Science.

Scwartz, M., & Walsh, M.F. (1974). Identical subject-generated and experimenter-supplied mediators in paired-associate learning. *Journal of Experimental Psychology*, 103, 878-884.

Shelton, J.R., Weinrich, M., McCall, D., & Cox, D.M. (1996). Differentiating globally aphasic patients: data from in-depth language assessments and production training using C-VIV. *Aphasiology*, 10 (4), 319-342.

Slamecka, N.J., & Graf, P. (1978). The self generation effect: Delineation of a phenomenon. *Journal of Experimental Psychology: Human Learning & Memory*, 4, 592-604.

Souliez, L., Pasquier, F., Lebert, F., Leconte, P., & Petit, H. (1996). Generation effect in short term verbal and visuospatial memory: Comparisons between dementia of the Alzheimer type and dementia of the frontal lobe type. *Cortex*, 32, 347–356.

Steele, R., Weinrich, M., Wertz, R., Kleczewska, M., & Carlson, G. (1989). Computer-based visual communication in aphasia. *Neuropsychologia*, 27, 409-426.

Tyler, S.W., Hertel, P.T., McCallum M.C., & Ellis, H.C. (1979). Cognitive effort and Memory. *Journal of Experimental Psychology: Human Learning & Memory*, 4, 592-604.

Weinrich, M., Shelton, J.R., McCall, D., & Cox, D.M. (1997). Generalization from single sentence to multisentence production in severely aphasic patients. *Brain & Language*, 58, 327-352.

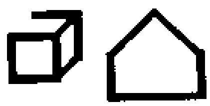
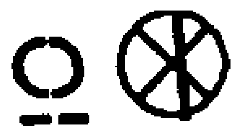
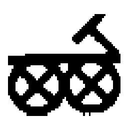
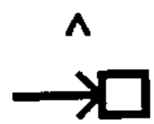
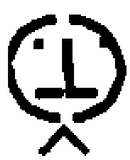
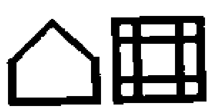
Weinrich, M., McCall, D, Weber, K.T., Thomas, K., & Thornburg, L. (1995). Training on an iconic communication system for severe aphasia can improve natural language production. *Aphasiology*, 9 (4), 343-64.

APPENDICES

Appendix 1

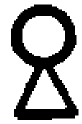
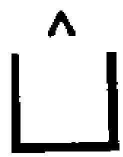
Numbered List of Fuller's(1997) 40 symbols

High Translucency–High Complexity Symbols

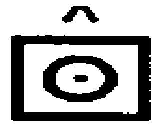
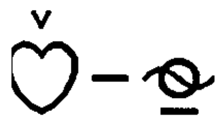
1	 **Brick**	**6**	 **Love**
2	 **Bus**	**7**	 **Pizza**
3	 **Car**	**8**	 **Push**
4	 **Chin**	**9**	 **Surprise**
5	 **Jail**	**10**	 **Train**

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

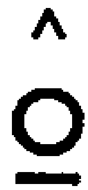
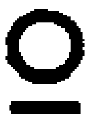
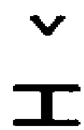
High Translucency–Low Complexity Symbols

11	 **apple**	**16**	 **girl**
12	 **banana**	**17**	 **jump**
13	 **bowl**	**18**	 **open**
14	 **dish**	**19**	 **stamp**
15	 **flag**	**20**	 **teeth**

Low Translucency–High Complexity Symbols

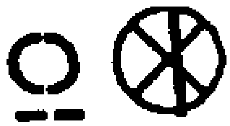
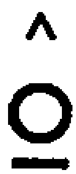
21	 **birthday**	**26**	 **sister**
22	 **coke**	**27**	 **sleep**
23	 **cookie**	**28**	 **sock**
24	 **pancake**	**29**	 **thirsty**
25	 **popcorn**	**30**	 **toothbrush**

Low Translucency–Low Complexity Symbols

31	 **eat**	**36**	 **muscle**
32	 **food**	**37**	 **name**
33	 **grass**	**38**	 **off**
34	 **head**	**39**	 **policeman**
35	 **lie**	**40**	 **small**

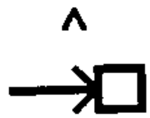
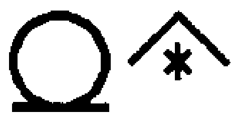
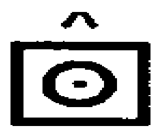
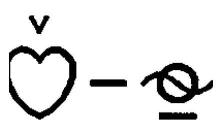
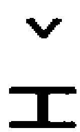
Appendix 2a
Symbol Set 1

H-high, L-low, T-translucency, C-complexity

HTHC 		**HTLC** 	
2. bus	**7. pizza**	**11. apple**	**13. bowl**
	**LTHC** 		
20. teeth	**22. coke**	**24. pancake**	**25. popcorn**
	**LTLC** 		
26. sister	**31. eat**	**33. grass**	**36. muscle**
			
37. name	**39. policeman**		

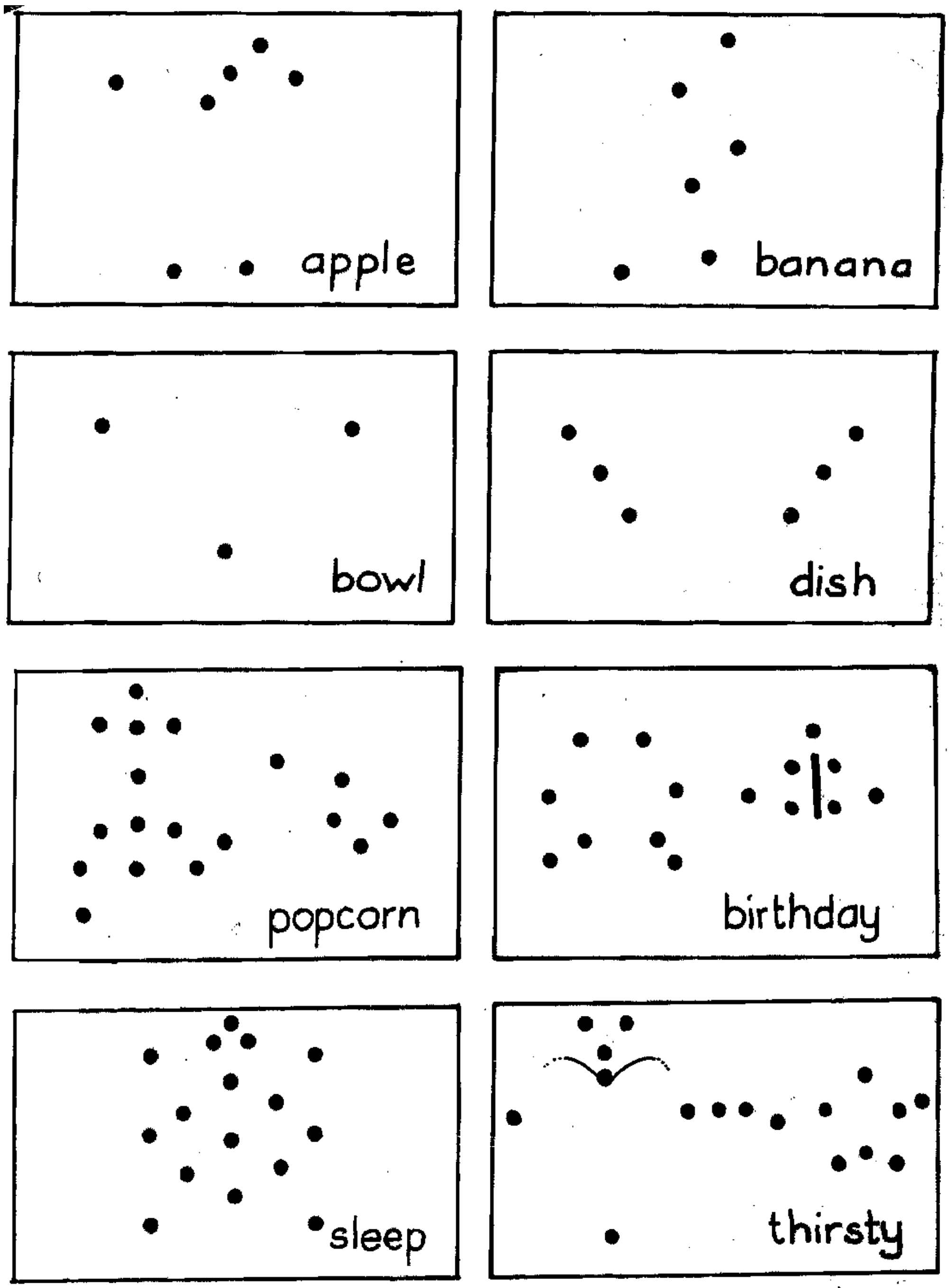
Appendix 2b
Symbol Set 2

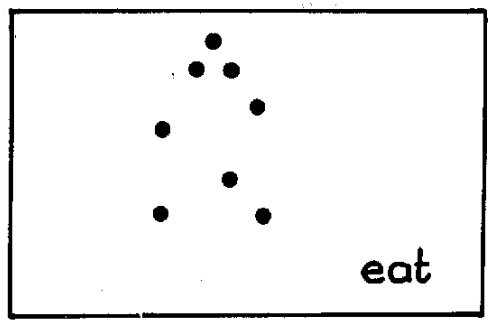
H-high, L-low, T-translucency, C-complexity

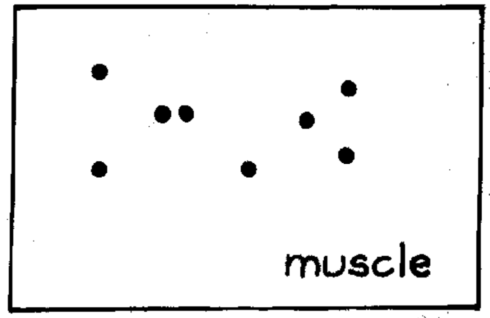
HTHC 		**HTLC** 	
3. car	**8. push**	**12. banana**	**14. dish**
	**LTHC** 		
17. jump	**21. birthday**	**27. sleep**	**28. sock**
	**LTLC** 		
29. thirsty	**32. food**	**34. head**	**35. lie**
			
38. off	**40. small**		

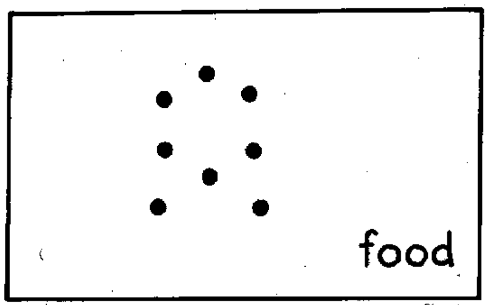
Appendix 3a

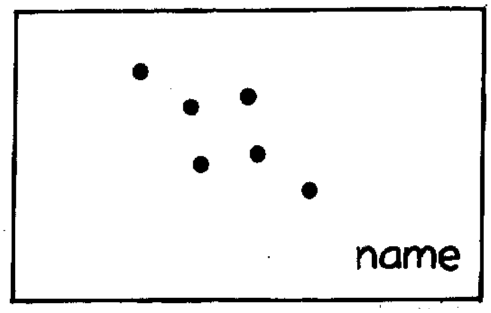
Connect–the-Dot Illustrations

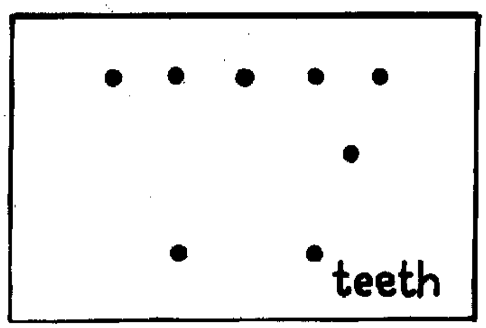


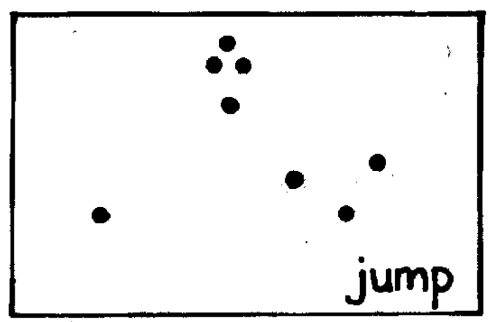

eat

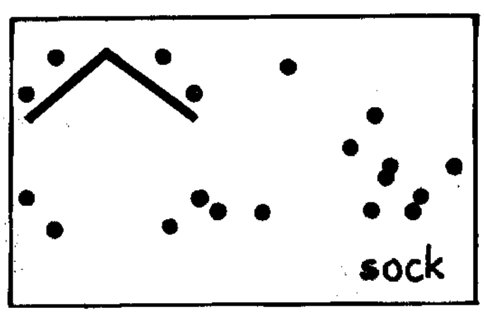

muscle

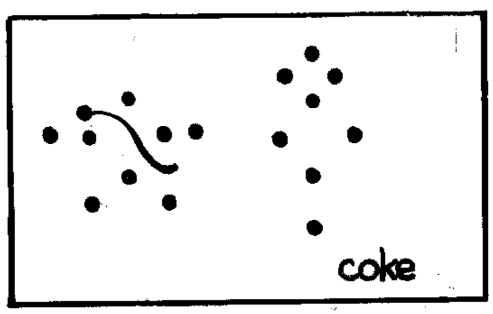

food

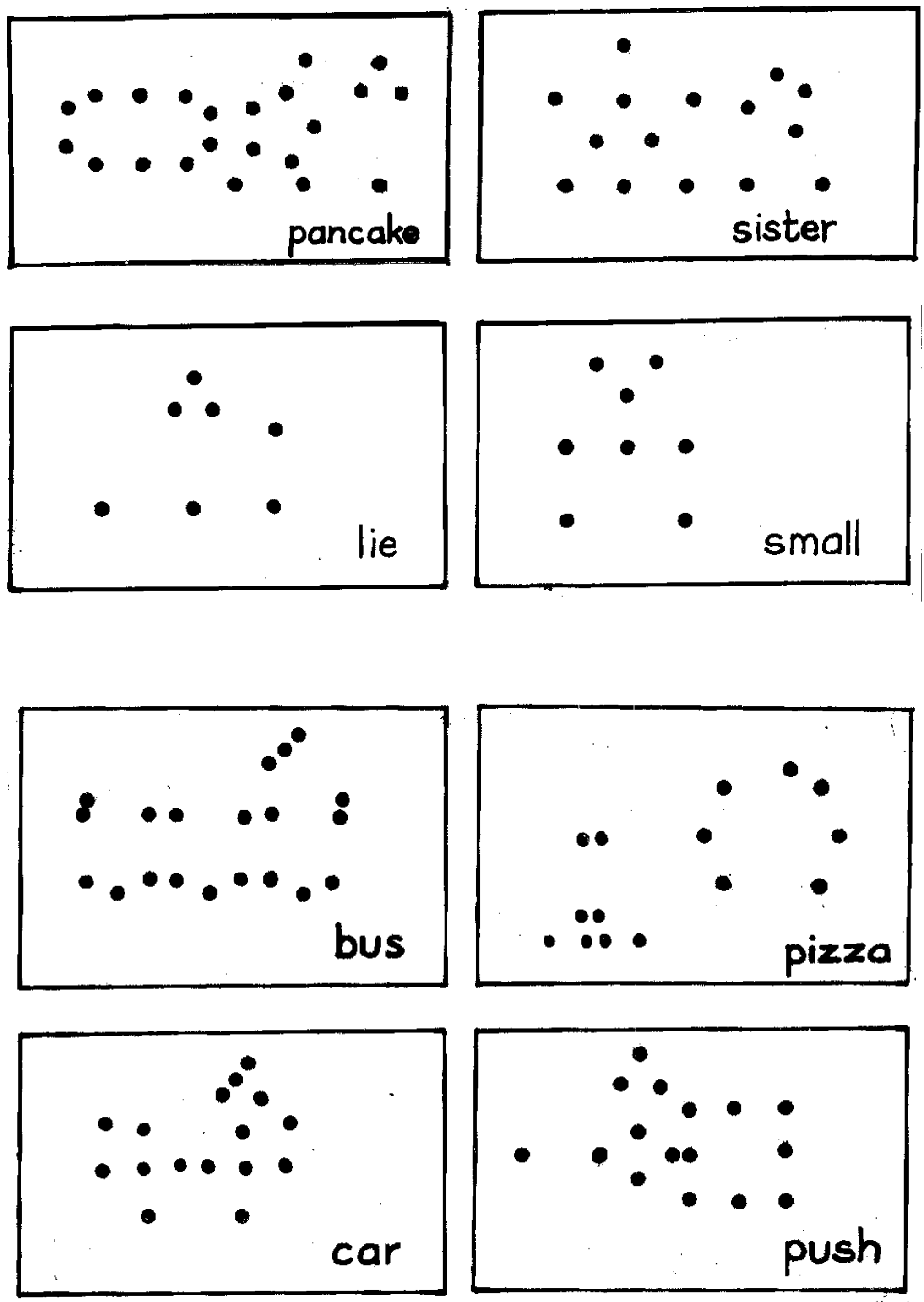

name


teeth


jump

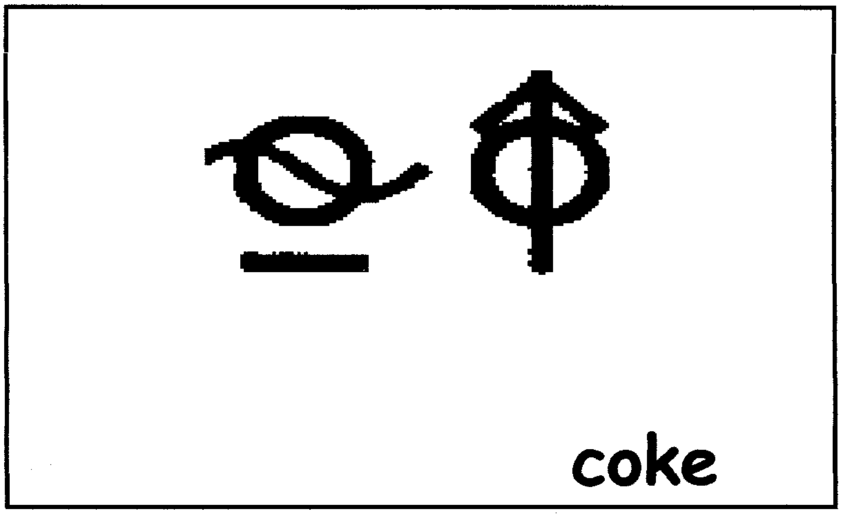

sock

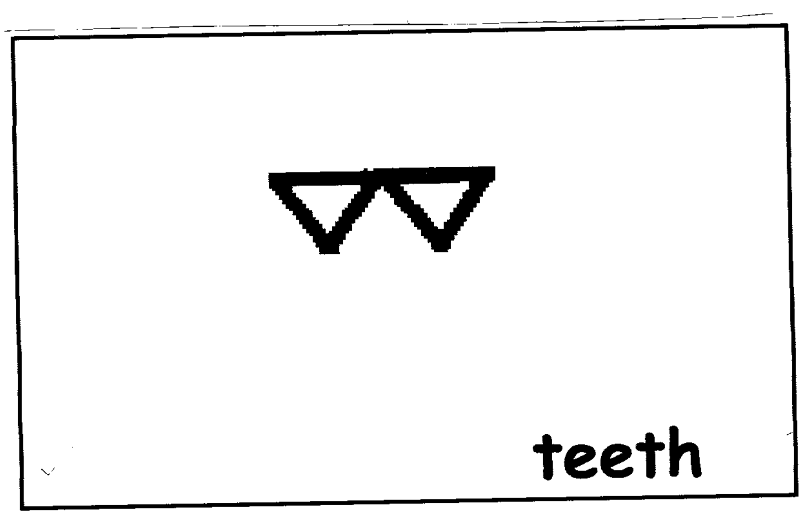

coke


pancake
sister
lie
small
bus
pizza
car
push

Appendix 3b

Examples of the Blissymbol Cards





Appendix 4

Symbol Rating Instructions

BOOKLET 1
TRANSLUCENCY

In this booklet you have to evaluate 40 symbols. The symbol and its representative word is given in the tables in this booklet. You are required to think about how related the symbol and the word it represents is. The word the symbol stands for is written below the symbol. Please try to locate the symbols and the representing words now. If you think the word is very strongly related to the symbol, then tick 1. If you feel the word and the symbol is definitely unrelated, tick 7. Use the numbers between 1 and 7 to rate various levels of the relationship between the word and the symbol. You may use a number more than once. Do you have any questions? Please start rating all 40 symbols now.

BOOKLET 2
FAMILIARITY

In this booklet you are required to make judgements regarding how familiar you are with the words provided. A word is provided in column one and is numbered from 1 to 40. Please locate this now. If you know the word and it is very familiar to you, tick 1. If you think the word is unknown and very unfamiliar to you, tick 7. Use the numbers between 1 and 7 to rate the various degrees of your familiarity with the word. You may use a number more than once. Please work slowly and rate all the words. Lets begin rating all the symbols now.

BOOKLET 3
FREQUENCY OF USE

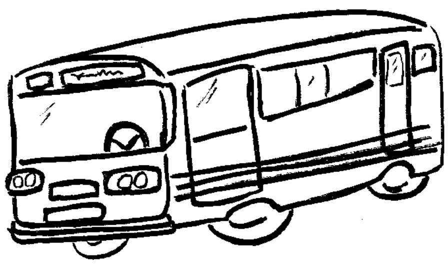
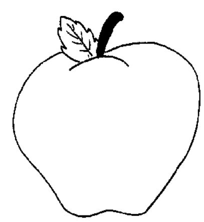
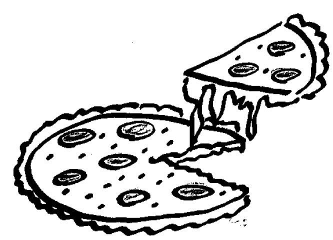
In this booklet you are required to make judgements regarding how often we use some words as opposed to others in everyday life. A word is provided in column one and is numbered from 1 to 40. Please locate this now. If you think we use the word often, tick 1. If you think the word is not used often, tick 7. Use the numbers between 1 and 7 to rate the various degrees of use of the word. You may use a number more than once. Please work slowly and rate all the symbols. Do you have any questions? Lets begin to rate all the words now.

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Appendix 5a

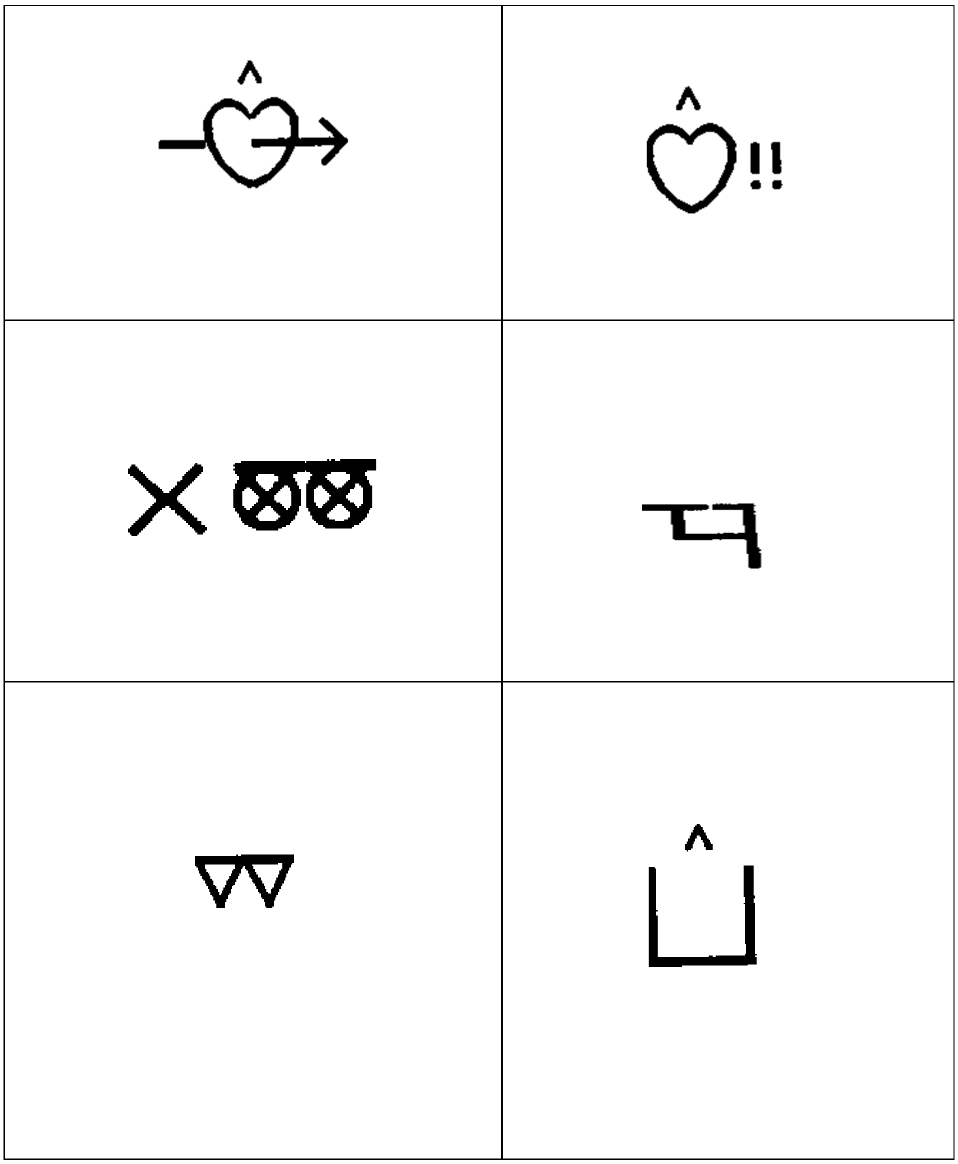
The Pointing and Receptive Language Test

Example of Grid

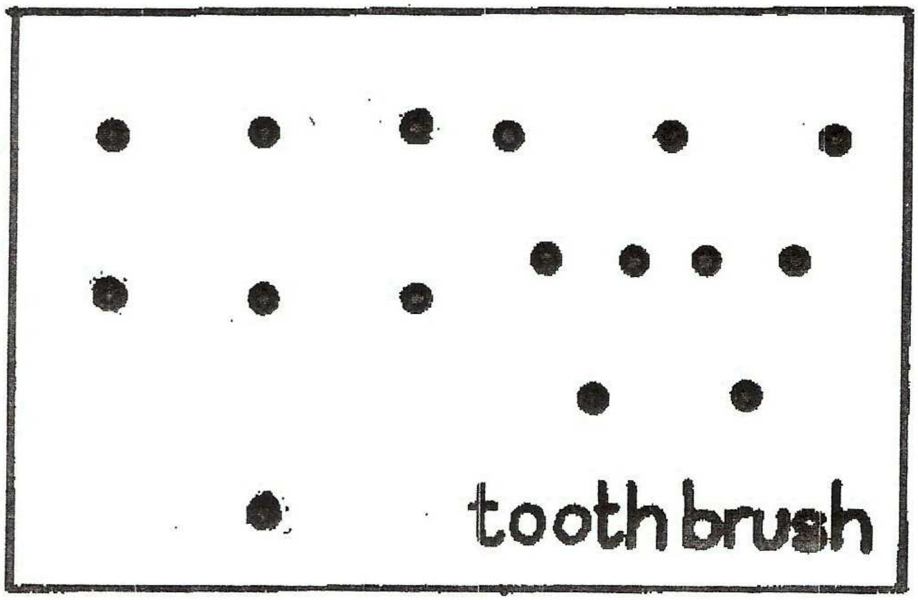
Appendix 5b

The Visual Discrimination Test



Appendix 5 c

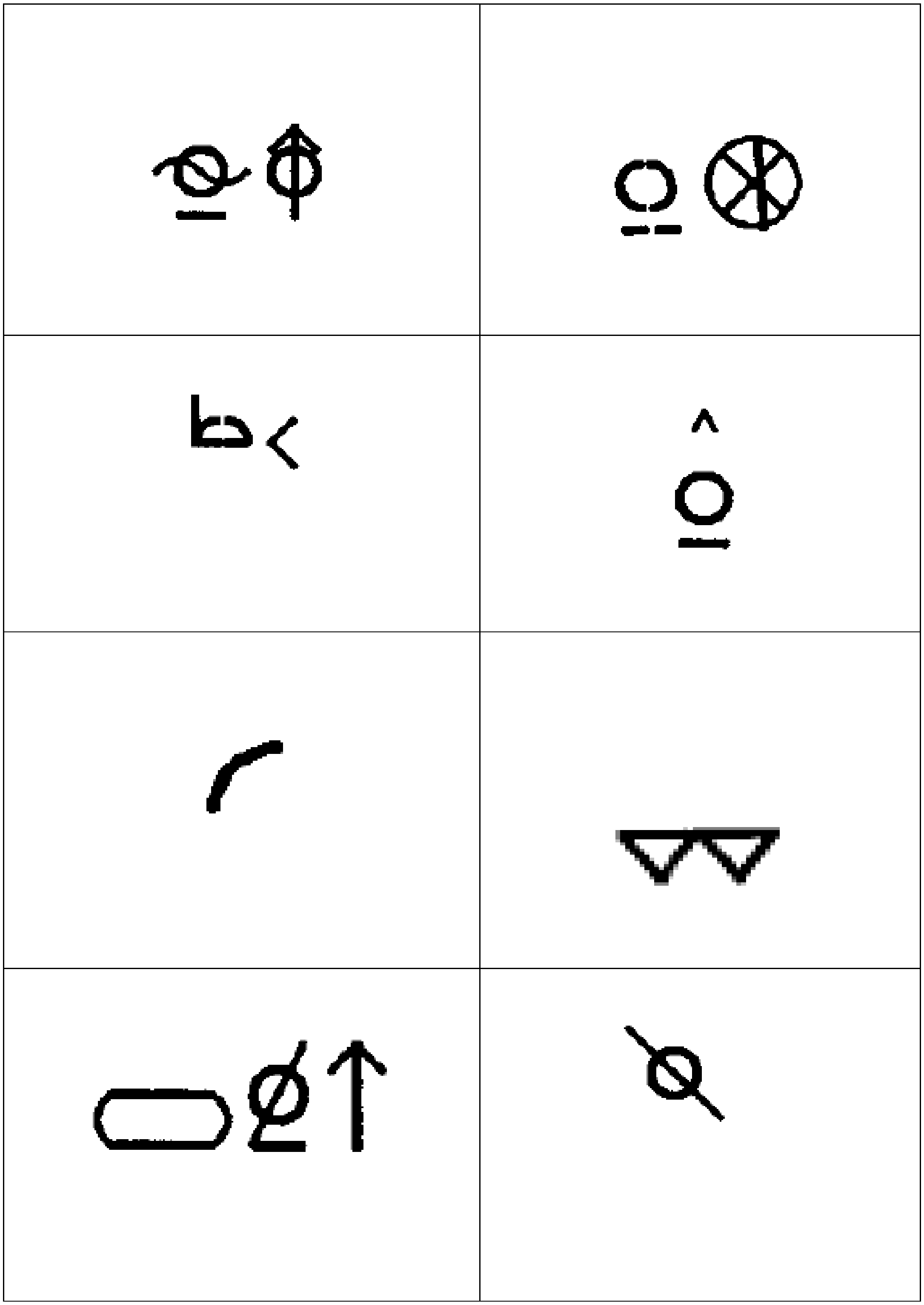
The Connect-the Dot Execution Test

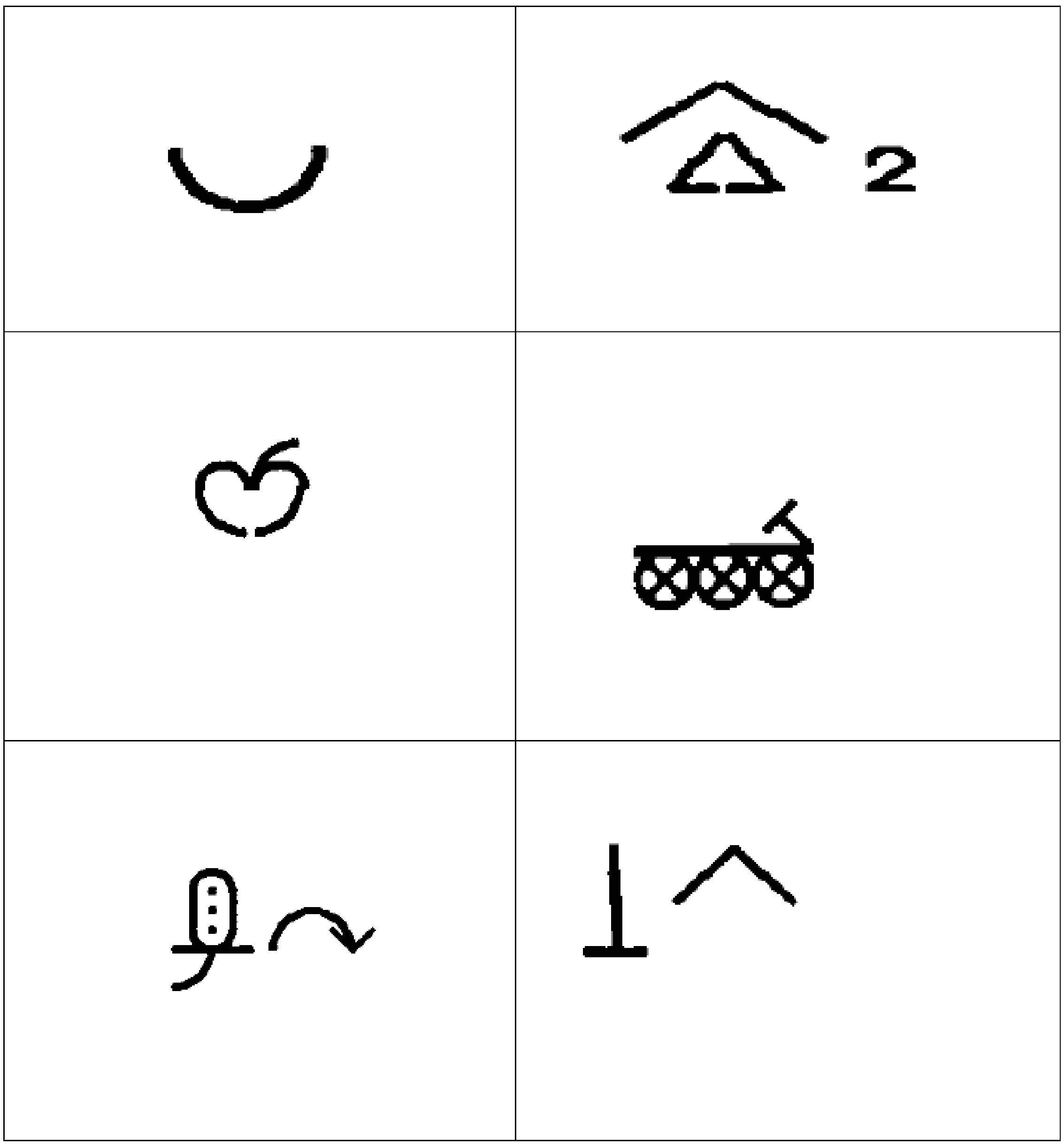


Appendix 6a

Example of a Probe Grid for Set 1

Symbol Set 1 page 1





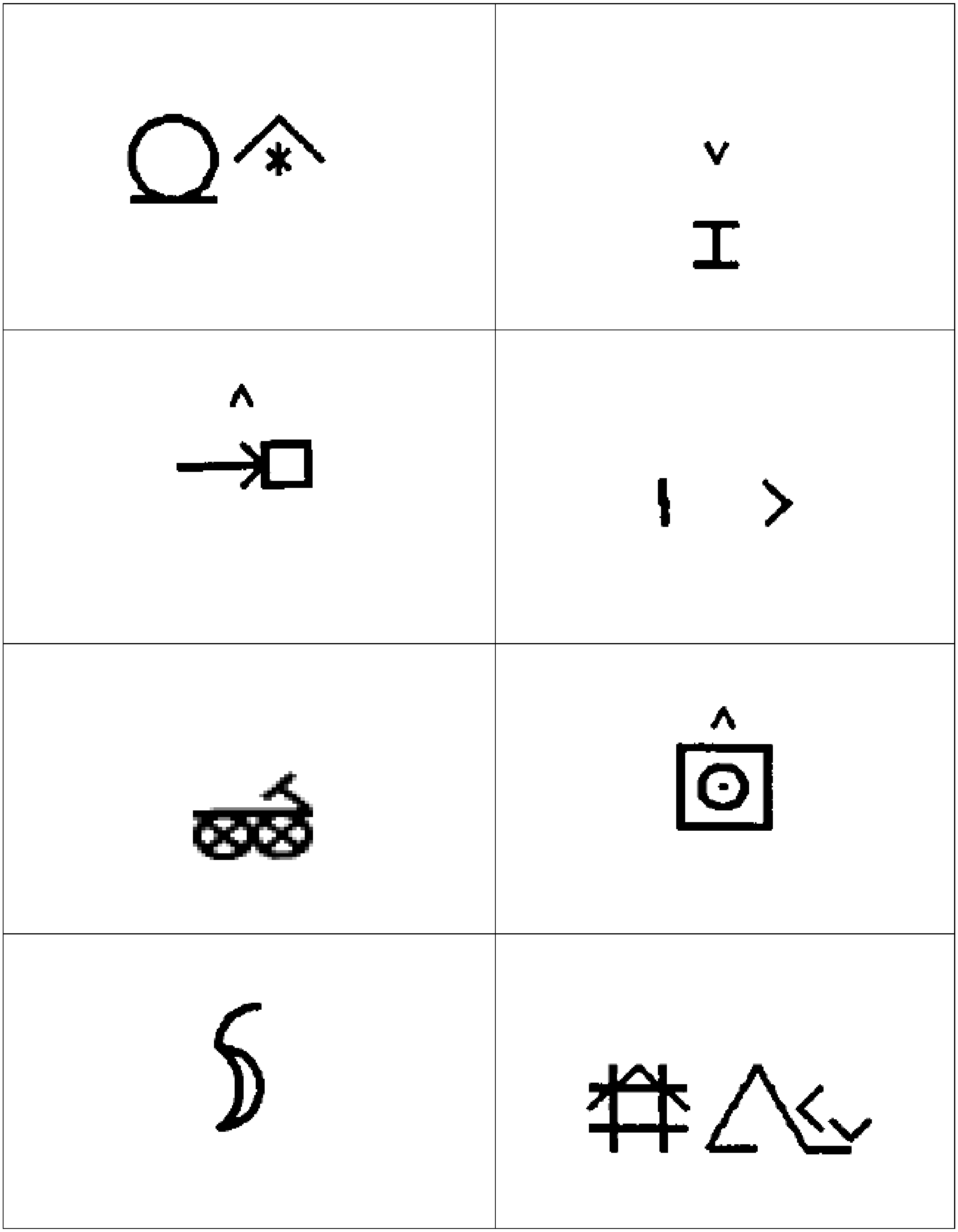
Probe Grid Set 1 page 2

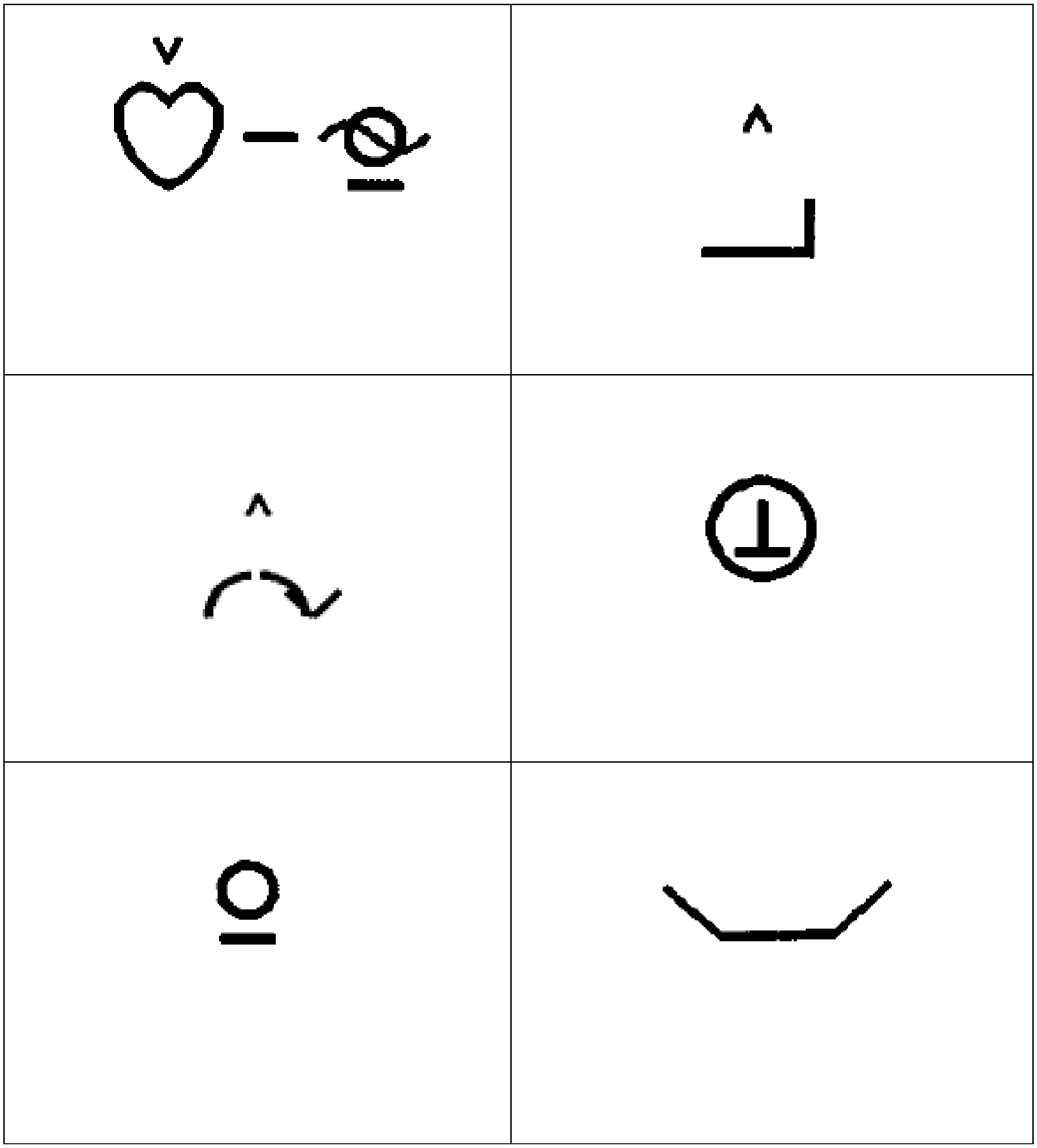
UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Appendix 6b

Example of a Probe Grid for Set 2

SET 2 page 1





Probe Grid Set 2 page 2

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Appendix 7a

Probe Measure Scoring Form

SYMBOL SET 1

Participant No.:……………………Probe Label: ………………………………..

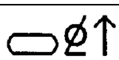
TREATMENT TYPE:……………………………….SESSION:……………….

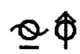
Procedure: Score a 1 for each symbol correctly identified. Score a 0 if incorrectly identified. Tally total number of correctly identified symbols.

Instructions: "Please point to the symbol that you think matches the word I say. Do you understand? Lets start. Show me ………"

SCORE:

Number of symbols correctly identified:____ Number of symbols incorrect:___

Symbol and Referent	Score	Symbol & Referent	Score
 **bus**		 **pizza**	
 **bowl**		 **muscle**	
 **pancake**		 **popcorn**	
 **sister**		 **policeman**	

Symbol and Referent	Score	Symbol & Referent	Score
 **coke**		 **name**	
 **teeth**		 **grass**	
 **eat**		 **apple**	

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Appendix 7b

Probe Measure Scoring Form

SYMBOL SET 2

PARTICIPANT NO:……………………………….Probe Label:……………….

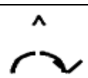
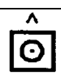
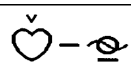
TREATMENT TYPE:………………………………….SESSION: ……………..

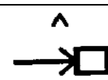
Procedure: Score a 1 for each symbol correctly identified. Score a 0 if incorrectly identified. Tally total number of correctly identified symbols.

Instructions: "Please point to the symbol that you think matches the word I say. Do you understand? Lets start. Show me ………."

SCORE:

Number of symbols correctly identified:____ Number of symbols incorrect:___

Symbol and Referent	Score	Symbol & Referent	Score
 jump		 banana	
 sleep		 thirsty	
 food		 car	
 lie		 head	

Symbol and Referent	Score	Symbol & Referent	Score
 push		 birthday	
 dish		 off	
 sock		 small	

Appendix 8a
Inter-Rater Procedure
Instructions to Raters

1. Translucency Rating

You are presented with pairs of symbols together with their referents. You are asked to rate how well matched the symbol pairs presented to you are in terms of their TRANSLUCENCY that is to compare how well the symbol pairs presented to you are related to their referents. If you feel the symbols are both equally related to their referents, that is, they are both the same in terms of their translucency, allocate the pair a 7. However, if you feel that the pair of symbols are different in terms of their translucency, that is not equally related to their referents, then allocate the pair a 1. Use the numbers between 1 and 7 to rate the relatedness of symbol pairs to their referents.

2. Frequency of Use

Now you are presented with pairs of symbol referents. You are now required to evaluate the symbol referent pairs for how often they are used in everyday life. If you feel both symbol referents in the pair share an equal level of use in everyday life, allocate the symbol pair a 7. However, if you feel the symbol referent pairs do not share an equal level of use in everyday life, that is one referent maybe used more often than the other, allocate the pair a 1. Use the numbers between 1 and 7 to rate the various levels of perceived use of the referent.

3. Familiarity

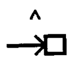
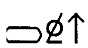
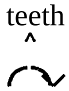
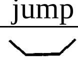
Now you are presented with pairs of symbol referents. You are now required to rate how well matched the symbol referent pairs are in terms of their familiarity to you. If you know both symbol referents in the pair equally well, rate the pair a 7. However, if you know one symbol referent more or less than the other, then rate the symbol pairs a 1. Use the numbers between 1 and 7 to rate the various levels of perceived familiarity between the symbol referents in the pair.

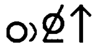
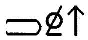
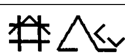
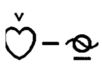
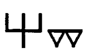
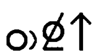
UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

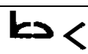
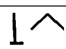
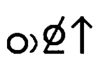
Appendix 8b
Likert Scale for Inter-Rater Procedure:
Frequency of Use Rating
Familiarity Rating

No.	REFERENT	RATING						
		1	2	3	4	5	6	7
1	bus car							
2	pizza push							
3	apple banana							
4	pizza pancake							
5	teeth jump							
6	dish bowl							
7	eat cookie							
8	coke popcorn							
9	pancake birthday							
10	sister sleep							
11	sock thirsty							
12	toothbrush cookie							
13	eat head							
14	toothbrush jump							
15	grass off							
16	sock dish							
17	lie name							
18	muscle small							
19	policeman food							
20	teeth cookie							

Appendix 8c
Likert Scale for Inter-Rater Procedure:
Translucency Rating

	Symbol Pair	RATING						
		1	2	3	4	5	6	7
1	 Bus  Car							
2	 Pizza  Push							
3	 apple  banana							
4	 Pizza  pancake							
5	 teeth  jump							
6	 dish  bowl							

7	 eat  cookie							
8	 coke  Popcorn							
9	 pancake  birthday							
10	 sister  sleep							
11	 sock  thirsty							
12	 toothbrush  cookie							
13	 eat  head							

14	 toothbrush  jump								
15	 grass  off								
16	 sock  dish								
17	 lie  name								
18	 muscle  small								
19	 policeman  food								
20	 teeth  cookie								

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Appendix 9
Inter-Rater Checklist for Treatment Reliability

Thank you for taking the time to complete this checklist. Your task is to evaluate the treatment procedures used during the experimental sessions. Three video recorded sessions have been randomly selected for your review. Kindly watch the video and then work through the checklist. You are required to tick YES or No for each question.

Rating Parameters	YES	NO
TRAINING PROCEDURES **A. Self-Generation (SG)Strategy**		
1. Presents complete symbol and dot drawing together?		
2. Instructions given on how to complete dot drawing?		
3. Complete symbol remains in view for reference?		
4. Where any construction cues given?		
5. Where any understanding cues given?		
6. Where all 14 symbols presented for completion?		
7. Did the exposure time exceed one minute?		
B. Non-generation (NG) Strategy		
8. Presents only complete symbol picture		
9. Referents name given.		
10. Instruction given to examine symbol?		
11. Where all 14 symbols presented?		
12. Where any understanding cues given?		
13. Was a maximum of one minute exposure time to each symbol allowed?		
PROBE MEASURES		
14. Have any cues being given to aid symbol identification during probe measures?		
15. Where all 14 symbols tested for identification?		
16. Using the recognition probe score form provide. Score the participants recognition levels. Now compare it to the previous examiners scores. Does your own score and the examiners score match?		

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Appendix 10
Letter of Consent

***Centre for Augmentative and* Alternative Communication**

***Sentrum vir Aanvullende en* Alternatiewe Kommunikasie**

& INTERFACE

University of Pretoria

2004 T-Systems Age of Innovation & Sustainability Awards: Excellence in Innovation and Sustainability: Social
2003 National Science & Technology Awards: Corporate Organization over the last ten years.
2002: Shirley McNaughton Award for Exemplary Communication received from the International Society for Augmentative and Alternative Communication
1998: Rolex Award for Enterprise: Associate Laureate
1995: Education Africa Presidential Award for Special Needs

website: http://www.up.ac.za/academic/caac

Fax/Faks: (012) 420 – 4389

Tel: (012) 420 – 2001
E-mail: erna.alant@up.ac.za
Faculty of Education / Fakulteit Opvoedkunde
Centre for Augmentative and Alternative Communication
Sentrum vir Aanvullende en Alternatiewe Kommunikasie
University of Pretoria, Lynnwood Road

Date

Dear………………………………………….,

I am currently completing a PhD in Alternate and Augmentative Communication at the University of Pretoria, Center for Alternate and Augmentative Communication (CAAC) under the supervision of Professor Erna Alant (TEL: 012 4204001).

The title of my research study is *The Application of the Self-Generation Effect to the Learning of Blissymbols by persons with Severe Aphasia*. I will be testing how the method of self-generation can help a person with severe aphasia learn symbols which then can be used to aid communication.

This letter seeks to obtain your consent for your or your spouse's/partner's/parent's participation in this research study.

Should you agree, the participant will be involved in approximately four sessions with me which will be conducted at Headway or any other venue that is most convenient to you including homevisits. There will be no charges for these sessions. Additionally, full confidentially will be maintained. At no time will your name or contact details be divulged. The study sessions will have the format of a typical speech therapy session. A short description of the sessions will now follow:

- Session 1 (approximately 45 mins): Basic screening assessment will be conducted in order to describe the speech-language difficulty and to determine eligibility for participation in the study,

- Session 2(approximately 1 hr): Training on learning 15 new symbols using two different therapy methods or approaches. This will include a short test following training to see how many symbols were learnt.

- Session 3(approximately 1 hr): This must occur 2 days after session 2. Includes re-training to learn same 15 symbols using two approaches. Testing to follow training.

- Session 4(approximately 1 hr): This must occur 7 days following session 2. Includes final training to learn the same 15 symbols with a testing procedure following training.

The materials I will be using during these sessions include symbol picture cards and symbol picture grids. The participant will be asked to complete a connect-the-dot picture of some symbols. At no time will the participant be exposed to any physical harm during the sessions. Family members are welcome to observe sessions which will be fully video recorded.

I do hope you will agree to participate in this study. The results will definitely go towards helping us understand how persons with severe aphasia can best be assisted by alternate forms of communication. My results will be shared with you as soon as it becomes available.

Looking forward to working together with you in this regard.

Thanking you

………………………………………
Priya Rajaram
B.Sp and Hearing (UDW), M.ECI (UP)
Audiologist and Speech Therapist
Parklands Hospital
TEL: 031-2081014/ 0722712270

Please sign to acknowledge consent of your or your spouse/ partner's participation.

Participants Name:…………………………………………………………
Sign:……………………………………………………………………….
Spouse/Partners Name:……………………………………………………
Sign:…………………………………………………………………………
Date:………………………………………………………………………….