UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

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.

DEFINING THE SELF-GENERATION EFFECT

Characteristics of the Self-Generation Effect
Section 2.2

↓

WHAT CAUSES THE SELF-GENERATION EFFECT?

Theories for the Self-Generation Effect

Semantic/ lexical activation theory	Cognitive Effort theory	Factor theories

↓

SELF-GENERATION AND PICTURE STIMULI

Section 2.4

↓

AAC & SEVERE APHASIA

Section 2.5 & 2.6

↓

AAC, SEVERE APHASIA AND SELF-GENERATION

Could self-generation maximise the learning of AAC systems?
Section 2.7

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.