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?

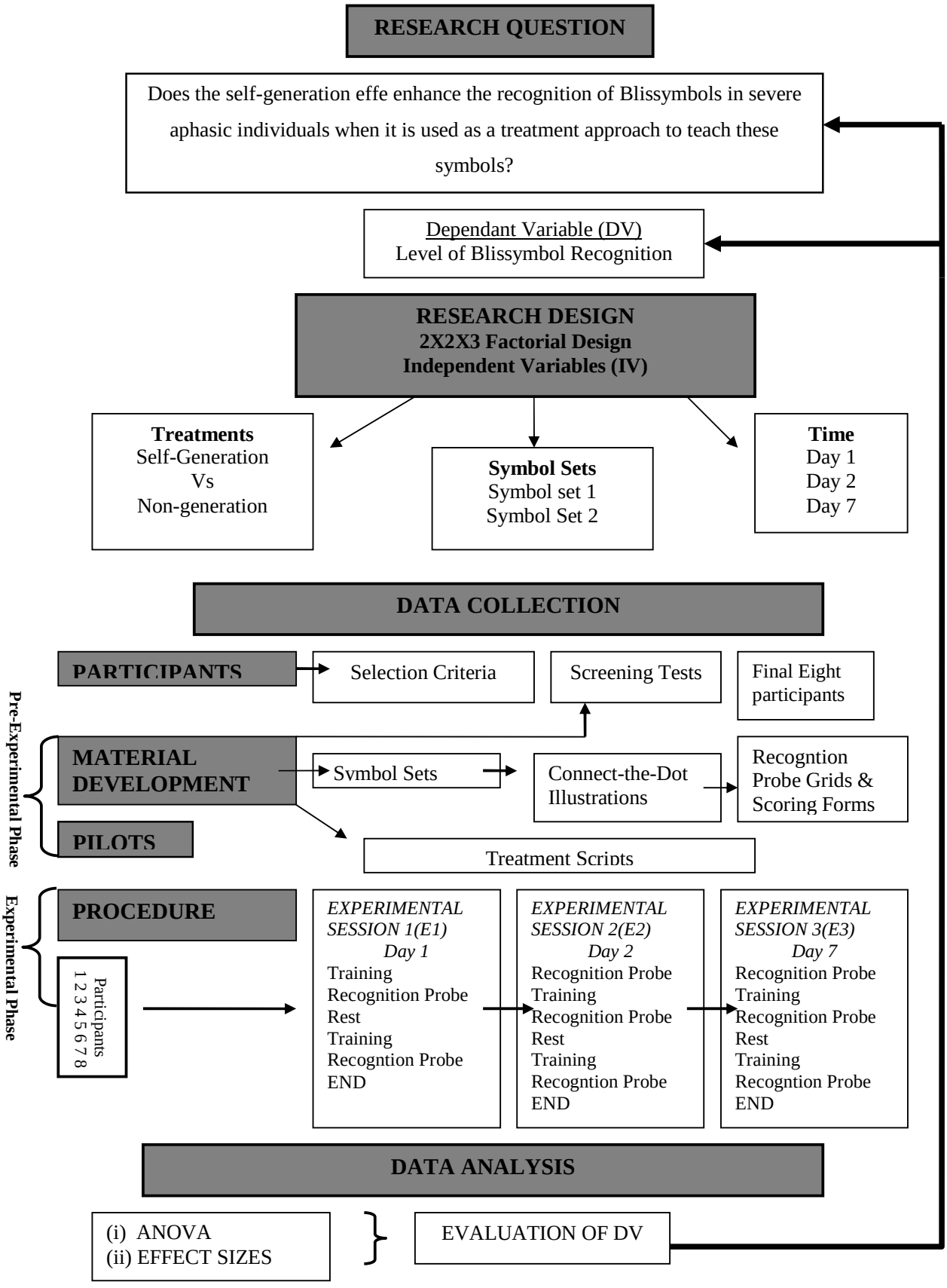


Figure 3.1 Flow diagram of the methodology

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.

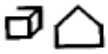
3.5.1 Development of the equivalent symbol sets

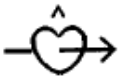
3.5.1.1 Defining the equivalency variables

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).

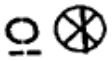
Table 3.4 Forty blissymbols within four groupings (Fuller, 1997)
Adapted from Koul & Lloyd (1998)

High Translucency–High Complexity Symbols


Brick


Love


Bus


Pizza

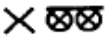

Car


Push


Chin


Surprise


Jail


Train

High Translucency–Low Complexity Symbols


Apple


Girl


Banana


Jump


Bowl


Open

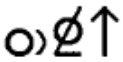
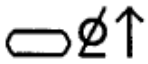
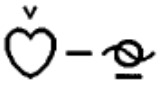
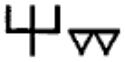

Dish


Stamp


Flag


Teeth

Low Translucency–High Complexity Symbols

	Birthday		Sister
	Coke		Sleep
	Cookie		Sock
	Pancake		Thirsty
	Popcorn		Toothbrush

Low Translucency–Low Complexity Symbols

	Eat		Muscle
	Food		Name
	Grass		Off
	Head		Policeman
	Lie		Small

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
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 4 To ensure an equal number of symbols to distribute, 23 (cookie) was randomly selected for removal. 24 pancake 22 coke 25 popcorn 26 sister	LTHC-total 4 To ensure an equal number of symbols to distribute, 23 (cookie) was randomly selected for removal. 28 sock 29 thirsty 21 birthday 27 sleep
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

3.5.2 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.