CHAPTER 3
METHODOLOGY

3.1 Introduction

This chapter provides an overview of the methodology used in the study. The aims of the study are discussed, followed by the specification of the design. The pilot study and recommendations from it are discussed. The participants are introduced, after which the material and equipment used are described. The procedures followed during the assessment and experimental stages of the main study are set out. Lastly, the data analysis procedures are discussed.

3.2 Aims

3.2.1 Main Aim

The main aim of the study was to determine the effect of an intervention strategy employed during shared storybook reading on the production of graphic symbol combinations (representing three types of semantic relations) by children with limited speech.

3.2.2 Subaims

In order to achieve the main aim, the following subaims were identified:

i. To determine the effect of the intervention strategy on the participants' ability to express the graphic symbol combinations targeted during intervention using a communication board,

ii. To determine the effect of the intervention strategy on the participants' ability to express graphic symbol combinations that were not specifically targeted during intervention (generalized production),

iii. To determine whether the type of semantic relation or the order of presentation influenced the participants' acquisition of symbol combinations,

iv. To analyse the structure of correct responses given by participants in terms of number of elements and order of elements in more depth.

3.3 Design

A multiple probe design across behaviours replicated across participants was employed. Three different types of semantic relations (agent-action, possessor-possession, and attribute-entity) were targeted in intervention. There were 10 items per type of relation, five of which were assigned as intervention items while the other five were used to test generalization. The independent variable was the intervention strategy, comprising a prompting hierarchy used in combination with a matrix structure of target items incorporated into a shared storybook reading activity. The dependent variable was the production of 15 graphic symbol combinations (five per type of semantic relation), using a communication board in response to picture stimuli and a cueing question (probe test—see Section 3.8.3.2). In addition, generalization to 15 untaught combinations (five per type of relation) was also measured using the same procedure. The study included a baseline phase where the production of the combinations was monitored by means of the probe test for at least three sessions before intervention began. Intervention commenced on the first type of relation, while the other two remained in baseline. During the intervention phase, production of the five target combinations chosen for a particular type of relation was prompted and modelled during storybook reading. The participants' ability to produce these combinations (as well as generalization to untaught combinations) was monitored during the intervention phase using the probe test. Once either the teaching or learning criterion was reached on the particular type of relation, intervention ceased on that relation and commenced on the next relation. The order in which the three types of semantic relations were targeted was systematically varied across participants. The ability to produce the combinations was monitored postintervention for the first two types of semantic relations targeted per participant.

3.4 Stages

The study consisted of various stages. A brief overview is given in Figure 3.1.

Approval of the Research Ethics Committee of the Faculty of Humanities of the University of Pretoria was obtained first. Next, the researcher obtained consent
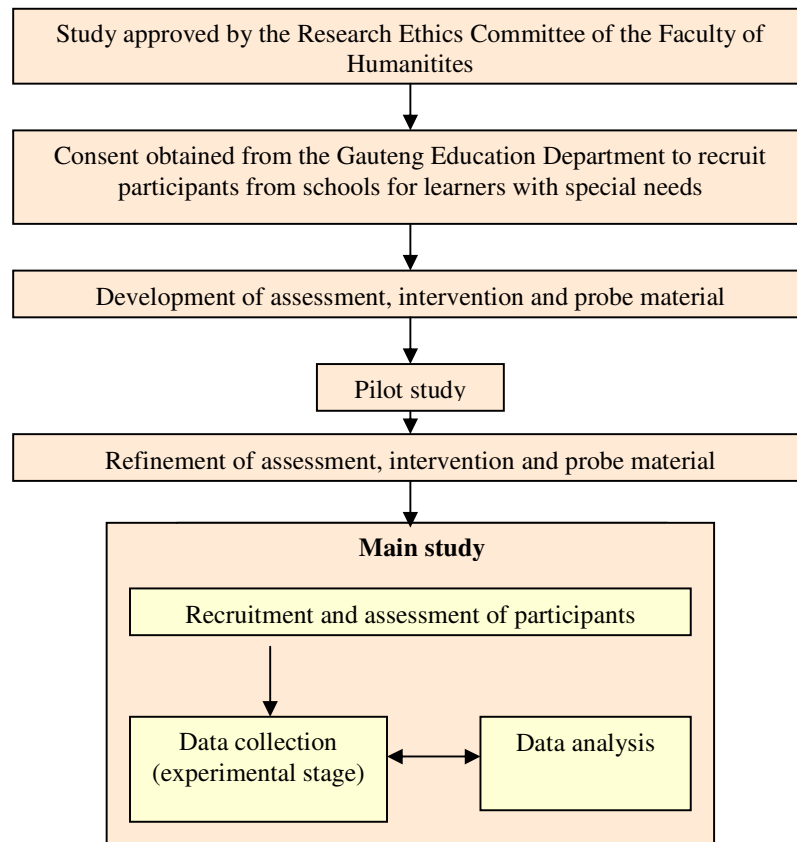
```
┌─────────────────────────────────────────────────────────────┐
│  Study approved by the Research Ethics Committee of the        │
│  Faculty of Humanitites                                        │
└─────────────────────────────────────────────────────────────┘
                              │
                              ▼
┌─────────────────────────────────────────────────────────────┐
│  Consent obtained from the Gauteng Education Department to     │
│  recruit participants from schools for learners with special  │
│  needs                                                         │
└─────────────────────────────────────────────────────────────┘
                              │
                              ▼
┌─────────────────────────────────────────────────────────────┐
│  Development of assessment, intervention and probe material   │
└─────────────────────────────────────────────────────────────┘
                              │
                              ▼
                     ┌──────────────┐
                     │  Pilot study │
                     └──────────────┘
                              │
                              ▼
┌─────────────────────────────────────────────────────────────┐
│  Refinement of assessment, intervention and probe material    │
└─────────────────────────────────────────────────────────────┘
                              │
                              ▼
┌─────────────────────────────────────────────────────────────┐
│                        Main study                             │
│  ┌─────────────────────────────────────────────────────────┐ │
│  │       Recruitment and assessment of participants         │ │
│  └─────────────────────────────────────────────────────────┘ │
│                          │                                    │
│                          ▼                                    │
│  ┌──────────────────┐         ┌──────────────────┐           │
│  │ Data collection  │◄───────►│  Data analysis   │           │
│  │ (experimental    │         │                  │           │
│  │ stage)           │         │                  │           │
│  └──────────────────┘         └──────────────────┘           │
└─────────────────────────────────────────────────────────────┘
```

Figure 3.1. Overview of the stages of the study.

from the Gauteng Education Department to recruit learners from schools for learners with special needs in the province. Subsequently, material was developed for assessment of potential participants, as well as for the intervention procedure and the probes (measurement). The next stage was to pilot all the procedures (assessment, intervention and probes) with one participant, in order to verify the appropriateness of material and procedures. Procedures and material were consequently amended as necessary. Following this, the main study commenced. First, participants were recruited, assessed and selected. Thereafter the experimental stage commenced, during which the baseline probes were conducted with the selected participants, followed by the systematic introduction of intervention and intervention probes across the three types of symbol combinations. The data was collected over the course of two months. As data was collected, it was analysed

and graphic portrayals of participant performance were created. Once all the data was collected, further analyses pertaining to overall performance were done.

3.5 Terms

Terminology around multiple probe designs can be confusing. For example, some authors (cf. Schlosser, 2003b) seem to use the term *probe* as a noun, while others advise that it should be used as an adjective (Gast & Ledford, 2010, p. 295). In order to clarify how terms relating to the experimental stage of this study are defined, a list follows:

- ○ ***Probe***: Measurement of the dependent variable, that is, the production of graphic symbol combinations targeted during intervention, as well as the measurement of generalization to untrained items;

- ○ ***Probe test***: Picture description task used to measure the dependent variable as well as performance on generalization items;

- ○ ***Baseline probe***: Measurement of the dependent variable and generalization items before intervention commenced;

- ○ ***Intervention probe***: Measurement of the dependent variable and generalization items during the time when intervention was given;

- ○ ***Postintervention probe***: Measurement of the dependent variable and generalization items after intervention on the type of semantic relation had ceased;

- ○ ***Intervention***: Independent variable or treatment, consisting of a prompting hierarchy used to prompt the production of selected combinations (intervention items) from the matrix during shared storybook reading (five items per story); in accordance with the design, the independent variable was applied consecutively to three behaviours (i.e. three types of semantic relations).

- ○ ***Shared storybook reading***: Context used during which intervention was applied;

- ○ ***Response during shared storybook reading***: Participants' responses to the various levels of prompting given during shared storybook reading were captured from the video recordings using data recording sheets (see Appendix A). Correct responses to the first level of prompting were graphed.

- ○ ***Baseline phase***: Period of time during which baseline probes were administered;

- o *Intervention phase*: Period of time during which intervention and intervention probes were administered;

- o *Postintervention phase*: This refers to the period of time during which postintervention probes were administered.

3.6 Pilot study

A pilot study was conducted in order to assess the appropriateness of the selection criteria, the material and the procedures proposed for the study. Procedural integrity checklists for intervention and probe test procedures were also developed and tested during the pilot study. Prior to the commencement of the pilot study, clearance from the Research Ethics Committee of the Faculty of Humanities of the University of Pretoria was obtained (see Appendix B). Consent was also obtained from the Gauteng Education Department to approach public schools for learners with special educational needs in order to recruit participants (see Appendix C).

3.6.1 Participant

One girl (aged 6;5) from a school for children with physical and/or learning disabilities took part in the pilot study. Consent was obtained from the principal, the governing body as well as from the parents (see Appendix D). The participant complied with the original set of selection criteria provided in Appendix E.

The participant was from a middle class socioeconomic background. Her home language was English. She attended an English medium Grade R[3]/Grade 1 combined classroom at a school for children with physical and/or learning disabilities. She was following a Grade R curriculum.

According to parent report, the participant developed typically until the age of 2, at which time she became ill and regressed rapidly in her motor abilities, losing the ability to walk and speak. At the time of the study, she presented with spastic

---

[3] Grade R describes the reception year, which would be the equivalent of the Kindergarten year in the USA. Children are typically 5-6 years of age. It is not a compulsory year of schooling.

quadriplegia. She made use of an electric wheelchair at home, which she operated independently. She was well-positioned in the wheelchair with a laptray and footrests. At school, and sometimes at home, she was positioned in a custom-made buggy, also with a footrest and a laptray. She depended on her facilitator for mobility when in her buggy. The participant wore soft splints at school separating her fingers. She was able to point accurately using either her left or right hand, although pointing was slow.

The participant had severe dysarthria, and was only able to articulate the words *yes, no, Lu* (name of a cartoon character) and *Rian* (name of her friend). She communicated mainly by answering yes/no questions, facial expression, pointing and eye-gazing to objects and people in the environment as well as using some gestures (for EAT, DRINK, PRAY, HOUSE). She also had a communication book with 360 PCS (each accompanied by a written sentence, phrase or word), 13 written words without PCS, the alphabet, numbers and eight photographs of people. The PCS were divided into 14 categories, of which 10 were specific semantic categories (e.g. weather, personal information, people etc.) and four represented specific word classes (e.g. verbs, prepositions, etc.). The frame of each cell was colour coded roughly within the categories mentioned above. The PCS and photographs were also in colour. There was a maximum of 56 cells per page. According to the participant's mother, the book was not used much at home, and the participant did not use it spontaneously. Her teacher also reported that the book was not readily available in class and was therefore not used much. According to her mother and speech language therapist, the participant communicated in single-symbol messages (gestures, spoken words, pointing to PCS, objects and people) and did not combine symbols.

Her receptive vocabulary was assessed by means of the Peabody Picture Vocabulary Test—Revised (PPVT-R) (Dunn & Dunn, 1981). The participant achieved an age equivalent score of 6;1, scoring within the 47th percentile, equivalent to a standard score of 99. Her receptive English abilities thus seemed age appropriate.

The participant had received speech and language therapy for about four years at the time of the study. Intervention aims had included oral and feeding skills, improving communication through aided strategies (PCS in a communication book) as well as literacy skills. At the time of the study, the speech language therapist at school had just introduced her to The Grid 2 (communication and access program) by Sensory Software International (Ltd.), and focused on teaching scanning with switches, because the participant struggled to use a conventional mouse. Literacy skills were also targeted in therapy. Regarding scholastic skills, the participant could do sums up to 10, and also read and spell some 3-letter words.

The participant enjoyed books and the family took out eight books a week from the local library, which were read to the participant. She remained relatively passive during storybook reading, not least because of her severe communication difficulties. Regarding play, the participant engaged in imaginative play and was able to combine play schemes, such as consecutively dressing, feeding and putting her doll to sleep.

3.6.2 Objectives, materials, results and recommendations

Table 3.1 outlines the objectives, materials, procedures, results and recommendations of the pilot study.

Table 3.1

Results of the Pilot Study

Objectives	Materials	Procedures	Results	Adjustments made
To evaluate the appropriateness of the selection criteria for participants	List of selection criteria (see Appendix E)	Three schools and two centres for children with severe disabilities were visited to identify possible participants with the help of teachers and/or therapists. Children that were identified were then briefly screened or observed in class to determine whether they complied with selection criteria.	A total of 14 children were briefly screened or observed. Only one child complied with all the selection criteria. Participants were mostly either too verbal (five were able to express more than 30 words through speech) or did not have adequate comprehension skills in English (five). One child was already combining symbols (natural gestures), one struggled to access the communication board accurately and one exhibited noncompliant behaviour, which was deemed as having the potential to interfere with intervention.	It became clear from the recruitment procedures that selection criteria are relatively strict. However, this is common in single subject designs (Bedrosian, 2003). Recruitment for the main study was decided to be done in another city where there were more English medium special schools. It was decided that the understanding of the specific relations targeted would be a descriptive rather than a selection criterion, because literature is divided on the precedence of comprehension of two-word semantic relations over production of such relations (see for example Chapman & Miller, 1975). A criterion regarding the ability of children to concentrate on a 10 min long story was added. Once recruitment started for the main study, some further adjustments were made. A summary of the adjustments is given in Table 3.2.
To evaluate the appropriateness of the test of comprehension of relations targeted	30 A4 sheets depicting each of the relations targeted with at least four foils per relation (see Section 3.8.2.7)	Three 3-year-old and three 4-year-old typically developing children underwent the procedure (see Section 3.8.2.7). The test was then also administered to the pilot participant.	The typically developing 3- and 4-year-old children were able to point out the correct pictures with 94% accuracy (range: 86.6-100%). The pilot participant correctly pointed out 93.3% of the relations targeted.	The material and procedure used to test comprehension of relations targeted seemed appropriate. As mentioned above, the ability to understand the relations targeted became a descriptive rather than a selection criterion in the main study.
To evaluate the appropriateness of the procedure and material used to test the ability to	21-item board of transparent PCS, based on the "ability to identify line drawings" test	The participant was asked to point to each of the 21 symbols on the screening overlay in response to the spoken word.	The participant pointed out all 21 symbols correctly.	The board seemed appropriate to screen the ability to recognize and point out PCS symbols on a 21-item overlay. However, seeing that a similar procedure was followed to determine the recognition of the 21

Objectives	Materials	Procedures	Results	Adjustments made
recognize and point to 21 transparent PCS	(Dada, 2004)			graphic symbols used during intervention, this screening test was found to be somewhat superfluous. It was therefore decided to omit this procedure for the main study.
To evaluate the appropriateness of the communication board used during shared storybook reading and during the probe test	Communication board with 21 symbols (17 PCS symbols and 4 hand-drawn symbols) arranged according to the Fitzgerald Key (Fitzgerald, 1959).	As an assessment measure, the participant was asked to point to each of the 21 symbols on the board in response to the spoken word. Any symbols that were not immediately recognized were taught using a paired association teaching strategy. The communication board was then also available to the participant during the probe test procedure and the shared storybook reading activity.	During assessment, the participant correctly identified 20 symbols. For *SHIRT*, she pointed to *DIRTY*. These two symbols were thus taught to her by paired association. After a 2 min teaching sessions, the participant pointed out these symbols correctly. All symbols were then retested, and the participant pointed all out correctly. The participant used the symbols appropriately during the probe test and shared storybook reading.	None
To determine the appropriateness of the eliciting material used during the probe test	30 A4 sized pictures depicting the relations targeted.	The probe test was conducted with the pilot participant during baseline, intervention and postintervention phases. This entailed requesting the participant to label each of 30 A4 pictures depicting the 15 target and 15 generalization items.	Overall, the probe test seemed to measure the production of graphic symbol combinations successfully. However, the following was noted: - After intervention commenced on the first type of semantic relation (attribute-entity), the participant described two of the five pictures illustrating a dog (for agent-action items) as *DIRTY*. It was noted that the dog was always depicted with spots, which looked similar to the pictures depicting dirty items. - The participant's performance on possessor-possession items was below that of the other two types of semantic relations.	- The pictures of the dog were changed to remove the spots. - Possessor-possession pictures were adjusted to have only two possessors on each picture, rather than three. - In order to maintain uniformity across all pictures, all pictures were coloured.
To determine the appropriateness of the procedure used to conduct the probe test and to develop a checklist for the procedural integrity of the probes	30 A4 sized pictures depicting the relations targeted, communication board, a Canon Legria FS 306 video camera mounted on a tripod, PC and software for	An initial checklist outlining the procedural steps was drawn up before the start of the first baseline probes. The probe test was then conducted with the pilot participant during baseline, intervention and postintervention phases according to these procedural guidelines. The checklist was completed by the researcher, as she rated her own performance from a video recording on the same day as the probe had been conducted. After completion of all probe test sessions, an independent observer used the procedural	The following was noted as the checklist was used: - While the checklist initially stipulated a waiting time for a response of maximally 5 s, waiting time tended to be longer than 5 s as the participant had a slow response time due to motor limitations - The checklist did not specify how many times a cueing question would be asked, which resulted in the question being repeated at times - The checklist did not specify the amount of time that the researcher needed to wait after the participant pointed to one symbol to allow the participant enough time to initiate pointing to a	The procedure for the main study was amended on the following points (which were included in the checklist used for procedural integrity): - A maximum response time of 10 s was set to accommodate participants with slower response times; - The cueing question or mand was only asked or given once; - The researcher waited 3 s after the participant pointed to one symbol to allow the participant to initiate the

Objectives	Materials	Procedures	Results	Adjustments made
	transfer and playback of recordings, procedural integrity checklist for probe test	integrity checklist to rate 3 randomly selected probe test sessions (25%).	second symbol. Consequently, the time between the participant responding and the researcher moving on to the next item varied. - The checklist did not specify when the participant would be given a break. - The checklist included one general rating on the presence of distractions, but did not provide the possibility of rating whether distractions occurred in conjunction with specific items.	process of pointing to a second symbol, unless the participant indicated that he/she had finished her turn by looking at the researcher, or trying to page to the next picture. - The participants were given a break after completing 10 items - The presence of distractions was to be rated per item.
To determine the appropriateness of the material and procedure used during shared storybook reading (intervention) and to develop a checklist for the procedural integrity of the intervention	Three stories with illustrations, communication board, a Canon Legria FS 306 video camera mounted on a tripod, PC and software for transfer and playback of recordings, procedural integrity checklist for intervention	The three storybooks developed for the intervention were piloted with six typically developing children (ranging in age from 2;5 to 3;3) (see Section 3.8.3.4). An initial checklist for procedural integrity was drawn up before the start of the intervention sessions (shared storybook reading sessions). Five intervention sessions were conducted per type of semantic relation. During each session, the relevant story was read to the participant and the prompting hierarchy was employed to prompt the production of the target graphic symbol combinations from the participant. The checklist was completed by the researcher, as she rated her own performance from a video recording on the same day as the shared storybook reading session had taken place. The checklist was then refined and completed by an independent observer based on video recordings of three randomly selected shared storybook reading (intervention) sessions (20% of total).	The storybooks were found appropriate for use with typically-developing children aged 2;5 to 3;3 (see also Section 3.8.3.4). Overall, the intervention seemed to promote the production of the symbol combinations targeted as well as the generalization of these skills to untrained combinations of the same kind (see Appendix F for a graphic portrayal of the results of the probe test measurements). While employing the prompting hierarchy, it was found that the second level of prompting did not seem to flow naturally in some instances. The expectant time delay (after every prompt) furthermore tended to be longer (max of 10 s) than initially stipulated. The prompting hierarchy also did not specify how to handle self-corrections. It was furthermore found that the last picture of the second story elicited a nontarget combination (*BOY RUN*) while the last picture of the third story seemed to elicit an incorrect combination (*BUNNY HAND* rather than *BUNNY TUMMY*). The checklist included one general rating on the presence of distractions, but did not provide the possibility of rating whether distractions occurred in conjunction with specific items.	- An expectant time delay of up to 10 s was stipulated after each prompt. - The first and second levels of prompting were combined. - The way self-corrections were to be handled was specified in the prompting hierarchy. - The last picture of the second story was adjusted so that the picture eliciting the nontarget combination could be removed. - The last picture of the third story was amended to depict the relation targeted more clearly. - The checklist was amended to reflect the changes to the prompting hierarchy and to allow rating distractions per item.
To determine whether the three behaviours targeted were independent of each other as is required in a multiple probe design across	Visual portrayal of participant's performance	The participant's results were visually portrayed and analysed to determine whether the introduction of intervention targeting a specific semantic relation caused any change in the baselines of the relation(s) not yet treated. Results are given in Appendix F.	Although there was some activity in untreated baselines after introduction of treatment (see Appendix F), there were no ascending baselines and no overlapping data between baselines and intervention. This seemed to indicate that behaviours were sufficiently independent from each other to be suitable for a multiple probe design.	None

Objectives	Materials	Procedures	Results	Adjustments made
behaviours				
To determine whether video recordings were effective to record responses during the probe test and whether these recordings allowed for the rating of the reliability of the transcription and classification of responses by an independent observer	A Canon Legria FS 306 video camera mounted on a tripod, PC and software for transfer and playback of recordings, score sheets to transcribe and rate responses .	The camera on the tripod was placed directly in front of the participant to capture her pointing to the communication board. All probe test sessions were recorded. At the end of each day's recording, the video recording was transferred to a PC using appropriate software. The researcher viewed the recording and transcribed the participant's responses onto a score sheet. Each response was classified as correct or incorrect. The number of target graphic symbols produced per response (one or two) was also noted. The structure of correct responses was furthermore classified according to number and order of elements. After completion of all probe test recordings, an independent observer viewed the recordings of three randomly selected sessions and transcribed and coded the participant's responses.	It was found that responses were mostly clearly visible on the video recording. The score sheets were found appropriate to capture the data. A point-by-point agreement of 88% was obtained as a measure of transcription reliability. The disagreement in 12% of the responses could partly be ascribed to difference in interpretation (e.g. researcher might interpret an action as a purposeful point, whereas independent observer might interpret is as an unintentional touching of a symbol). In some cases it seemed that the recording was not clear. Sometimes, the participant's other arm or fingers obscured the exact picture she was pointing to. It was also noted that on two occasions, the picture shown to the participant obscured which symbol she was pointing to. A point-by-point agreement of 99% was obtained as a measure of reliability of classifying the responses as either correct or incorrect, indicating that the classification could be executed reliably.	During the main study, the researcher adjusted the angle of the camera and removed anything that obscured the recording.
To determine whether video recordings of the probes as well as the intervention procedures allowed the rating of the procedural integrity of the intervention procedure as well as the probes by an independent observer	A Canon Legria FS 306 video camera mounted on a tripod, a Panasonic NV-GS75 video camera mounted on a tripod, PC and software for transfer and playback of recordings, procedural integrity checklists for both probe test and intervention.	The camera on the tripod was placed directly in front of the participant to capture her pointing to the communication board. All probe test sessions and all shared storybook reading (intervention) sessions were recorded. During four intervention sessions and one probe test session an additional camera on a tripod was placed either behind the participant facing the researcher or next to the participant and the researcher, in order to capture what the researcher was doing. The researcher rated the procedural integrity of every session using a preliminary version of the procedural integrity checklist. After completion of the recordings, an independent observer viewed the recordings of three randomly selected probe test sessions and three randomly selected intervention sessions. Using these recordings, the independent observer rated the procedural integrity of the probe test and intervention procedure.	From the ratings done by the researcher herself and those done by the independent observer, it became apparent that the following procedural aspects were not always clearly visible from the recordings made by the first camera: - The way the experimenter was seated; - Whether the picture or story illustration was presented in a way clearly visible to the participant; - How the specific aspect on the possessor-possession pictures was pointed out to the participant. The second camera made these aspects more visible, but made it more cumbersome for the independent rater due to having to watch two recordings.	The angle of the first camera as well as the angle at which the researcher was seated was slightly adjusted so that both the participant and his/her responses on the board as well as the picture stimuli presented were captured by one camera.

Chapter 3: Methodology

3.7 Participants

3.7.1 Selection criteria

A homogeneous sample of participants is recommendable for a single subject design, since the likelihood of consistent findings is greatly increased (Wolery & Lane, 2010). At the same time, this can lead to very stringent selection criteria, which can complicate participant recruitment, especially amongst a population such as children with limited speech (Bedrosian, 2003). After her analysis of 22 efficacy studies employing a single subject design, Bedrosian (2003) indicated that language comprehension, language production, cognitive level, intervention history, sensory status, and the preintervention levels of the dependent variable are crucial variables that should be as homogeneous as possible across participants. As far as possible, these variables were therefore taken into consideration when compiling selection criteria for the study. Furthermore, the selection criteria established by Binger and Light (2007) and Binger et al. (2008) were used as guidelines, as these two studies also targeted symbol combinations. The original selection criteria for participants are given in Appendix E. After the pilot study, adjustments were made to selection criteria. When recruitment of participants started, further adjustments were necessary for a variety of reasons. All adjustments made to the selection criteria are set out in Table 3.2. The final selection criteria are summarized in Table 3.3.

Although it would have been preferable to stipulate prior experience with using graphic symbols for expressive purposes as a selection criterion, this would have further reduced the number of potential participants, because AAC is not uniformly implemented by therapists and no mandate for its implementation exists in South Africa. Furthermore, the age range was also larger than in the studies by Binger and Light (2007) and Binger et al. (2008). During recruitment, it was generally found that the younger children often did not have sufficient English language skills to be included.

Table 3.2

Adjustments Made to Selection Criteria

Original criterion	Adjustment	Reason for change
Little or no functional speech (less than 30 intelligible spoken words)	Limited speech (less than 50 percent comprehensible to unfamiliar partners in the semantic context conditions of the I-ASCC (Dowden, 1997)	Little consensus existed amongst service providers and parents in reporting the number of intelligible spoken words, with parents generally reporting more than 30 and service providers reporting considerably less. A more objective measure was needed.
Using single graphic symbols expressively	This criterion was abolished.	It was difficult to recruit enough participants who complied with this criterion, possibly because AAC is not yet routinely implemented from an early age in South Africa. Furthermore, a previous study (Binger et al., 2008) showed that a child without prior experience with graphic symbols learnt to combine graphic symbols in intervention.
Not combining symbols for expressive communication	Not combining graphic symbols for expressive communication	Parent and service provider report did not always corroborate on the original criterion, as some participants seemed on occasion to combine vocalizations and/or gestures/signs. However, according to report, none combined graphic symbols.
Being able to comprehend at least 80% of the graphic symbols used on the communication board with a maximum of five training sessions provided if necessary	Being able to comprehend at least 75% of the graphic symbols used on the communication board with a maximum of five training sessions provided if necessary	This criterion was relaxed to include more participants.
Being able to comprehend at least 80% of the semantic relations targeted in intervention	This criterion was abolished.	Literature is divided on the precedence of comprehension of two-word semantic relations over production of such relations (see for example Chapman & Miller, 1975).
English home language	Having received English medium tuition for at least 1.5 years	It was not possible to recruit enough suitable candidates who had English as a sole home language.
No criterion on behaviour and/or attention skills included	Ability to concentrate on a 10-min long story	Inability to concentrate on the story read during intervention would interfere with the participants' ability to benefit from the intervention.

Table 3.3

Final Selection Criteria

Criterion	Motivation	Measure
Limited speech (less than 50% comprehensible to unfamiliar partners in the semantic context condition of the I-ASCC (Dowden, 1997)	Participants should not be able to meet all their communication needs using speech (i.e. they should be candidates for using AAC).	Index of Augmented Speech Comprehensibility in Children (I-ASCC) (Dowden, 1997)
Not combining graphic symbols for expressive communication	The aim of the study was to facilitate production of graphic symbol combinations.	Parent, teacher and therapist report
Able to accurately point to items on a 21-item communication board	Participants needed to be able to direct-select so that they could make use of the communication board without too much motor effort.	Participants were asked to point out items on a 21-item communication board with graphic symbols.
Functional vision and hearing	Participants needed to be able to hear spoken instructions and the story being read out loud to them. They also needed to see the story's pictures and the graphic symbols.	Parent report. Participants were expected to point out graphic symbols out of an array of 21, in response to a verbal request. This gave an indication of functional vision and hearing.
Being able to comprehend at least 75% of the graphic symbols used on the communication board with a maximum of five training sessions provided if necessary	In order to be used for expressive communication, participants needed to know what concepts the symbols represented.	Participants were asked to point to graphic symbols on the communication board used in the study in response to spoken words.
Aged 3-10 years	The age range was delimited in order to ensure that material would be appropriate to participants.	Parent report
Having received English medium tuition for at least 1.5 years	Since the intervention was conducted in English, participants had to have had a fair amount of exposure to English in order to benefit from the intervention.	Parent report
Receptive English language skills at an age equivalent of at least 30 months	Participants had to understand the stories presented in order to benefit maximally from the intervention.	The Peabody Picture Vocabulary Test, Fourth Edition (PPVT-4) (Dunn & Dunn, 2007) as well as the receptive subtests of the Clinical Evaluation of Language Fundamentals – Preschool UK (CELF-Preschool[UK]) (Wiig, Secord, & Semel, 2000) were administered to determine receptive language abilities.
Able to concentrate on a 10 min story	The intervention required participants to engage in shared storybook reading for about 10 min at a time.	Parent and teacher report

3.7.2 Recruitment and assessment of participants

Consent was obtained from the Gauteng Department of Education to recruit participants from schools catering for learners with special needs in six different districts (see Appendix C). These districts were proposed due to their physical accessibility for the researcher (convenience sampling). The principals and governing bodies of five schools for learners with special educational needs were approached by letter and consented to recruit participants from amongst the learners at the school (see Appendix G). The directors of two centres for children with special needs (run as nongovernment organizations) were also approached in writing and gave consent to recruit participants from amongst the children attending the centres. Speech language therapists and/or class teachers were then asked to identify possible candidates from their classes or caseloads. Nine children from four schools and one centre were identified as possible participants. Parents of these children were approached by letter to request consent for the possible participation of their child in the study (see Appendix H). Parents of all nine children consented, two after first requesting a face-to-face meeting with the researcher and one after conducting a telephone conversation with the researcher. Since sessions were to be conducted at school, class teachers were also asked for consent to work with potential participants at school (see Appendix I). All class teachers gave consent.

Subsequently, the children were asked for their assent (see also Section 3.5) to participate in the assessment procedure (see Section 3.9.2.1). All nine children assented. Four children did not comply with the selection criteria. Three had English language skills of an age equivalent below 2;6 according to the Peabody Picture Vocabulary Test, Fourth Edition (PPVT-4) (Dunn & Dunn, 2007). One child struggled to comply during the session. The parents and class teachers of the five children who did comply with the selection criteria were contacted to arrange suitable times and dates for the data collection. In spite of parent, teacher and/or therapist reports that none of the five children had been observed to produce any graphic symbol combinations, two children spontaneously produced agent-action combinations during the initial baseline, prior to the commencement of intervention for any of the combinations. These children made use of personal communication booklets with 559 and 616 PCS symbols respectively,

predominantly representing nouns (68% and 71% respectively). Typically, only one word class was represented per page, necessitating navigation across pages to produce (most) symbol combinations. Partner interaction style may have also been of such a nature that only single symbols were expected in interaction. These factors might have prevented these two participants from displaying their symbol combination skills. When given a communication board with different word classes and presented with picture material depicting agent-action combinations, both participants started to combine symbols "spontaneously". Because they did not produce any of the other two types of semantic relations spontaneously during baseline, they still received intervention; but since there were only two opportunities to illustrate the effect of the intervention, their results were not analysed further. The graphic portrayals of their performance are provided in Appendix J.

3.7.3 Description of participants

Additional descriptive information was gathered, including the participants' ability to understand the 30 semantic relations targeted during intervention. Diagnosis, intervention history, exposure to storybook reading at home and level of play were additional descriptive variables. To supplement clinician-administered receptive language measures, items from the receptive subscale of the Bzoch-League Receptive Expressive Emergent Language Scale Second Edition (REEL-2) (Bzoch & League, 1991) for ages 24-36 months were included in the parent interview, as well as some language markers from the list of Speech and Language Milestones (Department of Education and Culture, 1996) for ages 36-72 months. An adapted version of the Language Development Survey (LDS) (Rescorla,1989) was administered as part of the parent interview to obtain information about expressive vocabulary. Information on the participants' prior exposure to graphic symbols and their ability to use graphic symbols for expression was obtained from parents, therapists and teachers. A summary of participant characteristics is given in Table 3.4.

3.7.3.1 Participant 1

Participant 1 was a boy aged 8;0 from a middle-class socioeconomic background. He lived with his parents in a townhouse. The family spoke Northern Sotho

Table 3.4

Participant Characteristics

No	Age[a], gender	Disability	Home language and proficiency[b]	PPVT-4 scores			CELF-Preschool[UK] receptive language scores	LDS	I-ASCC		Comprehension of relations targeted			Compr. of graphic symbols	Main communication modes
				Stand Score	%ile	Age eq.			No context	Sem. context	A-A	P-P	A-E		
1	8;0 M	Spastic quadriplegia following near – drowning incident at age 3	English and Northern Sotho Capabilities in Northern Sotho: 30/35 items (86%) correct[c]	73	4	5;0	Age eq.: 4;0 Raw s.: LC: 14 BC: 13 SS: 18	189 c.a.w. 139	13%	27%	10/10	10/10	10/10	100% on 2nd trial	Single spoken words, vocalizations, word approximations
2	7;9 M	Cerebral Palsy (spastic quadriplegia with more involvement on left side)	Northern Sotho 17/35 items (49%) correct[d]	26	<0.1	2;6	Age eq.: 2;11 Raw sc.: LC: 7 BC: 7 SS: 13	185 c.a.w. 79	3%	17%	6/10	8/10	7/10	76% on 2nd trial	Vocalizations and word approximations, pointing to objects and people, some Makaton gesture approximations, miming, idiosyncratic gestures
3	10;8 F	Cerebral Palsy (spastic quadriplegia)	Tshivenda 24/35 items (69%) correct[e]	31	<0.1	3;4	Age eq.: 3;2 Raw sc.: LC: 7 BC: 14 SS: 13	158 c.a.w. 14	0%	7%	8/10	9/10	10/10	95% on 2nd trial	Vocalizations, word approximations, pointing to objects and people, infrequent use of PCS boards in class

Note. LC = subtest on comprehension of linguistic concept; BC = subtest on comprehension of basic concepts; SS = subtest on comprehension of sentence structure; c.a.w. = clearly articulated words; A-A = agent-action; P-P = possessor-possession; A-E = attribute-entity.
[a] Age at beginning of the study. [b] As tested by receptive subtests of Sotho Expressive Receptive Language Assessment (Participants 1 and 2) and Venda Expressive Receptive Language Assessment (Participant 3). [c] A total raw score equivalent to 86% correct equates to Z score 1.54 and %ile 93.9 for 3.9-4.2-year-old isiZulu speaking children. [d] A total raw score equivalent to 49% correct equates to Z score -1.64 and %ile 5.1 for 3.9-4.2-year-old isiZulu speaking children. [e] A total raw score equivalent to 69% correct equates to Z score 0.10 and %ile 53.9 for 3.9-4.2-year-old isiZulu speaking children

Chapter 3: Methodology

and English at home. His father worked, while his mother was a homemaker. She particularly remarked that she had quit her job at the time of her son's near-drowning accident in order to be able to take care of him. However, she was in the process of training as a beautician at the time of the study. His father seemed to take on a decision-making role regarding the children, and asked to meet the researcher before giving permission for his son to participate in the study. His mother, however, was responsible for caregiving tasks.

Participant 1 had been attending an English medium public school for children with physical and/or learning disabilities for 1;5 years at the time of the study. He was attending Grade 1 (academic stream) at the time of the study.

Participant 1 had suffered severe asphyxia as a result of a near-drowning incident at age 3;6. He had been in a coma for 2 months following the incident, and consequently had presented with severe motor problems and no speech. At the time of the study, Participant 1's gross and fine motor skills were still severely affected. He displayed spasticity and dystonia in all four limbs. He used an electric wheelchair at home and at school, which he operated independently with his right hand. According to his therapist, his speech was limited to about 10 clearly articulated words (e.g. *yes, no, mom, dad)*, although he could produce many word approximations, which were understood by familiar partners. According to the I-ASCC (Dowden, 1997) his speech intelligibility was 13% and 27% in the *no context* and *semantic contex*" conditions respectively (unfamiliar partner). His speech was slow and effortful and characterized by poor breath control; he also tended to produce only initial syllables of words. He communicated mostly through single word approximations, as well as by answering yes/no questions. However, his parents reported that he used some sentences at home. His parents also reported about 139 clearly articulated words according to the adapted LDS (Rescorla, 1989). He had previously been provided with a communication board with PCS, mounted on his laptray. He had also been given a communication book with PCS. The book had consisted of an index page of four to five categories (e.g. *school, home, I need/want*) with corresponding vocabulary pages. He had used the board and the book previously to resolve

communication breakdowns. However, he had not been able to turn the pages of the book independently. It seemed that he did not continue using the book and board—his therapist presumed they were too limiting. At the time of the study, he had also recently received his electric wheelchair, which had not been fitted with a laptray; his board and book were therefore not always accessible. His therapist had decided to rather introduce him to The Grid 2 Windows-based communication and access program from Sensory Software International (Ltd.), and to concentrate on literacy skills in order to enable him to express any message he wanted to.

Regarding his receptive language skills, his mother reported that she thought his English skills were better than his Northern Sotho skills. Both were spoken at home. According to the language milestones given during the interview, she estimated his receptive language skills at a level of at least 6 years. His receptive Northern Sotho skills as evaluated by the Sotho Expressive Receptive Language Assessment (SERLA; Bortz, 1997) showed better proficiency in the African language than the proficiency of either of the other two participants. His receptive English language skills were also better than those of the other two participants were (see Table 3.4, Section 3.7.3). He achieved age equivalents of 5;0 and 4;0 on the PPPVT-4 (Dunn & Dunn, 2007) and the Clinical Evaluation of Language Fundamentals – Preschool UK (CELF–Preschool[UK]) (Wiig et al., 2000) respectively. Since the latter two assessment tools are not normed for the South African population, these scores have to be interpreted with caution.

Participant 1 started attending a care centre for children with severe disabilities 6 months after the near-drowning incident, where he received a period of speech and language therapy. After 2.5 years, he started attending the school where he received regular speech and language therapy. The main aim of intervention at the time of the study was for him to learn The Grid 2 computer program and improve his literacy skills. Regarding scholastic skills, his teacher reported that he was able to spell some 3-letter words, and was reading some slightly longer words. He was learning to do addition and subtraction of numbers up to 10. His teacher reported that it usually took him long to understand and learn.

His teacher reported that stories were read in a group situation in class on most school days. Participant 1 seemed to enjoy story time and tried to answer questions posed to him. His parents also read stories to him on weekends. Regarding play, Participant 1's physical challenges limited his ability to engage in pretend play. He did seem to engage in some pretend play with, for example, toy cars.

3.7.3.2 Participant 2

Participant 2 was a boy aged 7;9 from a working-class socioeconomic background. He lived with his parents in a one-roomed apartment on top of a six-storey building, sharing ablution facilities with another family. His home language was Northern Sotho. His care fell mostly to his mother and paternal grandmother. His mother worked shifts as a floor manager at a fast food restaurant. When her shifts necessitated that she be away outside of school hours, Participant 2 either attended a local crèche or was looked after by his grandmother. Occasionally his father would also take care of him. Participant 2 spent many weekends with his grandmother. His grandmother worked as an assistant in the preschool class of a Jewish school, and it was evident that she tried to apply some of the experience and knowledge she gained through her job to set up activities (e.g. games, learning the alphabet and storybook reading) that she felt might benefit her grandson's educational and communication progress.

Participant 2 had been attending an English medium public school (with associated preschool) for children with physical and/or learning disabilities for 3 years at the time of the study. He was attending Grade R at the time of the study.

Participant 2 was born with spastic quadriplegia affecting the left side of his body more than the right side. He was ambulatory, but walked with an uneven gait. He pointed accurately and with ease using his right hand. His speech language therapist reported severe apraxia of speech. According to the report of his teacher, the speech language therapist and his mother, he used very few intelligible words (e.g. *mama, papa, no, bye).* His speech was 3% and 17% intelligible to an unfamiliar partner in the no context and

71

semantic context conditions of the I-ASCC (Dowden, 1997). His word approximations consisted mostly of vowels. When completing the LDS, his mother did report that he could clearly articulate 79 of the 311 words on the LDS (Rescorla, 1989)—many more than she had indicated during the interview. He also communicated using some Makaton sign approximations, as well as idiosyncratic gestures, miming and pointing to objects and people. He had been exposed to PCS for receptive vocabulary development, but not for expressive purposes. According to his mother, his teacher and the speech language therapist, Participant 2 had started to combine concepts expressively (e.g. he would sometimes mime and also use idiosyncratic gestures). However, he still communicated primarily in one-concept utterances (an estimated 90% of the time).

Regarding his receptive language skills in his home language, his mother reported these to be on an age equivalent level of about 3;6 to 4;6. When his Northern Sotho receptive skills were tested using the SERLA (Bortz, 1997), he seemed to perform below the level reported by his mother (see Table 3.3; see also Section 3.8.2.6 for further information on the SERLA). When questioned about this, his mother indicated that Participant 2 had been exposed to English, Zulu and Sotho in the crèche. His cumulative understanding of all three languages may thus have been better than the results of formal tests targeting only one language would have shown. His English receptive language skills tested at age equivalents of 2;6 and 2;11 on the PPVT-4 (Dunn & Dunn, 2007) and the CELF—Preschool UK (Wiig et al., 2000) respectively. Scores have to be interpreted with caution as these assessment tools are not standardized for the South African population.

Participant 2 had received regular speech and language therapy since entering the school. Intervention aims had included improved oral motor skills, improving speech intelligibility through structured syllable and word training (Kaufman programme; Kaufman, 2005) as well as improved receptive language skills. However, his therapist indicated that she thought he would need augmentative methods of communicating in the future. Regarding scholastic skills, Participant 2's teacher reported that the aims for him

were to start identifying some letter names as well as numbers up to 10. However, she indicated that he seemed to learn slowly.

Participant 2 was exposed to storybook reading in a group format at school, two to three times per week. His teacher reported that he seemed to enjoy story time and would try to imitate actions or sounds. He tried to answer some questions using single word approximations. He seemed to enjoy physical outdoor play as well as construction (building blocks) with some simple symbolic actions (e.g. pretending to drive a car) evident on occasion.

3.7.3.3 Participant 3

Participant 3 was a girl of 10;8 from a middle-class socioeconomic background. She lived with her parents, two sisters (aged 14 and 4 years) and an uncle in a five-bedroom house with a garden. Her home language was Tshivenda. Her fathers' position in a national government department necessitated frequent trips around the country. Her mother was a homemaker, a role she described as taxing, especially in view of having a child with a disability. For example, not all parts of the house were wheelchair accessible and she indicated that carrying her daughter around had become very cumbersome. Once again, it seemed that her father was the one who mainly took decisions regarding the children (he also asked to meet the researcher before giving permission for his daughter to participate in the study), while her mother was responsible for caregiving tasks.

Participant 3 had been attending a double medium (English and Afrikaans) public school for children with physical disabilities for 6.5 years at the time of the study. She had been attending the English medium class for the initial 3 years, and was then (on request from her parents), placed in an Afrikaans medium class for 3 years. However, she had been placed back in the English class at the beginning of the school year in which the study took place (6 months prior to study). Her mother felt that her receptive English skills were good due to watching many English programmes on television. Her receptive Tshivenda skills seemed, according to parent report, to be on about a 3;6- to 4;6 age equivalent level. These findings are corroborated by her performance in the Venda Receptive Expressive Language Test (VERLA) (Bortz, 1997), as indicated in Table 3.4

(see also Section 3.8.2.6 for further information on the VERLA). Her English receptive language skills tested at age equivalents of 3;4 and 3;2 on the PPVT-4 (Dunn & Dunn, 2007) and the CELF—Preschool UK (Wiig at al., 2000) respectively. As the latter two assessment tools are not standardized for the South African population, these scores have to be interpreted with caution.

Participant 3 was born with spastic quadriplegia. She was not ambulatory, but used a wheelchair at school (not self-propelled). At home, she did not use a wheelchair at the time of the study, since the one she had used before had become too small. She was therefore carried around by her mother. Participant 3 could point accurately, but pointing was slow and effortful due to severe spasticity in her arms and hands. According to her mother, Participant 3 used about four to five Tshivenda words at home (e.g. for *hungry* and *water*), as well as some English word approximations (e.g. for *television* and *juice*). She would communicate almost exclusively with one word at a time. Her teacher and speech language therapist reported that, at school, she sometimes tried to produce spoken words, but would produce only the vowel sounds and velar stops ([g] and [k]). Her word approximations were not understandable unless the hearer had precise contextual clues. The comprehensibility of her spoken English as judged by an unfamiliar listener was 0% in the no context condition, and 7% in the semantic context condition of the I-ASCC (Dowden, 1997). According to her mother, she could clearly articulate 14 of the 311 words on the LDS (Rescorla, 1989).

Participant 3 used two communication boards with 20 and 24 PCS respectively to communicate in class. She usually needed prompting to use the boards, and would point to one symbol at a time. Yes/no-questions were used to clarify messages. She also used an alphabet board and a board with numerals for schoolwork. She had been taught to spell some 3- and 4-letter words.

Participant 3 had received regular weekly speech and language therapy since entering the school at age 4. At the time of the study, intervention aims included improved receptive language skills and learning to use PCS to express herself. Regarding

scholastic skills, Participant 3 could identify numerals up to 10 and could also read and spell some 3- and 4-letter words.

Storybook reading took place almost every school day in a group format in the classroom. Participant 3 seemed to enjoy this, but her teacher reported that she had difficulty responding to questions. Regarding play, her mother reported that dolls were her preferred toys, and that she engaged in some simple pretend play (feeding, putting doll to sleep) with dolls. Access to and manipulation of toys was, however, difficult, and Participant 3 spent much of her free time at home watching television.

3.8 Equipment and materials

3.8.1 Equipment

A Canon Legria FS 306 video recorder was used to film the probe test and shared storybook reading sessions. A Panasonic Mini Cassette Recorder (Model no. RQ-L10) was used to record the production of words used to score speech comprehensibility according to the I-ASCC (Dowden, 1997).

3.8.2 Materials used during assessment of participants

3.8.2.1 Peabody Picture Vocabulary Test, Fourth Edition (PPVT-4)

The PPVT-4 (Dunn & Dunn, 2007) was used to obtain a standard score, percentile rank and an age equivalent score of participants' receptive vocabulary in English. As this assessment tool is not normed for the South African population, the scores obtained by participants have to be interpreted with caution.

3.8.2.2 Clinical Evaluation of Language Fundamentals – Preschool UK (CELF–Preschool[UK])

The three receptive subtests of the CELF–Preschool[UK] (Wiig et al., 2000) were used to determine participants' receptive English language abilities in the following areas:

- understanding of linguistic concepts,
- understanding of basic concepts,
- understanding of sentence structure.

Once again, this assessment tool is not standardized for the South African population, and therefore the scores obtained by participants have to be interpreted with caution.

3.8.2.3 Parent, teacher and therapist interviews

Interview schedules for parents, teachers and therapists of the participants were developed in order to obtain relevant background information. The parent interview schedule included items from the receptive subscale of the REEL-2 (Bzoch & League, 1991) for ages 24 to 36 months, as well as items from the list of Speech and Language Milestones for ages 36 to 72 months (Department of Education and Culture, 1996). The interview schedules are provided in Appendix K.

3.8.2.4 Language Development Survey (LDS)

In order to obtain an idea of the expressive vocabulary of the participants, an adaptation of the LDS (Rescorla, 1989) was used. This instrument was originally developed as a parent-completed screening tool of expressive vocabulary for children aged 18 to 35 months. The LDS (Rescorla, 1989) gives a list of 311 words of which typically developing children aged 2 years are expected to produce at least 50. The LDS (Rescorla, 1989) was adapted for the South African context (Gonasillan, 2011) and further adapted by the current researcher to include report of other modalities, including signs and gestures, pointing to pictures or graphic symbols, pointing to objects or persons or other (see Appendix L). Parents were further required to distinguish between words that were clearly articulated versus those that were not clearly articulated. Results from the adapted LDS have to be viewed with caution, since the South African version and additional adaptations by the researcher departed from the original instrument and are not standardized. It is unclear, for example, whether a parent's designation of a word as "clearly articulated" would mean the word is understandable to unfamiliar listeners in a situation where no context is given. Furthermore, including modalities such as pointing to objects, persons and pictures entails the risk of overestimating expressive vocabulary,

because pointing to these entities may merely serve to draw attention to them, rather than to express a concept. However, pointing to aspects within the environment is often an important way to communicate for children and adults with limited speech, especially if they do not have access to an extensive formal AAC system. The instructions requested parents to distinguish between the two intentions of pointing and report only on pointing that served to express a concept, yet this distinction may have been difficult.

On the other hand, use of an adaptation of the LDS may have underestimated participants' expressive vocabulary, since the original measure is clearly aimed at much younger children and the word list may not be comprehensive enough to capture expressive vocabulary size of older children, even those with limited expressive skills. Although parents had the opportunity to add additional words, this is in general more difficult for them to do than to work from an existing list.

3.8.2.5 Index of Augmented Speech Comprehensibility in Children (I-ASCC)

This nonstandardized clinical measure by Dowden (1997) was used to obtain a more objective indication of the comprehensibility of the participant's speech. The measure includes 30 word pools of 10 words each relating to different semantic or contextual categories. One word was chosen randomly from each of these 30 word pools. In three cases, this word was deemed unfamiliar to children in the South African context. Two of the words were changed to more familiar words designating the same concept (i.e. *mittens* was changed to *gloves*, and *store* was changed to *shop*). In one instance another word from the pool was substituted (i.e. *snow* was replaced with *stones*). In three instances the selected word was deemed difficult to depict visually and therefore another word from the pool was selected to replace it (i.e. *picture* was replaced with *radio*, *grr* was replaced by *quack* and *fruit* was substituted with *sandwich*). The word *banana* happened to have been selected twice from different word pools, and the second occurrence of the word was thus replaced with *watermelon*. The pictures, target words and eliciting phrases are provided in Appendix M.

3.8.2.6 South African Language Assessments

For various cultural-historic reasons standardized assessment materials for children in any of the African languages spoken in South Africa are extremely limited. A list can be found in Mphahlele (2006). The South African Language Assessment (Bortz, 1997) counts among the few nontranslated measures which target language skills beyond vocabulary in five African languages, including Northern Sotho and Tshivenda. It is also the only language assessment measure known to the author for Tshivenda. For these reasons, it was decided to use this measure to obtain an impression of home language proficiency of the participants. However, norms are available only for the isiZulu version, specifically for isiZulu-speaking children aged 3;9 to 4;2 (z-scores and percentile ranks based on the total raw score), although the isiZulu version was pilot tested on children ranging from 2;9 to 5;5.. The receptive subtests from the Venda Expressive Receptive Language Assessment (VERLA) and the Sotho Expressive Receptive Language Assessment (SERLA) (Bortz, 1997) could thus only be used to obtain a subjective impression of the receptive skills of the participants.

The test was administered by two mother tongue speakers of Tshivenda or Northern Sotho, who each had experience in conducting assessments with young children (an educational psychologist and a speech language therapist). Apart from the lack of norms, results may also have been affected by the influence that urbanization has had on African languages in South Africa. Due to frequent contact with members of other language groups as well as exposure to English, speakers often engage in complex patterns of code-switching and the resulting language that is used and which children are exposed to can differ in many ways from the rural variety. The rural forms tend to be regarded as the standard versions of the language by urban residents, while they describe their own varieties as "diluted", "divided" or "skimming the top" (Slabbert & Finlayson, 2000). Although the urban mother tongue speakers conducting the assessments modified the wording where they felt that children would not understand the "rural" or "standard" version (as is explicitly required in the test instructions), children may still have been disadvantaged through underexposure to the more formal version of the African language and test results may have underestimated their receptive language skills.

3.8.2.7 Test of comprehension of relations targeted

In order to test understanding of the targeted symbol combinations, each of the combinations (intervention and generalization items) was represented in a picture. A minimum of four foils were used together with each picture. The foils were constructed in such a way that there were at least two distracters per semantic role. Thus, for agent-action combinations (e.g. *The dog runs*), there were two foils depicting the same agent as the target, but different actions (e.g. *The dog sleeps* and *The dog eats*), as well as two foils depicting the same action as the target, but different agents (e.g. *The boy runs* and *The cat runs*). The pictures used to test possessor-possession combinations were slightly different, in that three possessors were depicted on one sheet of paper, each having various items as possessions (hat, shoes, tummy, hands, nose). There were thus, theoretically, more than two foils for the possession role. Some of the pictures were taken from Blacksheep Press (2004; 2006), while others were hand-drawn. The target and foils for one combination were depicted on one sheet of A4 paper. For the agent-action and attribute-entity combinations, the five pictures were put into a 2 x 3 grid, with the position of the target being systematically varied. (See Appendix N for examples of the materials used during the test.)

The appropriateness of the material as well as the procedure was pretested by involving three 3-year-old and three 4-year-old typically developing children (age range 3;0 to 4;5). Each child was seen individually (either at school or at their home) and presented with the picture material described above. They were then verbally asked to point out the picture corresponding to the relation targeted, by a question or mand such as *Where is (relation targeted)?* or *Show me (relation targeted).* No further prompts were given and children were not given feedback on the correctness of their response. The number of correct identifications ranged from 26 to 30 for the 30 relations, with an average of 28.2 (94%) correct identifications. The procedures were thus deemed appropriate for testing comprehension of the relations.

3.8.3 Material used during data collection (experimental stage)

3.8.3.1 Matrices

Making use of the matrix strategy (Nigam et al., 2006), two words fulfilling a specific semantic role were systematically combined with five words fulfilling another semantic role for each of the three types of semantic relations targeted. This resulted in 10 combinations per type of semantic relation. The combinations are presented in Table 3.5.

Table 3.5

Summary of Combinations Targeted for Intervention and Used to Test Generalization

Semantic relation	Intervention items	Generalization items
Agent-action	The dog cries	The dog falls
	The dog sleeps	The dog runs
	The boy falls	The dog laughs
	The boy runs	The boy cries
	The boy laughs	The boy sleeps
Possessor-possession	The girl's hat	The girl's shoe
	The girl's nose	The girl's tummy
	The girl's hand	The bunny's hat
	The bunny's shoe	The bunny's nose
	The bunny's tummy	The bunny's hand
Attribute-entity	Dirty shirt	Dirty car
	Dirty pants	Dirty aeroplane
	Dirty teddy	Broken teddy
	Broken car	Broken shirt
	Broken aeroplane	Broken pants

The following factors were taken into consideration in selecting the combinations:

- Each combination needed to be easily depicted, in order to develop picture material for probes and for use during intervention that could elicit the semantic relations expressively.
- The combinations targeted during intervention needed to be taken up in a story.

The 21 words making up the three matrices were chosen with the following criteria in mind:

- Words needed to be chosen that could function in a matrix where all words fulfilling one semantic role were combinable with all the words fulfilling the complementing semantic role.

- Words needed to be simple enough to be appropriate for children on a receptive language age equivalent of 30 months. To this end, the LDS (Rescorla, 1989) was consulted. This instrument was developed as a screening tool of expressive vocabulary for children aged 18-35 months. Of the 21 words, 17 were taken from the LDS (Rescorla, 1989).

- Words were selected that could be relatively easily represented with graphic symbols. At the same time, these graphic symbols needed to be sufficiently different from each other so as not to cause confusion.

In order to assign intervention and generalization items, each of these 10 combinations (per type of semantic relation) were divided into five pairs, based on the two words fulfilling the first semantic role (e.g. for agent-action combinations, *The boy sleeps* would be paired with *The dog sleeps*). One of each of these pairs was selected to be incorporated into a story, with care being taken that each of the two words fulfilling the first semantic role occurred at least twice (e.g. at least two combinations had to have *the dog* as an agent). Selection was furthermore based on whether the combinations could be logically incorporated into a story line. The other combination in the pair was then automatically assigned as a generalization item.

The three matrices for the three types of semantic relations are presented in Appendix O.

3.8.3.2 Probe test

The probe test was developed to measure the participants' ability to express the combinations (both those targeted during intervention and those used to test generalization) using graphic symbols, both during the baseline and intervention phases.

Similar pictures were used as those depicting the target combinations in the test of comprehension of targeted relations (see Table 3.1, Section 3.6.2 for minor changes made to the pictures). For agent-action and attribute-entity combinations, the pictures were enlarged and coloured and each picture was presented on one A4 page. For possessor-possession combinations, a girl and a bunny were depicted on an A4 sheet. It was decided that the researcher would point out the aspect of the picture being asked about using a stick (the stick was narrower and could be used to point more accurately than a finger). The probe test thus consisted of 30 A4 pictures (of which the 10 testing possessor-possession combinations were identical). (See Appendix P for examples of the pictures used during the probe test.)

3.8.3.3 Communication board

A communication board with each of the 21 graphic symbols derived from the three matrices was constructed. Of the 21 symbols, 17 were PCS and four were hand drawn. The four hand-drawn symbols represented the concepts *NOSE, TUMMY, DIRTY* and *BROKEN*. The PCS for the concepts *TUMMY* and *NOSE* consist of the body parts drawn in isolation, which was judged as potentially confusing. Light and Drager (2007) remark on the tendency of children to represent concepts grounded in context, without isolating parts of the whole (p. 208). The hand-drawn symbols thus had more context, for example, the symbol for *NOSE* consisted of a drawing of the whole face with the nose enlarged, while the symbol for *TUMMY* consisted of a whole body, with the tummy enlarged. The PCS for *BROKEN* is a cracked cup. This was not deemed generic enough, as the targeted relations were *broken car*, *broken aeroplane* and so on. Using the picture of a broken cup to symbolize *BROKEN* therefore seemed potentially confusing. Instead, a rectangle, snapped in two, was drawn to represent *BROKEN*. Similarly, a rectangle with black marks on it was drawn to represent *DIRTY*.

Since the aim of the intervention was for participants to express semantic relations using graphic symbols, graphic symbols were organized according to the Fitzgerald Key (Fitzgerald, 1959), and the background of each category was colour-coded. Categories, from left to right, included:

- who (agents) and whose (possessors), coded in purple,

- verbs (actions), coded in pink,

- adjectives (attributes), coded in blue,

- what (objects), coded in yellow.

This organization is not strictly according to word class, but rather according to semantic case or thematic role of the word. As the specific semantic case of each of the words was predetermined, it was possible to organize the board in this way. Often, the use of specific vocabulary items on a board is not as predictable, in which case it is easier to organize the board according to word class, because the semantic case of a word is not predetermined (e.g. the *BOY* might be an agent, a possessor, a recipient, etc.). However, the original Fitzgerald Key (Fitzgerald, 1959) uses a semantic case organization rather than an organization according to word class. A representation of the board is provided in Appendix Q.

3.8.3.4 Stories

The researcher developed three stories to incorporate each of the three sets of five intervention items. Each item was incorporated twice into the story to allow for two teaching opportunities. Thus, the first story contained each of the five agent-action combinations twice, the second each of the five possessor-possession combinations twice, and so forth. The stories were developed based on the following principles:

- Use of vocabulary that is simple to understand for children whose language comprehension is on an age equivalent level of at least 30 months

- Use of simple sentences

- Use of a story grammar pattern of one or more simple episodes (Peterson & McCabe, 1983); a simple episode consists of an initiating event which results in an overt attempt by the main character, with a direct consequence.

After the stories were developed, the percentage of vocabulary items that appear in the Language Development Survey (Rescorla, 1989) was determined. The LDS (Rescorla, 1989) provides a list of words of which typically developing children aged 2

are expected to produce at least 50. Of the vocabulary items included in the stories (not counting pronouns, articles and auxiliary verbs) 52%, 46% and 58% respectively were found in the LDS (Rescorla, 1989) for Stories 1, 2 and 3 respectively. The readability of the stories was also determined from an online readability calculator based on the Flesch-Kincaid Readability Index (Joe's Web Tools, n.d.). Grade equivalents of -1.1, 0.3 and 0.5 were obtained for Stories 1, 2 and 3 respectively. The stories thus had a readability level below the first grade suggesting that, overall, the stories consisted of simple short sentences and words with few syllables.

The suitability of the stories for children of language age 2;6 to 3 was confirmed by reading each of the stories individually to each of six typically developing children (ranging in age from 2;5 to 3;3). All sessions were video recorded. All six children were able to concentrate on the stories told. All were engaged, looking at the illustrations and making appropriate eye contact with the researcher. All responded to questions and comments by the researcher most of the time. The stories were therefore considered suitable for children of language age 30 months upwards.

The stories were illustrated by a graphic artist. (See Appendix R for the stories and examples of the illustrations). Mostly, only one target relation appeared in an illustration. Where two or more illustrations of target relations appeared in a picture, removable parts or flaps were used in order to separate the pictures of the target relations visually from each other. The illustrations were printed on A4 paper (landscape format), with text appearing below the illustration. Each page was laminated and the pages were ring bound.

The three stories were comparable in terms of number of words and number of illustrated pages. The story incorporating agent-action combinations consisted of 160 words and had 14 illustrated pages. The story that incorporated the attribute-entity combinations had 182 words and 11 illustrated pages, while the story that incorporated the possessor-possession combinations consisted of 211 words and 12 illustrated pages.

3.8.3.5 Data recording sheets for data collection

Two types of data recording sheets were developed. First, a sheet for collecting data from the probe test was developed. Before each administration of the probe test, the picture material used to elicit responses was placed in random order. A score sheet was then compiled reflecting the order of the items. Space was provided for transcription of the participant's response, as well as for classifying it as either correct (containing both target graphic symbols) or incorrect. (An example of a probe test score sheet is provided in Appendix S.)

Second, a data recording sheet was developed to capture the participants' responses to the various levels of prompting employed during shared storybook reading (see Appendix A). This information was gathered merely for descriptive purposes and for keeping record of participants' progress during the shared storybook reading activities. The target combinations were listed in the order in which they appeared in the story, providing space to transcribe the participants' responses to each level of prompting.

3.8.3.6 Checklists for procedural integrity

Checklists were developed to rate the integrity of the procedure used during the probe test (see Appendix T) as well as for the procedure used during intervention (see Appendix U). In accordance with the recommendations by Gast (2010), the score sheets endeavoured to allow scoring each procedural variable.

3.9 Procedures

3.9.1 Ethical considerations

Clearance for the study was obtained from the Research Ethics Committee of the Faculty of Humanities of the University of Pretoria before any data collection commenced, including the pilot study (see Appendix B). Prior to recruitment of participants, consent was also obtained from the Gauteng Education Department to recruit participants from schools for learners with special educational needs (see Appendix C). Once permission had been granted, principals and governing bodies of the

selected schools were approached and informed in writing of the details of the study. Written consent was obtained before potential participants' parents were approached (see Appendix D [pilot study] and Appendix G [main study]).

Any study involving human participants needs to abide by the appropriate ethical principles, summarized under autonomy, beneficence and justice in the Belmont report (National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research, 1979). Autonomy implies that participants' right to be informed of all aspects of the study and their freedom to choose whether they would like to participate or not needs to be respected. When participants in a study are under age (as was the case in the current study), parental permission and child assent are required in the place of informed consent (Rossi, Reynolds, & Nelson, 2003). In the current study, only children whose parents or legal guardians (and, where appropriate, teachers) gave consent participated in the study. Parents' (and, where appropriate, teachers') informed consent was obtained by providing them with a letter containing detailed written information on the study and requesting their response to indicate their consent or refusal for their child to participate in the study (see Appendix D [pilot study] and Appendices H and I [main study]). Prior to each session, each participant was requested assent for participation. All children could indicate *yes* and *no* using gestures and/or vocalizations. The content of the request was as follows: *Hello (child's name). I want to work with you today. Do you want to come and work with me today?* Sessions were only conducted if participants assented.

The principle of beneficence requires that participation in the study should have benefits for the participants and that any possible negative consequences of participation should be limited. In the current study, participation entailed intensive one-on-one training in graphic symbol combination skills over a period of at least 15 days for each participant. Seeing that participants all had limited speech, this skill would be seen as important to enhance their communication and linguistic abilities. The researcher tried to avoid possible negative consequences related to conducting the study during school hours by scheduling the sessions in such a way as not to clash with important academic activities. Furthermore, the researcher informally met potential participants before the

assessment procedure commenced, in order for them to be familiar with the researcher before any formal procedures commenced. Thus the researcher sought to minimize the risk of children feeling ill at ease with an unfamiliar person testing them.

The principle of justice requires that burden and benefit be spread evenly across the population who would ultimately benefit from the results. This intervention study aimed to facilitate a skill in a very specific group of individuals. As the training programme had not been previously evaluated, the selection criteria for the current study were strict, in order to recruit only participants for whom the likelihood of benefit from the intervention was high.

3.9.2 Settings

All procedures involving the participants directly were conducted at the schools the participants attended, as well as within the participants' home settings when this was necessitated by holidays or nonattendance. For Participant 2, sessions were also conducted at the crèche that the participant attended during the holidays. Participants 1 and 2 attended the same school (School A), while Participant 3 attended a different school (School B). Both schools were public schools. School A was an English medium school for learners with physical and/or learning disabilities. School B was a dual medium (English and Afrikaans) school for learners with physical disabilities. At each of the two schools, procedures were conducted within a therapy room, and at the crèche in an empty classroom. Within the home settings, sessions were conducted in bedrooms (Participants 1 and 2) or the family lounge (Participant 3). The latter was the only setting that did not have a door closing it off from the rest of the house. The participant and researcher were seated next to each other with a work surface in front of the participant. The researcher used this work surface to display the necessary materials. The assessment materials, the storybooks used for intervention and the probe test pictures were elevated to allow the participant to see them. The communication board was mounted on a stand at an angle of about 60° to allow for easier access.

3.9.3 Stages of main study

The main study consisted of various stages, as illustrated in Figure 3.1. The recruitment and assessment of participants has been briefly described in Section 3.7.2. Further details are provided below (Section 3.9.4). This was followed by the experimental stage, which entailed measuring the dependent variable across a baseline and an intervention phase (for all three types of semantic relations targeted), as well as during a postintervention phase (first two types of semantic relations targeted). During the intervention phase, the treatment (independent variable) was also administered. Data analysis was the last stage.

3.9.4 Assessment of participants

During this stage, the researcher determined whether the participants complied with the selection criteria and gathered additional descriptive criteria. Furthermore, the participants were given training on any graphic symbols (from the 21 graphic symbols used during intervention), which they did not recognize on first exposure. The procedures involving the participants directly were conducted over 2 to 3 days, with sessions lasting about 60 min. Breaks were given to prevent fatigue. Administration of the PPVT-4 (Dunn & Dunn, 2007), CELF–Preschool[UK] (Wiig et al., 2000), VERLA/SERLA (Bortz, 1997) and I-ASCC (Dowden, 1997) proceeded as required by the instructions of these assessment tools. Some of the other procedures used are described below.

3.9.4.1 Parent, teacher and therapist interview and completion of LDS

The parents of the participants were interviewed to obtain relevant background information. Parent interviews were conducted at the participants' homes. Similarly, teachers and speech language therapists of the children were also interviewed to obtain a more comprehensive picture of the child's functioning. Teacher and therapist interviews were conducted at school. (The interview schedules are described in Section 3.8.2.3 and presented in Appendix K.) Interviews lasted between 10 and 20 min. The researcher also asked parents about the participants' expressive vocabulary using the adapted form of the LDS (Rescorla, 1989). The LDS was completed at the participant's home or at the

parent's workplace. (The adapted form of the LDS is described in Section 3.8.2.4 and the form is presented in Appendix L.) The completion lasted about 20 to 30 min.

3.9.4.2 Comprehension and training of graphic symbols

In order to assess receptive knowledge of the 21 graphic symbols used in the study, participants were given the communication board constructed for use during the probe test and during the shared storybook reading activity. (The board is described in Section 3.8.3.3 and presented in Appendix Q.) Participants were asked to point out each of the 21 concepts on the board. They were asked a question or given a mand such as *Show me ___(word),* or *Where is _____(word)?* Incorrect responses were immediately corrected, in anticipation of the next step (training). The 21 concepts were tested in random order, with one trial per graphic symbol. Participants who scored 100% correct on the first testing were retested on all 21 graphic symbols. If they achieved 75% or more correct on the second testing, they were included in the study. Those who did not achieve 75% or more on the second testing as well as those who did not score 100% on first testing were provided with paired-associate training of those symbols not correctly identified, with retesting and retraining of these specific symbols up to five times. If 100% accuracy on the specific symbols was not reached after five training sessions, participants were excluded. If 100% accuracy was reached within these five training sessions, all 21 symbols were retested. The cut-off for inclusion in the study was 75% or more correct on the retesting of all 21 symbols. The process is depicted diagrammatically in Figure 3.2.

3.9.4.3 Comprehension of relations targeted

Participants were presented with the pictures of the targeted relations as well as the foils (see material described under Section 3.8.2.7 and the example in Appendix N) and asked to identify the relation targeted by pointing. See Table 3.4 (p. 67) for the results.

3.9.5 Data collection/experimental stage

The experimental stage consisted of the measurement of the dependent variable by means of the probe test, as well as the administration of the independent variable (intervention aimed at fostering the production of semantic combinations through graphic symbols). The probe test will be described first, since it was administered in the baseline,
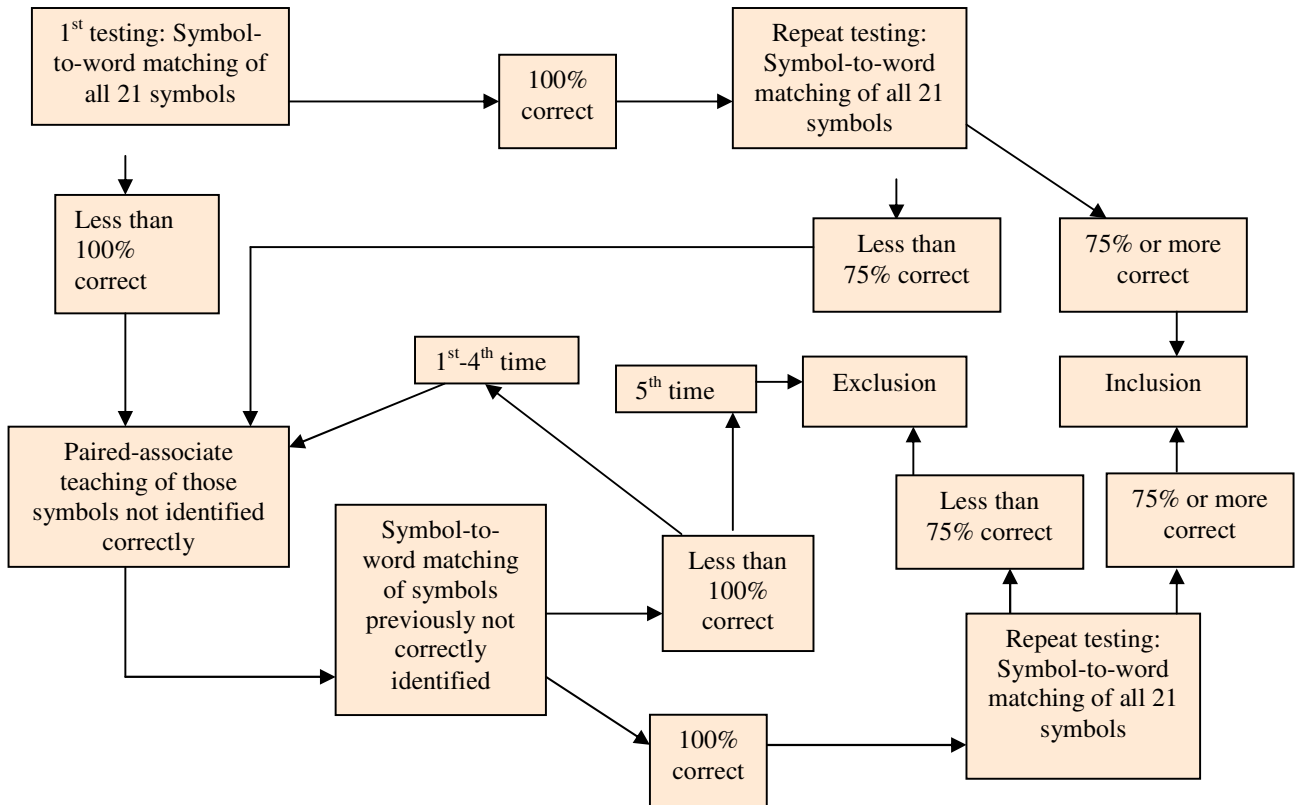

Figure 3.2. Assessment and training procedure: comprehension of graphic symbols.

intervention and postintervention phases. The probes administered by means of the probe test during baseline, intervention and postintervention phases will be described next, while the intervention strategy will be described last.

Sessions were scheduled as frequently as the school and family schedule allowed, but not more than one per day. For Participant 1, 22 sessions were conducted over a period of 52 days, which meant an average of about 3.0 sessions per week. A maximum

of 5 sessions and a minimum of 1 session per week were conducted. For Participant 2, 24 sessions were conducted over a period of 40 days, averaging to 4.2 sessions per week. A maximum of 6 sessions and a minimum of 2 sessions were conducted per week. With Participant 3, 26 sessions were conducted over a period of 47 days, which worked out to an average of 3.9 sessions per week. A maximum of 6 and a minimum of 2 session were conducted per week.

3.9.5.1 Probe Test

The probe test was employed to determine the participants' ability to express the 30 semantic combinations (15 intervention items and 15 generalization items) by means of graphic symbols throughout the experimental phases of the study. A description of the probe test material is given in Section 3.8.3.2. All administrations of the probe test were video recorded. Before the 30 items were administered, they were placed in random order. The items were administered in three groups of 10, interspersed with short breaks during which a choice of a sticker or a reinforcing nonrelated activity was given to the participant (e.g. access to a battery-operated toy). Each participant also collected a sticker on a score sheet for every 10 items completed. When 10 stickers had been collected, the participant was allowed to choose a small gift from a selection (e.g. bracelets, small toy cars, hair accessories, erasers, pencils, toy figurines). During the probe test, only one trial was given per item. Participants were seen individually. The participant had the communication board available on a table or laptray in front of him/her. The researcher presented the participant with a picture and asked an open-ended question or gave a mand for a response. Mands and questions differed slightly for each semantic relation; they are summarized in Table 3.6.

Table 3.6

Questions and Mands Used to Elicit Responses During the Probe Test

Agent-action combinations	Attribute-entity combinations	Possessor-possession combinations
What is happening on this picture?	What is this?	What is this?
Tell me about this picture.	Tell me about this picture.	Tell me about this.

91

A response was scored as correct if the participant pointed to at least both target symbols (in any order). The researcher acknowledged any response in a neutral way (e.g. *I see. Oh.*). The responses were not corrected and no prompts for elaboration or direct models were given. If the participant did not respond within 10 s, it was considered as no response. If the participant started responding within the 10 s, he/she was allowed to complete the response. After a response, the researcher waited an additional 3 s before moving on to the next picture, to ensure the participant had completed his/her response. Noncontingent encouraging feedback (e.g. *You are working hard. You are pointing like a star.*) was given intermittently to encourage the participant to continue. One administration of the probe test (with two breaks) took about 10 to 20 min.

3.9.5.2 Baseline probes

During baseline, the probe test was administered to determine the participants' ability to express the semantic relations (intervention items and generalization items) by means of graphic symbols before intervention commenced. Three consecutive baseline probes were conducted before intervention commenced on the first type of semantic relation. When intervention commenced on this type of semantic relation, the other two types of semantic relations continued untreated, and were monitored with baseline probes. Baseline probes for these relations coincided with intervention probes on the semantic relation that was being treated, since all 30 items of the probe test were administered every time (some of which may have been items that had already received treatment, while others had not). Probes were conducted after the first intervention session that targeted the first type of semantic relation and, subsequently, after every second intervention session targeting that type of semantic relation. The baseline probes for the relations that had not yet been targeted were therefore conducted on days that corresponded to the first, third and fifth (and possibly seventh and ninth) day of intervention of the relation that was being targeted in intervention. Once intervention started on the second type of semantic relation, the baseline probes continued for the last semantic relation at the same intervals.

3.9.5.3 Intervention probes

On the first, third, fifth (and where needed, seventh and ninth) day of treatment, probes were conducted to monitor the ability to produce the combinations targeted in intervention as well as untrained items of the same type of semantic relation. These probes were conducted by means of the probe test. On the days when both the intervention procedure and the probes were conducted, probes were always conducted after the intervention procedure.

3.9.5.4 Postintervention probes

For the first and second type of relation targeted in intervention, probes continued after intervention had ceased. These postintervention probes were conducted on days during which intervention probes were conducted on the semantic relation treated at that stage.

3.9.5.5 Intervention

Intervention took place within a shared storybook reading context. The order in which the three types of semantic relations were targeted was counterbalanced across the five participants that commenced with the study. The order in which relations were targeted for the three participants, whose results will be discussed, is presented in Table 3.7.

Table 3.7

Order in Which the Semantic Relations were Targeted for Each Participant

Order in which semantic relations were targeted	Participant 1	Participant 2	Participant 3
1st semantic relation	Attribute-entity	Agent-action	Possessor-possession
2nd semantic relation	Agent-action	Possessor-possession	Agent-action
3rd semantic relation	Possessor-possession	Attribute-entity	Attribute-entity

Since the data of two participants could not be used because of unstable baselines, the order of the relations for each of the remaining three participants is not completely

counterbalanced. The agent-action combination, for example, appears in the second position twice, and the attribute-entity combination appears twice in the final position.

The intervention on the first semantic relation commenced after three consecutive baseline sessions. All procedures were video-recorded. A checklist with all the important aspects to be adhered to during intervention is provided in Appendix U. During intervention, the researcher engaged in shared storybook reading with the participant. This included reading the story, while showing the illustrations, commenting and elaborating as needed. As far as possible, any initiations by the participant were accommodated and responded to. For example, while reading Story 1 (agent-action; see Appendix R), a participant pointed to the illustration of the dog in the picture showing the boy crying and the dog licking his face (see Appendix R). The researcher then commented, *Yes, the dog is licking the boy's face*. The participant had the communication board available on a table or laptray in front of him/her. The researcher employed a prompting hierarchy before each target item to create an opportunity for the participant to express or learn to express the particular semantic combination using graphic symbols. The prompting hierarchy consisted of

- Level 1: drawing the participant's attention to the picture depicting the target semantic relation (e.g. picture showing a boy running) by pointing and verbalizing (e.g. *look, oh-oh*, etc.) and pausing for 10 s;

- Level 2: asking an open-ended question to elicit the semantic relation (e.g. *What is happening here?*) followed by a 10 s pause;

- Level 3: requesting the participant to express the semantic relation using the communication board (e.g. *Tell me with your board*) followed by a 10 s pause;

- Level 4: providing an aided model of the semantic relation, followed by a request to imitate the aided model, followed by a 10 s pause; and

- Level 5: providing physical assistance to produce the 2-symbol semantic relation using the communication board.

A correct production following any level of prompting was confirmed and reinforced by another aided model from the researcher. The complete prompting procedure and feedback provided is set out in Figure 3.3.
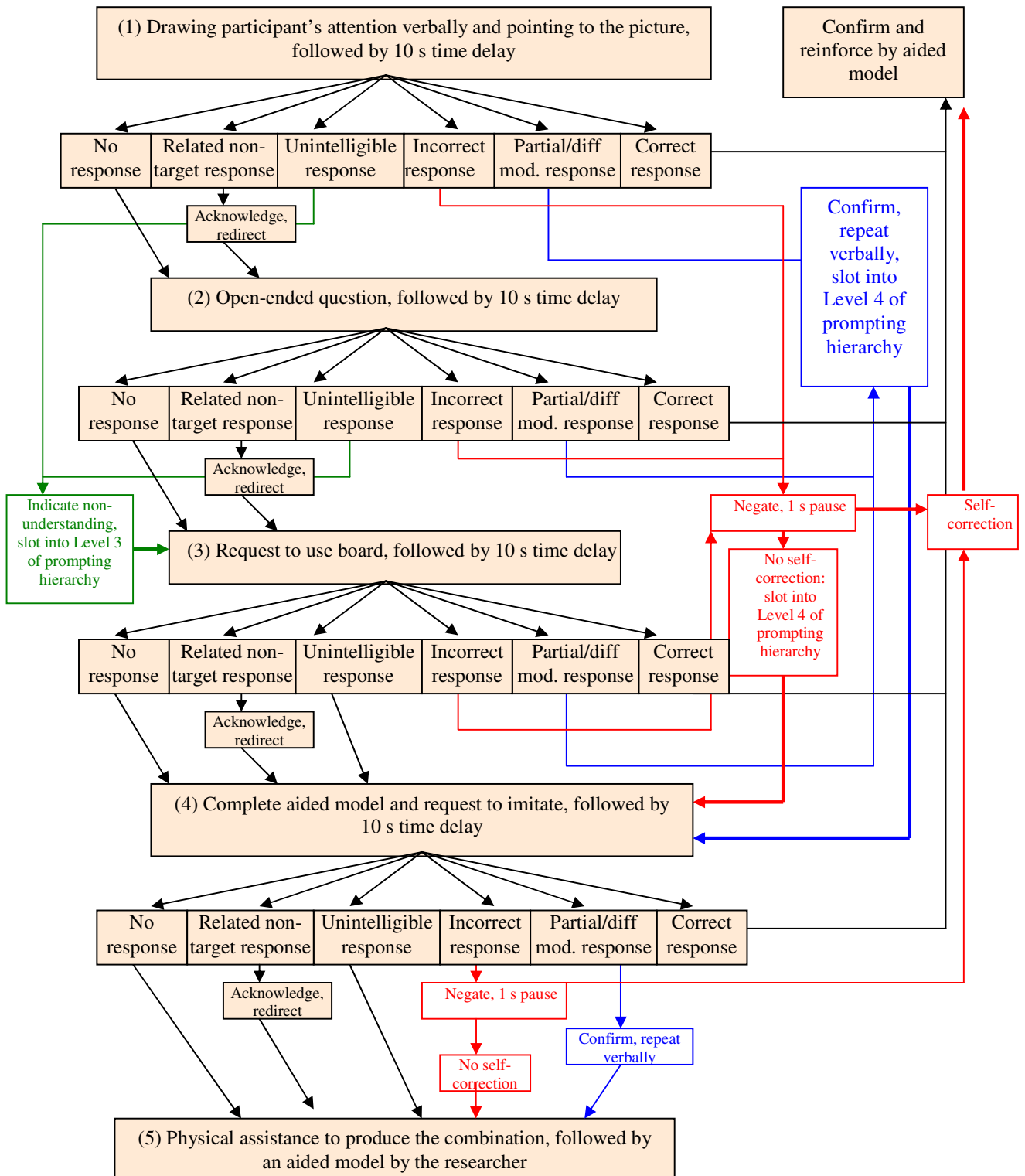
Figure 3.3. Schematic representation of prompting hierarchy employed during intervention.

A response was considered correct if the participant pointed to at least both graphic symbols (in any order) making up the target semantic relation. Any spontaneous self-corrections (corrections within 1 s) were treated like a correct response. On days during which the probe test was conducted after the intervention, the participant was encouraged (after completion of the story) to remember what he/she had learnt during the story when completing the probe test. Each shared storybook reading session lasted about 10 min.

In order to prevent participants from reacting negatively to extended repeated testing and intervention, both a teaching and a learning criterion were set. Intervention ceased on the semantic relation treated when either of the following conditions were met: once a participant's score increased by at least two correct answers (i.e. 40%) for two consecutive probes as compared to baseline average (with a minimum of three probes conducted during intervention), or after a maximum of nine teaching sessions.

3.9.5.6 Treatment boost

When participants achieved two consecutive 0% scores during intervention probes directly after treatment commenced, or when a drop in performance was seen on the intervention items during the intervention phase, a treatment boosting procedure was implemented before the following intervention probes. After the story had been read to the participant, and before the probe test was conducted, the following steps were taken:

- The participant was briefly reminded of the combinations learnt by giving him/her two aided models (e.g. *Remember what we learnt in the story. We learnt about the {GIRL girl's} {HAT hat} and the {BUNNY bunny's} {SHOE shoe}*).
- The correspondence between the probe test pictures and the story pictures was clarified, by giving two examples of corresponding pictures (e.g., while showing the probe test and story pictures, *Look, this is a bunny and this is also a bunny.*). Only single words (no word combinations) were used to clarify the correspondence.
- The participant was encouraged to remember what was learnt in the story when completing the probe test.

If participants still did not produce the appropriate combinations within the first ten items in the probe test, steps 1-3 were repeated before completing the next 10 items, and again before the last 10 items when necessary.

3.10 Data analysis

Each administration of the probe test was video recorded. Score sheets (see Appendix S) were used to transcribe the participant's response to each item on the test from the recording. The transcription was done on the same day as the recording was made. Each response was then classified as correct (i.e. containing both of the target symbols) or incorrect. Correct responses were further classified as either containing only two symbols or containing more than two symbols. Those containing two symbols were further classified as those containing the two symbols in the same order as targeted during storybook reading, or as those containing the two symbols in reverse order. The percentage of correct responses per semantic relation was calculated and depicted graphically per participant per relation. The total percentage of correct responses per phase per relation per participant was also calculated. This enabled comparisons of performance across participants as well as across types of semantic relations and the order in which the relations were presented.

The percentage of nonoverlapping data (PND) was calculated for the intervention and postintervention phases by determining the percentage of data points where the percentage of correct responses was more than the highest percentage achieved during baseline (Gast & Spriggs, 2010). The precise formula is as follows:

$$\frac{\text{No. of data points within a phase where \% correct responses is higher than highest \% achieved during baseline}}{\text{Total no. of data points for this phase}}$$

Furthermore, improvement rate difference (IRD) was calculated to determine the effect size of the treatment. According to Parker, Vannest, and Brown (2009), IRD is "the improvement rate (IR) of the treatment phase(s) minus the improvement rate of the baseline phase(s)" (p. 138). The formula for calculating IRD is thus $IR_T - IR_B = IRD$ (Parker et al., 2009, p. 138). IR for each phase is defined as the number of improved data

97

points divided by the total number of data points within that phase (Parker et al., 2009, p. 139), with the formula as follows:

$$\frac{\text{No. of improved data points}}{\text{Total no. of data points}}$$

Confidence intervals (CIs) (85%) were also established using the NCSS two proportions test module, to determine the certainty with which the effect size could be regarded as true. The CIs calculated were based on bootstrapping, as recommended by Parker et al. (2009). Bootstrapping allows estimations without needing to assume a normal distribution, but rather by simulating repeated observations from the actual data obtained.

For descriptive purposes, participants' responses to the various levels of prompting employed during shared storybook reading were captured from the video recordings of intervention sessions on a data recording sheet (see Appendix A). In order to obtain an impression of the progress participants made during shared storybook reading, all their correct responses (i.e. those containing at least both target symbols) to the first level of prompting were graphed as well.

3.10.1 Procedural integrity

In order to establish treatment integrity, Schlosser (2003a, p. 193) recommends that 20% to 40% of all sessions be rated for procedural integrity by an independent observer. Sessions rated should be equally distributed across all phases of the study. Checklists were therefore developed during the pilot study both for the procedure used during the probe test (see Appendix T), as well as for the procedure used during intervention (see Appendix U). For each participant, an independent observer viewed video recordings of one to two randomly selected probe test sessions from each of the phases of the study, these being

- baseline phase across all three semantic relations,
- intervention phase for first relation targeted (coinciding with baseline phases of the second and third relation),

- intervention phase for the second relation targeted (coinciding with postintervention phase for the first relation and baseline phase for the third relation), and

- intervention phase for third targeted relation (coinciding with postintervention phases for the first and second relation).

This amounted to a total of between 20% and 33% of all probe test sessions per participant per phase. The independent observer furthermore viewed video recordings of one to two randomly selected intervention sessions per relation for each participant, amounting to 20% to 33% of all intervention sessions. The independent observer rated the adherence to the procedural steps using the checklists. The percentage of adherence was calculated by the following formula:

$$\frac{\text{number of steps correctly executed}}{\text{total number of steps}} \quad \text{X } 100$$

3.10.2 Reliability of transcription and data collected

For each participant, an independent observer viewed video recordings of one to two randomly selected probe test sessions from each of the phases of the study, amounting to a total of between 20% and 33% of all probe test sessions, as recommended by Ayres and Gast (2010). The independent observer transcribed the participants' responses by writing down which PCS symbols the participants pointed to, using appropriate blank data collection score sheets like those used by the researcher (see Appendix S for an example). Point-by-point agreement on the transcription was calculated by the following formula:

$$\frac{\text{Number of agreements}}{\text{Number of agreements plus disagreements}} \quad \text{X } 100$$

The independent observer furthermore classified each response as correct or incorrect from the video recordings of the sessions viewed. Point-by-point agreement on the data was calculated by the following formula:

$$\frac{\text{Number of agreements}}{\text{Number of agreements plus disagreements}} \quad \text{X } 100$$

3.11 Summary

This chapter provided an overview of the methodology employed in the study. The aims and the design were stipulated. The pilot study and consequent recommendations for the main study were discussed. The participant recruitment was explained and a description of the participants was given. The equipment and materials used were described. The procedures used during the assessment and experimental stages of the main study were explained. The procedure used for the analysis of the data was briefly explained, as were the procedures used to calculate procedural integrity and reliability of the data.