CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

In this chapter the results of the study are described and discussed according to the objectives set out in Chapter 3. The frequency of correct responses per label will be presented. An analysis of errors will be presented and discussed. Finally possible influences on correct responses will be considered.

The entire body of data is presented in the form of a matrix in Appendix Q. Note that the columns present *symbol numbers* and the rows *presentation numbers*. The use of these two phrases needs to be clarified since it will be referred to throughout the discussion.

The *symbol numbers* were determined randomly by retrieving the 36 individual symbols one by one from a bag. The symbol that was retrieved first was numbered 1, the second symbol retrieved was numbered 2 etc. To simplify the test procedure, symbol labels were presented in this order, so that the label for symbol 1 was presented first, the label for symbol 2 was presented second and so forth. *Presentation numbers* therefore refer to the order in which labels were presented.

4.2 Missing data

There were three sources of errant data:

- It was mentioned in 3.5.3 that although the testing procedure was not timed, the researcher did not allow unusually slow participants to hinder the flow of the testing. No more than 40 seconds was allowed per item. In most instances the prompt 'okay…turn the page' from the research assistant induced the slower participants to select a symbol, but some turned the page without indicating a choice. Such instances were coded as 'no response'.
- In spite of the vigilance of the researcher, it happened five times that participants marked two symbols on one page in response to a single label. Such responses were likewise coded as 'no response' since they could not be used.
- The activity graphic in the top right hand corner of the communication overlay was not removed from the overlay since it does not constitute print. Although this block was not mentioned or pointed to during training, some participants marked it as a choice on some occasions. For coding purposes the activity graphic was assigned the number 50.

In eight instances participants clearly cancelled their first choice of a symbol and marked another one. The second choice was used in calculations.

From Table 18 it is clear that missing data had the greatest influence on presentation numbers 1, 3, 14 and 17. Since only symbols that were indicated by nineteen or more participants are discussed in this paper, the influence of the missing data was deemed negligible.

Table 18: Missing data

Presentation Number	1	2	3	13	14	17	20	21	22	26	28	30	Tot
Frequency of 50	0	0	0	0	2	5	0	1	0	0	0	1	9
Frequency of no response	3	1	3	1	1	0	1	0	1	1	1	0	13
Percentage out of 94 (number of participants)	3,2	1,0	3,2	1,0	3,2	5,3	1,0	1,0	1,0	1,0	1,0	1,0	-
Percentage out of 3384 (participants x symbols)	0,09	0,03	0,09	0,03	0,09	0,14	0,03	0,03	0,03	0,03	0,03	0,03	0,65

4.3 Correct responses

Doherty et al. (1985) mention two types of transparency scores: subject scores, where each participant's accuracy in guessing the meaning of symbols is computed; and iconicity values, where the number of participants that responded correctly to each item is counted to represent each symbol's guessability. Iconicity values were the focus of this study, and are presented in Figure 3.

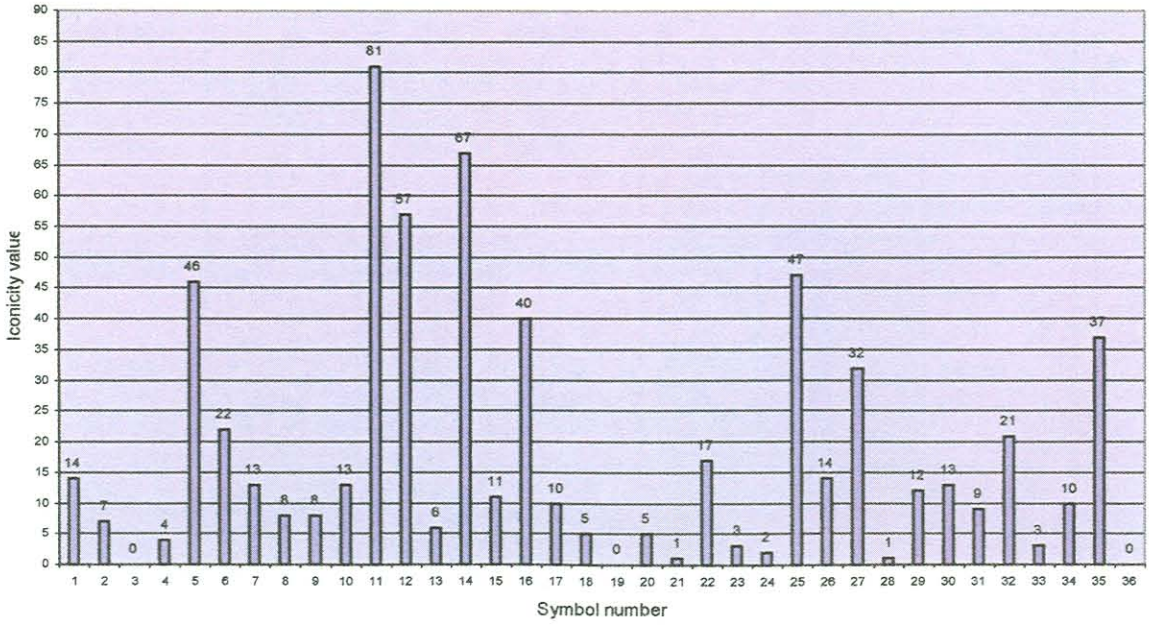
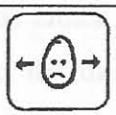
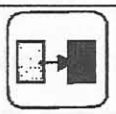
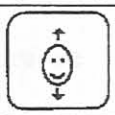
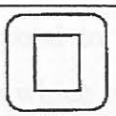
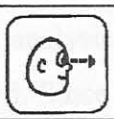
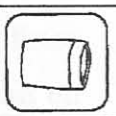
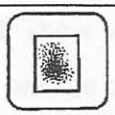


Figure 3: Correct responses per label

Table 19 visually presents the presentation order of labels and frequent reference to this table throughout the discussion will aid interpretation.

Table 19: Presentation order of the labels

Pres Nr	Label in English	Target symbol	Pres Nr	Label in English	Target symbol	Pres Nr	Label in English	Target symbol
1	What is next?		13	It is finished.		25	Puff it up.	
2	It is nice and soft.		14	Let us make the bed.		26	What a mess!	
3	No.		15	Thank you.		27	It looks like a bomb went off.	
4	You need to change them.		16	...the blanket.		28	Let us do it again.	
5	Whoops!		17	Let us put on...		29	Yes.	
6	We forgot.		18	...the sheets.		30	Put it here.	
7	What do you think?		19	Where is it?		31	You are welcome.	
8	It is nice and clean.		20	Look at this.		32	...the pillow case.	
9	Let us take it off.		21	Tuck it in.		33	Let me...	
10	It is crooked.		22	It is dirty.		34	It looks bad.	
11	You need to pull.		23	Fold it back.		35	Hold this, please.	
12	Put it in the tub.		24	Help me, please.		36	It looks good.	

(Pres Nr = Presentation number)

Doherty et al. (1985) used strict (iconicity values ≥ 75%) and lenient (iconicity values ≥ 50%) criteria for interpreting the transparency scores of Amer-Ind gestures. Although the present study did not investigate pure transparency, these criteria were nevertheless deemed useful.

lues. Accordingly, one symbol (symbol 11 []) was found to be iconic when the strict criterion was applied, and four symbols (symbols 11; 12 []; 14 []; and 25 []) when the lenient criterion was applied. Note that symbol 5 [] achieved an iconicity value of 49% (n=46) and was one vote short of being classified as iconic according to the lenient criterion. When the very liberal criterion (iconicity values ≥ 25%) of Hoemann (1975) was applied, eight symbols emerged as iconic (symbols 5; 11; 12; 14; 16 []; 25; 27 []; and 35 []). Thus either 2,8% or 11,1% or 22,2% of the symbols on the communication overlay were iconic for the participants involved, depending on the criterion used. The average of correct responses across all symbols was 17,75 (18,88%) with a standard deviation of 20,17. Table 20 shows a ranking of symbols according to their iconicity values. It is clear that this collection of symbols was largely non-iconic for the participants involved. Error responses might shed valuable light on how symbols are viewed, and will therefore be examined closely in the following section.

4.4 Analysis of errors

All responses are presented in the form of a matrix and visually in the form of a graph in Appendix Q. From this it is clear that error patterns can be examined from two viewpoints. The columns correspond to the 36 symbols, so that analysis per column will reveal those labels in response to which each symbol was indicated. Since such an analysis will focus on how participants viewed each symbol, symbol variables such as complexity and iconicity (Fuller & Lloyd, 1991; Fuller, 1997) will have to be investigated. Conversely, the rows correspond to the 36 labels, and analysis per row will show which symbols were chosen in response to each label. The focus of such an analysis will be on how participants interpreted each label, and referent variables (Luftig, 1983; Fuller & Lloyd, 1991; Fuller, 1997) such as concreteness vs abstractness and frequency of occurrence of the label will need to be considered. Since this study is concerned with the iconicity of symbols, the analysis of error patterns was done per column. However, a summary of analysis per row is presented in Appendix R.

Table 20: Ranking of symbols in intervals of percentage correct responses

Interval	Symbols and English phrases				
50% and over	You need to pull (n=81) 	Let us make the bed (n=67) 	Put it in the tub (n=57) 	Puff it up (n=47) 	
40% - 49%	Whoops! (n=46) 		...the blanket (n=40) 		
30% - 39%	Hold this, please (n=37) 		It looks like a bomb went off (n=32) 		
20% - 29%	We forgot (n=22) 		...the pillow case (n=21) 		
10% - 19%	It is dirty (n=17) 	What is next? (n=14) 	What a mess! (n=14) 	What do you think? (n=13) 	It is crooked (n=13) 
	Put it here (n=13) 	Yes (n=12) 	Thank you (n=11) 	Let us put on... (n=10) 	It looks bad (n=10) 
0% - 9%	You are welcome (n=9) 	It is nice and clean (n=8) 	Let us take it off (n=8) 	It is nice and soft (n=7) 	
	It is finished (n=6) 	...the sheets (n=5) 	Look at this (n-5) 	You need to change them (n=4) 	
	Fold it back (n=3) 	Let me... (n=3) 	Help me, please (n=2) 	Tuck it in (n=1) 	
	Let us do it again (n=1) 	No (n=0) 	Where is it? (n=0) 	It looks good (n=0) 	

4.4.1 Analysis per column

When the highest frequency responses were studied for each symbol, it became clear that for some symbols a considerable number of the participants agreed on a single specific label, be it the target label or a non-target label. For other symbols either many possible labels, or none were indicated. The term 'distinctiveness' was coined to describe how well-defined or specific the evoked meanings were that a symbol triggered in the mind of a viewer. This term should not be confused with 'perceptual distinctness' as described by Fuller, Lloyd & Stratton (1997). According to them perceptual distinctness refers to the degree to which the symbols in a group are clearly different or distinct from one another.

It is also important to note that 'distinctiveness' was not intended as an equivalent to 'iconicity'. Whereas both terms concern the visual relationship between a symbol and its referent, they indicate different aspects of that relationship. Iconicity pertains to the degree of visual similarity perceived, as demonstrated by the use of the three dimensions transparency, translucency and opaqueness (Fuller & Lloyd, 1991; Blischak et al., 1997). The term distinctiveness as used in this study, relates to the specificity of visual similarity perceived – whether participants perceive similarity to one referent, or to many or none.

Iconicity is measured by determining the frequency correct responses on a stimulus, which means that symbols can be described as 'more' iconic or 'less' iconic. It is clear that iconicity can be described as a continuum. Distinctiveness, as used in this study, is measured by investigating the distribution of all responses on a stimulus. Only the strongest responses are considered, so that a symbol can either be distinctive (evokes one meaning above criterion) or indistinctive (evokes more than one meaning or none above criterion). Due to the exploratory nature of the present study, the criterion used was arbitrarily selected. The subsequent classification of symbols allowed for no degrees of distinctiveness between the points of 'distinctive' and 'indistinctive'. This treatment of the variable does not exclude the possibility that it should by right also be placed on a continuum where symbols can be described as 'more' distinctive and 'less' distinctive. Such classification would be necessary if not only the pattern of distribution of responses are considered as in the present study, but also the strength or intensity of responses.

Since iconicity and distinctiveness are not opposing terms, a symbol can simultaneously be low in iconicity and distinct, as when few participants guess a symbol in response to the target label, but many of them choose it in response to a non-target label. A symbol can also be high in iconicity but indistinct, as when many participants choose a symbol in response to the intended label, but also in response to one or more other labels. Similarly a symbol can be classified as low in iconicity and indistinct, and high in iconicity and distinct.

The symbols from the present study were distributed across the four orthogonal groups: distinctive x more iconic; distinctive x less iconic; indistinctive x more iconic; and indistinctive x less iconic. To determine iconicity and distinctiveness two criteria were used. Regarding the iconicity of a symbol, the criterion suggested by Hoemann (1975) was used (iconicity values ≥ 25%). Admittedly this criterion is very lenient (Lloyd et al., 1985), but since this analysis was concerned with relative rather than absolute iconicity, it was considered appropriate. To describe distinctiveness, all response frequencies ≥ 20% were

investigated. Note that this cut-off point was arbitrarily selected and not statistically determined.

The distribution of the symbols from the present study across these four orthogonal classifications is presented in

Table 21.

Table 21: Distribution of symbols according to iconicity and distinctiveness

	More iconic (iconicity values ≥ 25%)	**Less iconic** (iconicity values < 25%)
Distinctive (only one response over 20%)	5; 12; 16; 25; 27; 35	4; 7; 13; 15; 20; 26; 28; 31
Indistinctive (More than one response over 20%, or no responses over 20%)	11; 14	6; 18; 32; 33; 1; 2; 3; 8; 9; 10; 17; 19; 21; 22; 23; 24; 29; 30; 34; 36

A discussion of symbols according to this classification follows.

4.4.1.1 Distinctive x more iconic

Symbols 5 []; 12 []; 16 []; 25 []; 27 []; 35 [] fell under this classification. This is no surprise since each of these symbols was indicated as iconic in the previous analysis. This analysis reveals that participants perceived a relatively strong visual relationship between these symbols and their target referents, and to those referents alone.

4.4.1.2 Indistinctive x more iconic

Two symbols were classified as indistinctive x more iconic, namely symbols 11 [] and 14 []. These symbols were indicated as the two most iconic symbols in the previous analysis. It is evident however that participants perceived visual similarities between these symbols and not only their target referents, but also other referents.

Symbol 14 (iconicity value=67) was chosen the most in total (n=214) and 15 participants selected it more than three times during the procedure (see Figure 4). The 147 error responses were distributed across 22 of the 35 non-target phrases, with the highest frequencies in response to the labels 'It is nice and soft' (n=28); 'Let us put on…' (n=25) and 'You need to change them' (n=19). It is clear that symbol 14 was highly indistinctive to participants.

A discussion of the perceptual features of the symbol and conceptual features of its label (Bloomberg et al., 1990) may shed some light on this observation. Perceptually symbol 14 depicts a human figure in front of a bed, with motion implied by postural cues in the figure

such as three bent limbs and a tilted head. These perceptual features should be easily identified. According to Friedman and Stevenson (1975) ten-year-old children interpret postural cues (where the posture of the figure deviates from the still position) efficiently as implying two-dimensional motion. Moreover, stick figures like the one in the symbol are generally well understood (Martlew & Connolly, 1996). The fact that this symbol is classified as iconic confirms that these features were easily recognised. From previous experience participants had adequate knowledge of this situation to link the perceptual information to the concept of making a bed.

The question remains why participants selected symbol 14 so often in response to other labels as well. This might possibly be explained by the fact that the conceptual features of the label 'Let us make the bed' were exceptionally close to the theme of the overlay. Pit is possible that underlying conceptual similarities existed between this label and the labels of some of the other symbols. All the non-target labels that were frequently associated with this symbol directly concern the action of making a bed and therefore support the notion of underlying conceptual similarities. It is postulated that the indistinctiveness of symbol 14 can be ascribed to the context in which it was presented, and that had this symbol been presented in a group of unrelated foils like in most other iconicity studies, it probably would have scored higher on distinctiveness.

The perceptual features of symbol 11 (iconicity value=81) include a human figure in implied motion and an object linked to the figure by rope. Two non-target labels were associated with this symbol by more than 20% of participants respectively: 'Let us take it off' (n=36) and 'What is next?' (n=21). The conceptual features of the label 'You need to pull' include a person, an object and movement in the direction of the person. The same can be said of the label 'Let us take it off', and therefore the confusion of the two labels for symbol 11 seems reasonable. The label 'What is next?' implies movement of a more abstract kind: from the present to the future. The target symbol for this phrase, symbol 1 [] indicates this movement with an arrow. The fact that symbol 11, where postural cues indicate movement, was preferred to symbol 1, suggests the possibility that participants did not make optimal use of the arrow as presenting information about movement.

It could be mentioned here that seemingly the question mark in symbol 1 was also not optimised by participants. Three of the symbols in the collection contained question marks: symbol 1, symbol 7 [] and symbol 19 []. It is postulated that if participants recognised and optimally utilised the question mark, they would have associated one these

symbols with the label 'What comes next?' since it is a question. Yet they most often associated a symbol that has no question mark (symbol 11). Unfamiliarity with punctuation marks was ruled out as a cause for this since participants had four to five years of schooling prior to testing.

4.4.1.3 Distinctive x less iconic

Table 22 is a summary of the symbols that fell under this classification.

Table 22: Symbols classified as distinctive x less iconic

Symbol number	Label	Symbol	Most frequent error label	Frequency
4	You need to change them.		What a mess!	19
7	What do you think?		Look at this.	29
13	It is finished.		No.	30
15	Thank you.		We forgot.	27
20	Look at this.		What do you think?	22
26	What a mess!		It is dirty.	19
28	Let us do it again.		It is crooked.	36
31	You are welcome.		It is finished.	39

For most symbols the frequently associated non-target labels can be motivated. Symbol 4 [] intends to depict a change of colour, but might also be interpreted as a change from clean to dirty, possibly accounting for the confusion with the label 'What a mess!'. If this explanation is accepted, it seems that participants did interpret the arrow in this symbol as indicating change.

Participants seem once again not to have made optimal use of the question mark in symbol 7 [], since they associated it with a label that was not a question. This appears to confirm the observations made in 4.4.1.2. The association of this symbol with the label 'Look at this' can possibly be clarified by assuming that the pointing finger in symbol 7 had been interpreted as indicating where to look. It is interesting to note that the direction of the two actions differ. The phrase 'What do you think?' implies observation in the external world leading to contemplation in the mind, so that the action is from external to internal (as symbol 7 indeed points out). Conversely the phrase 'Look at this' refers to the intention to look at

something whereupon gaze is directed in the external world, an action from internal to external, as seen in symbol 20 []. The fact that 'Look at this' was associated with symbol 7 might indicate that participants did not adequately utilise the directional quality of the pointing finger and the arrow in the symbols.

In this regard it is interesting to note that symbol 20 was associated in turn with the label 'What do you think?'. This can possibly be explained by examining language differences. The isiZulu phrase 'Ubona kanjani?' is the equivalent of 'What do you think?' but if translated literally means 'How do you see it?' (see Appendix H). Note that in this case the difference in direction of actions involved is imbedded in the fact that two languages are used. The English phrase 'What do you think?' suggests an external to internal action as discussed above, while the equivalent isiZulu phrase 'How do you see it?' implies an internal to external action. Thus the fact that participants selected symbol 20 [] in response to the label 'What do you think' is not surprising. It appears that they did in fact interpret the perceptual properties of symbol 20 as depicting the action of looking or seeing, but linked it to a non-target phrase that were to them conceptually close to the symbol.

To viewers that are unfamiliar with American Sign Language (ASL), symbols 13 []; 15 [] and 31 [] might be difficult to understand. The top hand in symbol 13 might be interpreted as showing the viewer a flat palm with fingers nearly pointing upward. This sign is typically interpreted as 'stop' or 'enough', and in the absence of these labels the closest alternative might have been 'No'.

Symbol 15 shows two hands on the chin of a face. The label 'We forgot' was associated with this symbol, possibly because people who are shocked or surprised sometimes put their hands over their mouths. If this interpretation is accepted, participants once again did not use information afforded by the arrows pointing outwards. Two arguments can be put forward. Either participants did not regard the arrows as showing movement, or they did not optimise the directional information afforded by it. They might have interpreted it as showing that the hands move towards the chin, confirming the observations made in 4.4.1.2.

Symbol 31 depicts two hands with empty palms turned upwards. If the hands were motionless in that position, it could be interpreted as showing that the hands are empty, possibly explaining why the label 'It is finished' was associated. The arrows however imply movement away from the face, a clue that was presumably not optimised by participants.

Symbol 26 [] was associated with the label 'It is dirty', seemingly due to corresponding conceptual features of this label and the target label 'What a mess!'.

Symbol 28 [] was associated with the label 'It is crooked'. This observation can be interpreted as meaning that the directional quality of the two arrows was not optimally utilised. The arrows were rather seen as two lines that are not straight. This once again confirms the hypothesis that participants did not make optimal use of the direction indicators or arrows in the symbols.

4.4.1.4 Indistinctive x Less iconic

This classification included two conditions: symbols with iconicity values < 25% and more than one error response ≥ 20%; as well as symbols that had no responses ≥ 20%.

Symbols from the first condition are presented in Table 23. Note that correct responses are not included in the discusssion that follows.

Table 23: Symbols classified as indistinctive x less iconic

Symbol number	Label	Symbol	Iconicity value	Frequent error label	Frequency of frequent error
6	We forgot.		22	Let me...	20
18	...the sheets.		5	It is nice and soft.	20
				Let us make the bed.	24
32	...the pillow case.		21	...the sheets.	21
33	Let me.		3	Thank you.	32
				Let us fold it back.	22

Symbol 6 [] was indicated 20 times in response to 'Let me…' whereas the target symbol for that label, symbol 33 [] was indicated only three times. It is possible that participants interpreted the thumb in symbol 33 as pointing to the back of the figure and not to him, whereas the hands in symbol 6 clearly touch the figure.

This hypothesis is supported when the error responses for symbol 33 are considered. It was selected 22 times in response to 'Let us fold it back', indicating that participants did indeed interpret the thumb as pointing to the back of the figure. Symbol 33 was also selected often in response to 'Thank you'. The reason for this is unclear. In the light of what has already been said about the direction of indicators (see 4.4.1.2 and 4.4.1.3), the likelihood exists that

participants interpreted the thumb as pointing upwards. This 'thumbs up' sign is used commonly among Zulus, often accompanied by the exclamation 'Sharp!', to indicate satisfaction. In the absence of that label, 'Thank you' may have been the closest alternative.

The labels with which symbol 18 [] was associated most often ('It is nice and soft' and 'Let us make the bed') need little explanation. A bed is typically soft, and beds need to be made. Symbol 14 [] drew 67 of the responses when the label 'Let us make the bed' was presented, and symbol 18 drew 24. The activity graphic (symbol 50 []) drew two responses and one response was missing. Thus all responses to this label were concentrated on the three symbols on the overlay that depicted beds. Symbol 14 proved more illustrative of this label than the other two. This might be due to the fact that symbol 14 included a human figure in implied motion (as discussed in 4.4.1.2). The referent 'Let us make the bed' falls under the verb category and participants might have reasoned that the symbol showing action is the most appropriate match for the label. It appears then that participants used the information about movement offered by postural cues optimally. It can also be argued that symbol 14 was selected more often because it offered the most information: it contained a figure and some 'sheets' as well as a pillow on the bed, whereas symbol 18 showed only a bed and a pillow.

Symbol 32 [] was as often indicated in response to the label '… the pillow case' as to the label '…the sheets'. It is possible that participants interpreted this symbol as resembling a pillowcase and sheets equally well. Alternatively, the following argument can be made. Participants perceived symbol 18 [] as fairly non-iconic (n=5), so that the overlay lacked a symbol that showed strong visual similarities to the referent 'sheets'. Participants were in essence forced to choose a symbol on grounds other than visual similarity. They could have argued that symbol 32 clearly depicted a pillow case, that '…pillow case' belonged to the same semantic category as '…the sheets' (namely bed linen), consequently symbol 32 would be the best possible choice. This argument is strengthened when it is noted that symbol 16 [] (which also belongs to the category of bed linen) was chosen 18 times in response to '…the sheets'. These observations illustrate again how the fact that all alternatives were related to each other, influenced the performance of participants.

Symbols 1 []; 2 []; 3 []; 8 []; 9 []; 10 []; 17 []; 19 []; 21 []; 22 []; 23 []; 24 []; 29 []; 30 []; 34 []; 36 [] showed low iconicity and no other peak responses. It seems that participants perceived no strong visual relationship between these symbols and any of the labels. In an attempt to understand these responses, symbols were grouped according to unifying factors and these groups will be discussed.

It was hypothesised that symbols 2; 8 and 22 offered too little information to allow participants to make a judgement. Interestingly all three referents are adjectival phrases with the purpose of describing an attribute of an unknown noun. Bloomberg et al. (1990) found adjectival modifiers to be generally less translucent than nouns across five graphic symbol systems, of which PCS was one. They argue that modifiers depict a specific attribute of a noun, and that in order to interpret such symbols correctly one must know which attribute to focus on lest the whole noun is taken as the referent. It is likely that symbols 2, 8 and 22 were expressly designed not to include recognisable objects in order to draw attention to the attribute that is to be described. For example, it is unclear whether symbol 2 [] represents a piece of cotton wool, a piece of dough or a cloud. Yet all these objects share the quality of softness, which is what symbol 2 intends to represent. Thus the object is unspecific or generic so that the viewer will not focus on the whole object, but on the attribute that is to be described. Likewise the rectangles in symbols 8 [] and 22 [] do not correspond well to any one object and can as a result represent any object. It is hypothesised however that these attempts at using generic objects, instead of guiding participants to focus on the relevant attribute namely softness, cleanness or dirtiness, decreased the informational value of the symbol to the extent that no meaning could be made of it. A wide variety of labels were infrequently associated with these symbols, supporting the notion that participants did not assign meaning to these symbols but rather selected them haphazardly.

Symbol 34 [] is an adjectival modifier that does show a very specific object, namely a face. Unlike most adjectival modifiers, it is not a specific attribute of the face that should be focused on to arrive at the referent. The referent is not, for example, 'It is closed' in which case the closed eyes would be the specific attribute. Rather, the face shows how one could react to the referent ('It looks bad'). This reaction would vary between cultures and between situations within cultures, which possibly accounts for the erratic way in which this symbol

was selected. It is possible that the participants in this study felt inhibited because of the protruding tongue. Zulu children are generally taught that it is rude to stick out one's tongue.

Cultural differences can probably also account for the infrequent selection of symbol 36 []. This sign is not used by Zulu people, so that even if they recognised that the symbol contained a hand held in a certain way, they were not able to link these perceptual features to the concept of 'good'.

Symbol 10 [] is an adjectival phrase that uses an arrow to point to the specific attribute to be focused on. Despite this clue participants still could not guess the target meaning of the symbol. This is once again offered in support of the possibility that participants did not make optimum use of the indicators in symbols.

This notion is further supported by symbols 1 []; 3 []; 9 []; 19 []; 21 []; 23 [] and 29 []. All of these symbols contain arrows. It is possible that the presence of arrows is not related to the low iconicity and indistinctiveness of these symbols. If however the evidence collected thus far is considered as a whole, it seems that the arrows could have been a cause of the low iconicity and indistinctiveness. For example, none of the symbols indicated as iconic contained arrows, and only five symbols containing arrows did not fall in the present classification. These are symbols 4 []; 13 []; 15 []; 20 [] and 31 []. It has already been shown that the arrows in symbols 13; 15; 20 and 31 were not interpreted optimally. The information yielded by the arrow in symbol 4 was used optimally (see 4.4.1.3). It seems then that participants failed to optimally extract meaning from the arrows contained in all symbols except one.

Symbols 17 []; 24 [] and 30 [] evidently did not evoke strong meaning for participants. The reason for this is not clear.

4.5 Possible influences on results

Three factors were investigated for possibly influencing the results, namely the total frequency of selection of symbols; the position of symbols on the communication overlay, which include a qualitative analysis of word classes; and the gender of participants.

4.5.1 Total frequency of selection of symbols

The methodology required only one choice per page, to ensure that all 36 symbols were available every time a participant had to make a choice. Consequently the possibility existed for a single symbol to be indicated in response either to more than one label, or to none. A frequency procedure showing how often each participant chose each symbol was performed on the data. This revealed that participants selecting certain symbols twice or thrice was common, and that in one case a symbol was selected up to nine times by one participant. Table 24 shows the distribution of such recurrences and Figure 4 presents it graphically.

Table 24: Distribution of recurrences

Symbol number	5	6	7	11	12	13	14	15	16	17	20	22	26	31
9 times	-	-	-	-	-	-	-	-	-	-	-	-	-	1
6 times	-	-	-	-	-	-	1	-	-	-	-	-	-	1
5 times	-	1	2	-	-	1	2	-	-	-	-	1	1	1
4 times	1	3	1	1	2	4	12	2	1	3	1	-	-	8

It was hypothesised that the more a symbol was selected, the higher the frequency of correct responses would be. To test this, the total frequency of selection per symbol (Figure 5) and the frequency of correct responses per symbol (Figure 6) were plotted on the same chart and compared (Figure 7).

It is evident that there is no relationship between the two sets of data to support the hypothesis. It can be concluded that the frequency of correct responses is not a function of total frequency of selection of symbols. Total frequency of selection may however reveal valuable insight into how certain symbols are viewed, as discussed in earlier sections.

4.5.2 Position of symbols on communication overlay

The possibility exists that participants were influenced in their choosing of symbols by factors such as placement on the periphery or in the centre of the overlay. It was hypothesised that symbols on the periphery could draw more attention because of less competing stimuli surrounding them. Conversely it could be supposed that the four symbols in the centre of the overlay would draw more attention because viewers focus there first. A further possibility would be for participants to concentrate on the symbols in the top left quadrant of the overlay. Fonseca and Lassey (1964, in Duncan et al., 1973) found that literate individuals preferred the top left quadrant of a page.

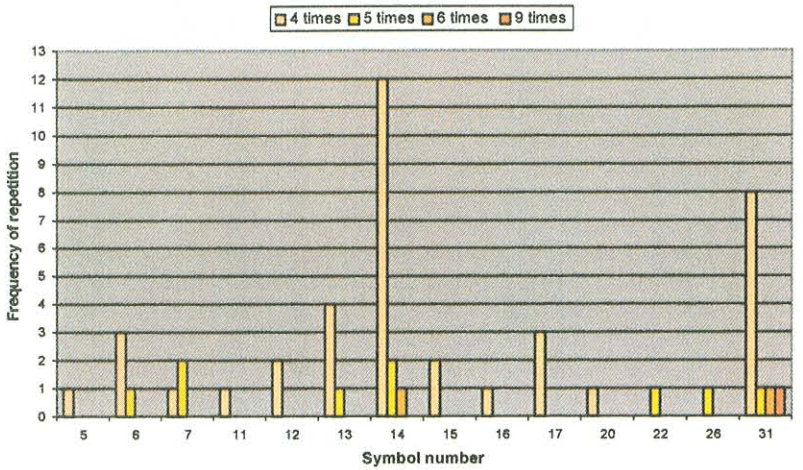


Figure 4: Distribution of recurrences

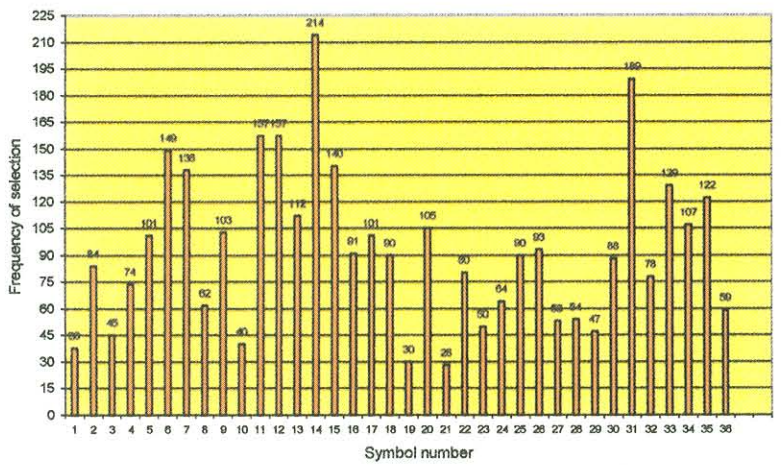


Figure 5: Total frequency of selection of symbols

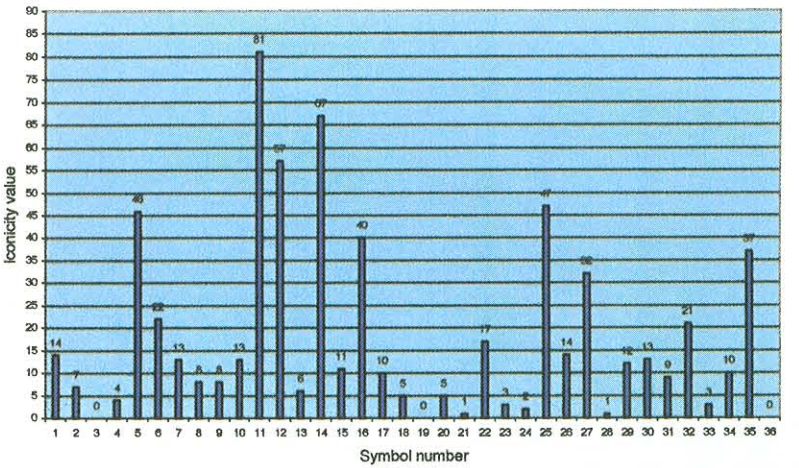


Figure 6: Correct responses per symbol

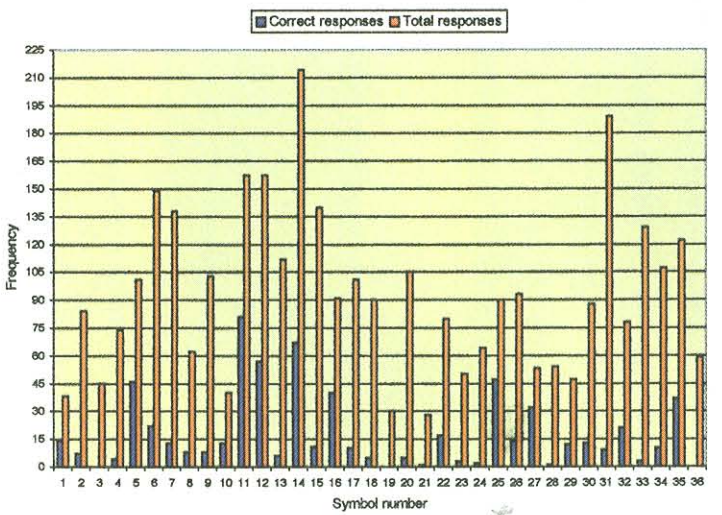


Figure 7: Correct responses and total frequency of selection

A qualitative analysis was performed in order to reveal possible patterns. The analysis entailed shading the blocks of a matrix-36 with differing intensities to indicate higher and lower frequencies of selection as a function of position on the overlay. This was done once for the total frequency of selection (see Figure 9) and once for frequency of correct responses (see Figure 10). Darker cells indicate the position of a higher frequency and lighter cells indicate the position of a lower frequency. The key gives specific frequency information. Figure 8 serves as a general summary of the placement of symbols, total frequency of selection and frequency of correct responses per symbol. It is intended as a quick reference for the interpretation of Figure 9 and Figure 10.

This presentation reveals that symbols placed on the periphery, the centre and the top left quadrant of the overlay were neither selected more often in total nor more often in response to the correct label. It seems that physical placement did not influence selection.

Another factor related to position could have influenced the choices of participants. To facilitate efficiency, the symbols on various communication overlays are consistently grouped according to grammatical categories namely Social (S) (pronouns, Wh-words, exclamation words and negative words), Verbs (V), Descriptors (D) (adjectives and adverbs), Prepositions (P) and Nouns (N) (Goossens' et al., 1992). The key concept of each sentence/phrase on the overlay serves as a basis for dividing the symbols into these categories. Symbols belonging to the same category are placed together so that they can be colour coded for easy access. Each overlay is therefore roughly divided into five columns, with all Social symbols placed to the very left of the overlay, followed by Verbs, Descriptors, Prepositions, and Nouns to the very right of the overlay. The letters next to the symbols in Figure 8, as well as dividing borders in Figure 9 and Figure 10, indicate these categories.

Previous studies investigating the comparative iconicity of grammatical categories showed that modifiers are the least iconic word class. Results regarding verbs and nouns are inconclusive. Luftig et al. (1983) found verbs significantly more translucent than nouns, while Mizuko (1987) found that for PCS nouns and verbs had very similar transparency values, with nouns achieving slightly higher scores. Bloomberg et al. (1990) found that nouns were more translucent than verbs across five graphic symbol systems, including PCS. Since word classes were arranged topographically, information about iconicity as a function of position on the overlay would simultaneously yield information about iconicity as a function of grammatical category.

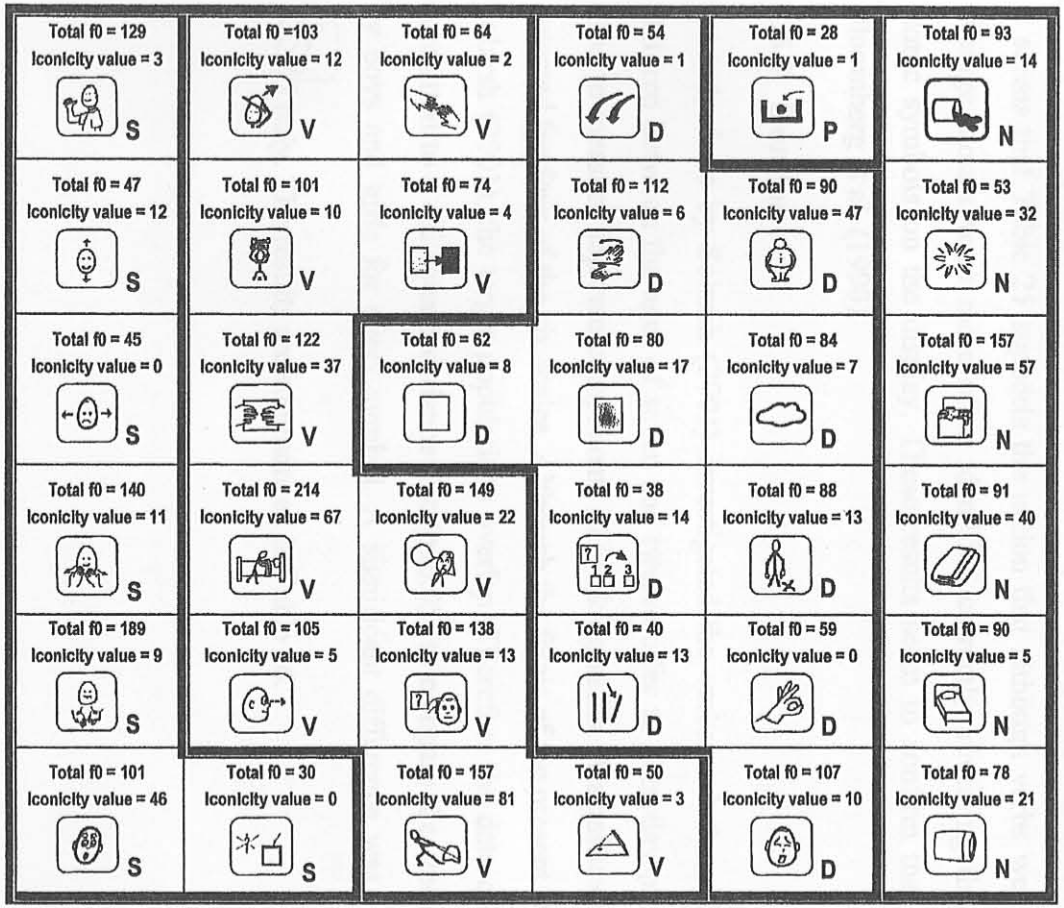


Figure 8: Total frequency of selection and iconicity value of each symbol as positioned on overlay

Key:

S = Social words
V = Verbs
D = Descriptors
P = Prepositions
N = Nouns
f0 = frequency

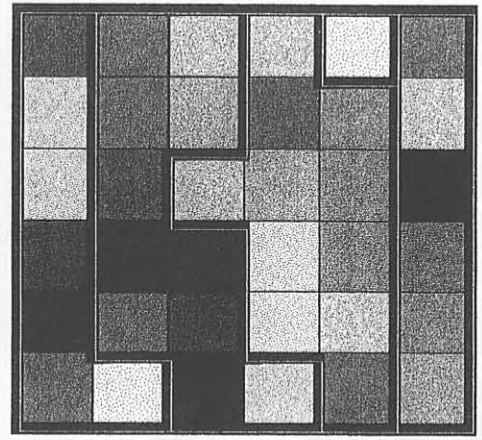


Figure 9: Total frequency of selection

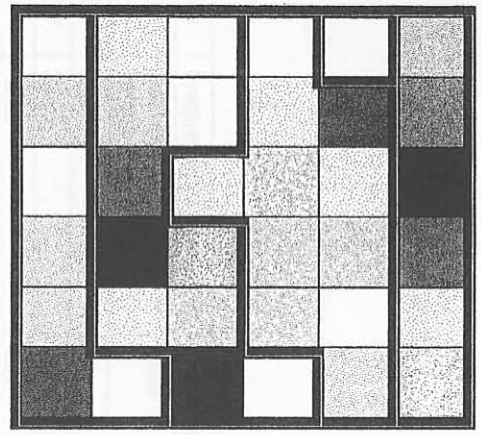


Figure 10: Frequency of correct responses (iconicity values)

Key:

A		B
11-20		0-4
21-30		5-8
31-40		9-12
41-50		13-16
51-60		17-20
61-70		21-24
71-80		25-28
81-90		29-32
91-100		33-36
101-110		37-40
111-120		41-44
121-130		45-48
131-140		49-52
141-150		53-56
151-160		57-60
161-170		61-64
171-180		65-68
181-190		69-72
191-200		73-76
201-210		77-80
211-220		81-84

- A= Total frequency of selection
- B= Frequency of correct responses (iconicity values).

When grammatical categories from this study are investigated (see Figure 10) it appears that as a group, nouns were correctly indicated more often than other categories. Admittedly the two symbols with the highest iconicity values (symbols 11 [] and 14 []) were verbs, but the remainder of the verb category shows lower iconicity values than the nouns. Verbs however, were chosen more often in total (see Figure 9). Although not tested statistically, it seems then that nouns were the most iconic.

These subjective findings were formalised and are presented in Table 25.

Table 25: Summary of total frequency of selection and iconicity values across word classes

Grammatical category	Total frequency of selection		Frequency of correct responses (iconicity values)	
	Average (total/no of symbols in category)	*Total*	*Average (total/no of symbols in category)*	*Total*
Social (7 symbols)	97,28	681	11,57	81
Verbs (11 symbols)	116,09	1277	22,90	252
Descriptors (11 symbols)	74	814	12,36	136
Prepositions (1 symbol)	28	28	1	1
Nouns (6 symbols)	93,66	562	28,16	169

It seems that Table 25 supports the notion that although verbs were chosen most often on average, nouns were more often identified correctly, revealing that nouns were the most iconic symbols on the display. These results seem to confirm that of Mizuko (1987) and Bloomberg et al. (1990).

4.5.3 Gender

A study done by Solarsh (2001) investigated the verbal solutions that rural Zulu-speaking children between the ages of seven and twelve offer to everyday problems. Six scales were used to measure separate components of thinking skills. A significant gender difference was detected for four of the six scales. Although the focus of the present study differs from that of Solarsh (2001), the target populations overlap. Therefore the data of the present study were submitted to a chi square variance test ($p \leq 0.05$) to compare the amount of correct responses by boys and girls for every symbol. A significant difference was revealed for Symbol 11 [] only. The results are summarised in Table 26.

Table 26: Gender differences

Gender	Amount of participants	Correct responses	p
Female	52	50	
Male	42	31	
			0,0018

It seems that gender did not influence performance on this task. These results agree with the findings of Duncan et al. (1973). They investigated several aspects of pictorial perception across different cultural groups and different levels of urbanisation. The Rural Zulu group performed poorly on all measures. The researchers found gender differences in the performance of the Rural Tsonga, Urban Tsonga and Urban Zulu groups, but not for the Rural Zulu group. They hypothesised that in both Tsonga groups and the Urban Zulu group boys performed better than girls since it was more common for boys to attend school than for girls. Very few children from the Rural Zulu group attended school, so that both genders were minimally exposed to Western pictorial conventions and both genders performed poorly. The present study was performed in an area approximately 100 km from the area of the Duncan et al. (1973) study, but thirty years later. Today children from both genders do commonly attend school so that they generally have equal opportunities for exposure to pictures and symbols. This might explain the absence of gender differences in the present study.

4.6 Summary

In this chapter the findings of the study are presented and discussed. The results reveal that the 36 PCS symbols concerned are between 2,8% and 22,2% iconic for the participants involved. It is proposed that the unique nature of the task resulted in symbols influencing each other, and therefore error responses were discussed alongside correct responses. Symbols are described according to iconicity as well as distinctiveness and possible reasons for the classification of each symbol are discussed. It has been determined that factors including the total frequency of selection of symbols, the position of symbols on the communication overlay and the gender of participants did not influence performance on the task. It is noted that symbols classified as nouns were as a group the most iconic.