YOUNG ADULTS' ASSOCIATIONS WITH MINSPEAK™ ICONS

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Inspired by and dedicated to

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ABSTRACT

Although the Minspeak™ approach is used on communication devices worldwide, little research has been conducted on its applicability within specific cultural contexts. The impact that users' familiarity of symbols and associations can have on learnability necessitates more systematic research on these issues.

This study was an investigation into the associations South African young adults made with selected Minspeak™ icons, used in Unity™ software. Associations were elicited from 480 able-bodied tertiary education students, using a cueing questionnaire. Words describing the associations were compared with the current Unity™ vocabulary to make preliminary suggestions as to the appropriateness of these icons and their associated meanings.

The results indicated that some of the icons and their encoded vocabulary items might be used successfully in the South African context, while others need to be adapted to be locally relevant. The results emphasised that iconic encoding systems based on commercially available graphic representational systems cannot merely be imported to South Africa due to the multicultural and multilingual nature of the context. Finally, a critical evaluation is done and recommendations for further studies are made.

KEY WORDS:

augmentative and alternative communication, iconic encoding, rate enhancement, associations, Minspeak™, Unity™, icons, vocabulary, rate enhancement

OPSOMMING

Die Minspeak™ benadering word wêreldwyd gebruik, maar daar bestaan min navorsing oor die toepaslikheid van hierdie benadering binne spesifieke kulturele kontekste. Daar is meer navorsing nodig oor die impak van AAK-gebruikers se bekendheid met simbole en assosiasies, op die aanleer van simboolsisteme.

Hierdie navorsingsprojek was 'n ondersoek na die assosiasies wat jong volwasse Suid-Afrikaners maak, met geselekteerde Minspeak™ ikone, wat gebruik word in Unity™ sagteware. 480 tersiêre studente het assosiasies gemaak na aanleiding van vraelyste. Woorde wat gebruik is om geassosiasieerde betekenisse te beskryf, is vergelyk met die woordeskat wat tans in Unity™ sagteware opgeneem is, om voorstelle te maak oor die toepaslikheid van hierdie ikone en die geassosieerde betekenisse wat daaraan geheg word.

Die resultate het aangedui dat sommige ikone en hul geassosieerde betekenisse moontlik suksesvol in Suid-Afrika gebruik kan word, terwyl ander aangepas moet word om relevant vir die plaaslike konteks te wees. Die resultate het beklemtoon dat enkodering sisteme wat gebaseer is op grafiese voorstellings nie bloot na Suid-Afrika ingevoer kan word nie, as gevolg van die multikulturele en meertalige aard van die populasie. Laastens, is 'n kritiese evaluasie van die studie gedoen en voorstelle vir verdere navorsing word verskaf.

SLEUTELWOORDE:
aanvullende en alternatiewe kommunikasie, enkodering, spoed verbetering, assosiasies, Minspeak™, Unity™, ikone, woordeskat, spoed verbetering

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF APPENDICES

CHAPTER 1
INTRODUCTION AND RATIONALE

1.1 PROBLEM STATEMENT

Natural speakers conduct conversations at between 150 and 250 words per minute. This allows for efficient communication of messages, which are formulated and spoken virtually simultaneously. However, the rate of communication for people with little or no functional speech, who make use of augmentative and alternative communication (AAC), is only 15 words per minute under most circumstances and in some cases as slow as 2 to 8 words per minute (Goldman-Eisler, 1986; Foulds, 1980, 1987). This is only a fraction (about 10 %) of what is achieved by natural speakers.

This drastic reduction in communication could interfere significantly when communicating with natural speakers who are accustomed to exchanging information at a more rapid pace . Accounts of communication partners walking away from or constantly interrupting the conversation with an AAC user are not uncommon. These AAC users often have difficulty getting into the conversation and meeting the demands of conversations in "real-time" (Light, Lindsay, Siegel & Parnes, 1990, p.184).

The rate of communication is not dependent solely on the number of selections that an AAC user has to make to complete a message, but is also determined by a number of interrelated variables. These include the average number of selections needed to transmit the message (the "linguistic cost"); the average number of motor acts required per selection; the average time per motor act; and the cognitive demands in terms of processing time and cognitive load in the process of deciding which motor acts and selections are necessary (Rosen and Goodenough-Trepagnier, 1981; Light et al., 1990).

The slow rate of communication which hampers many AAC users' effectiveness in communicating, necessitated the development of techniques to accelerate communication and to improve the timing of messages which are constructed making use of aided symbols. These techniques are commonly known as rate enhancement techniques (RETs). One of these

techniques is semantic compaction or Minspeak™ as it is known commercially, and will be the focus of the present study.

"Minspeak" is an acronym for minimum effort speech. It is an iconic encoding system that was developed in the United States and which uses multi-meaning icons to encode messages (see Chapter 2 for a detailed description). The use of iconic encoding techniques such as Minspeak™ requires a related skill, namely association. Individuals need to be able to use various aspects of a symbol to "remind" them of associated concepts or words (Beukelman and Mirenda, 1998, p.208).

The year 2000 marks the start of the third decade of the Minspeak™ approach to encoding messages. Minspeak™ is reportedly distributed and used with much success worldwide, yet in Africa the approach is still relatively unknown. Barry and Baker (1990) stated that although this approach has been well established clinically, it might be useful to review its theoretical status. Crucial aspects such as the appropriateness of the Minspeak™ approach to the South African context, the affordability of its implementation, usefulness of the established icons and associations, adaptations essential for making it culturally congruent need to be established for the South African context.

Ethical codes for accountable and effective service delivery in speech-language pathology require clinicians to develop individualized intervention programmes that are based "on the *specific cultural and linguistic needs* of the client and significant others" [italics added] (SASLHA, 1998, p.2). This requirement necessitates research into the appropriateness of the Minspeak™ icons and associations currently available to the South African population, to investigate local users' familiarity with the symbols and associations used.

When cross-cultural implementation of an intervention technique is considered, many factors like the influence of culture and especially language should be kept in mind. The consideration of linguistic diversity means that variability might exist between groups using different languages and even within a group using the same language (Ellis & Beattie, 1986, p.78). The differences between languages are extensive and immediately obvious: the number and kind of speech sounds and the way they are combined; different forms of nouns, pronouns, adjectives and articles, e.g. masculine, feminine or neutral. Word order and sentence structure varies, as well as different forms of the verbs. Furthermore, we live in a

multi-cultural society with possible additional dialectic variations, due to class, sex, occupation and geographic location. In fact, it seems that the only invariant linguistic units are prepositions (e.g. under, in) and adverbs (e.g. always, never) (Ellis & Beattie, 1986, p.79). It seems clear that AAC systems cannot simply be imported to South Africa to be used without investigation into the appropriateness of their use in the specific context. Although there is existing literature about the Minspeak™ approach including clinical issues, linguistic and cognitive processing, the author was surprised to find little information compared to other areas in the field of augmentative and alternative communication (AAC), and even less that had a strong theoretic/academic background. Information on how to adapt Minspeak™ for different cultures and contexts was very scarce.

This study was intended as a first study about the applicability of the Minspeak™ approach in South Africa, in an attempt to promote the investigation into appropriate strategies and techniques to enhance the communication rate of AAC users in the South African context. The author's intention with this study is to stimulate more systematic research on association-based iconic encoding systems like the Minspeak™ approach. This study is an investigation into the meanings that young adults, specifically tertiary education students, attach to selected Minspeak™ icons that are currently part of the UniChat™ starter pack overlays used with the ChatBox™, and Unity™ software for the AlphaTalker™, DeltaTalker™, Liberator™, Vanguard™, and Pathfinder™. The aim of the study is to compare the words used to describe the associations by the participants with the vocabulary used in Unity™ in the UK and US versions. The list of associated meanings might be useful to South African AAC users and their clinicians to provide guidelines for vocabulary to be included in their AAC systems.

1.2 DEFINITIONS OF TERMS

The following section will provide clarification on the frequently used terms used in this study.

1.2.1 Augmentative and alternative communication (AAC)

Augmentative and alternative communication (AAC) refers to those strategies that supplement or replace natural speech and/or writing making use of aided or unaided systems, in order to enhance the effectiveness of communication skills of people with little or no functional speech (Lloyd, Fuller and Arvidson, 1997, pp.1, 524). It is also described by the

American Speech-Language-Hearing Association (ASHA) as "an area of clinical practice that attempts to compensate - either temporarily or permanently - for the impairment and disability patterns of individuals with severe expressive communication disorders, including the severely speech-language and writing impaired" (1989, p.107).

1.2.2 Voice output communication aids (VOCAs)

This refers to an assistive communication device that can provide the user with either synthesized or digitized speech (Lloyd et al, 1997, p.543).

1.2.3 Unity™ software

Unity™ is the commercially available vocabulary encoded under Minspeak™ icons, which can be used by means of software on Minspeak™-based voice output communication aids, and comes with instructional manuals and materials. Different versions of Unity™ are available from Prentke Romich Company, including a 32-option version, a 128-version and the new 64-option version. A 16-option version is available in the programme called UniChat™.

1.2.4 Associations

When using an iconic encoding technique like Minspeak™, the skill of association is crucial so that individuals can use various aspects of a graphic representation, like an icon, to "remind" themselves of concepts and words coded by the specific icon or icon sequence (Beukelman and Mirenda, 1998, p.208). An association is thus the meaningful link between a graphic representation and the words or concepts represented by the symbol.

1.2.5 Rate of communication

For the purpose of this study the rate of communication will refer to the speed of output in terms of the amount of words expressed per minute (Foulds, 1980, 1987).

1.2.6 Little or no functional speech

Little or no functional speech will refer to individuals who are able to only use 15 or less words functionally and intelligibly (Burd, Hammes, Bornhoeft & Fischer, 1983).

1.2.7 AAC systems

This refers to "an integrated group of components, including the symbols, aids, strategies, and

techniques used by individuals to enhance communication" (ASHA, 1991, p.10).

1.2.8 An AAC user

Beukelman and Mirenda (1998, p.4) postulated that there is "no typical AAC user". The American Speech-Language-Hearing Association proposes that AAC users are those "individuals with severe communication disorders" who may "benefit from AAC - those for whom gestural, speech, and/or written communication is temporarily or permanently inadequate to meet all of their communication needs." They add that hearing impairment is not the primary cause of the communication impairment for these individuals (ASHA, 1991, p.10).

1.2.9 Communication

Communication may be linguistic or non-linguistic and refers to the "transmission or exchange of thoughts and information" between individuals by making use of any means, including amongst others speech, manual signs, gestures, traditional orthography, facial expressions, eye gaze, and graphic representational systems (Lloyd et al., 1997, p.526).

1.2.10 Technology

For the purpose of this study, technology refers to the "use of all materials (e.g. paper, board, displays), mechanical devices (e.g. switch-operated toys, electric-operated scan devices), and computerized devices (e.g. computers, communication devices)" (Quist and Lloyd, 1997, p.107).

1.3 OUTLINE OF CHAPTERS

Chapter 1 describes the rationale for this study, as well as an outline of the various chapters and clarification of the frequently used terms in this study. *Chapter 2* provides an overview of different rate enhancement techniques with specific focus on iconic encoding. A discussion of the different types of associations and the impact of culture on making such associations follow. The chapter concludes with a discussion of the cognitive demands facing an individual using a more sophisticated voice output communication aid (VOCA). The details of the research methodology is provided in *Chapter 3*, with focus on the selection and description of participants, the research design, the different phases of the research and the pilot study. This is followed by a description of the material used in this study and an

overview of the data collection procedure and statistical analysis.

In *Chapter 4*, the results of the study are presented and discussed, according to the different sub-aims of the study. The different associations elicited in this study are discussed in terms of areas of commonality and the percentages of the different common associations. This is concluded by a comparison of the elicited associations with the current Unity vocabulary. *Chapter 5* provides an integrated discussion of the results, followed by a critical evaluation of the study. The final section considers the clinical implications of the study and offers recommendations for future research.

1.4 ABBREVIATIONS

The following is a list of abbreviations frequently occurring in the study.

- AAC - Augmentative and Alternative Communication
- RET - Rate Enhancement Techniques
- VOCAs - Voice Output Communication Aids

1.5 SUMMARY

This chapter provided an overview of the rationale for this study, including the difficulties AAC users experience adding to a slower rate of communication and the subsequent development of rate enhancement techniques including encoding techniques. An overview of iconic encoding techniques is given against the background of the lack of culturally congruent intervention material for implementing this approach. This is followed by a clarification of the frequently used terms and an outline of the various chapters concludes the chapter. Chapter 2 will provide a detailed discussion of the different theoretical issues involved in rate enhancement techniques, with specific focus on iconic encoding.

CHAPTER 2
THEORETICAL BACKGROUND

2.1 INTRODUCTION

As stated in Chapter 1, there is a significant discrepancy in communication rate between AAC users and natural speakers. AAC teams have consequently developed a number of encoding and retrieval strategies to enhance the rate of communication. Each of these techniques potentially has its own set of prerequisite skill requirements to enable the user to benefit from the technique, e.g. a person needs adequate visual memory to use a specific visual memory encoding strategy as a means of rate enhancement. However, the complexity of abilities and skills required for effective implementation of specific rate enhancement techniques (RETs) have not yet been adequately researched. Interventionists need to systematically investigate these skills and find innovative ways of dealing with the skill requirements of rate enhancement techniques. The majority of rate enhancement techniques are technology driven and their skill requirements are dependent on the extent to which they comply with the laws of applying technology (Quist and Lloyd, 1997, pp.121–126). Chapter 2 will commence with a discussion of some of these laws and a discussion of different rate enhancement techniques, focusing on the technique that is relevant for this study, iconic encoding. This will be followed by a reflection on the cognitive demands associated with the use of rate enhancement techniques. Different aspects relevant to iconic encoding will be examined, including different types of associations, different semantic fields and the impact of culture on symbol learning. A discussion of the features of Unity™ will conclude the chapter.

2.2 THE LAWS FOR IMPLEMENTING TECHNOLOGY

Quist and Lloyd (1997, pp.121-126) proposed a number of laws that should be adhered to when implementing technology, including the law of practicality and use, the law of parsimony, the law of best fit and the laws of minimal learning, minimal energy, and minimal interference. Some of these laws have specific importance for the current study. The **law of parsimony** suggests that during the implementation of technology, procedures should be made "as simple as possible" (Quist and Lloyd, 1997, p.121). According to this law, when

selecting and implementing technology – especially for the purpose of rate enhancement – the AAC systems being considered should not be too elaborate, in order to prevent liabilities in terms of cost and lack of portability. When selecting a rate enhancement approach to use with the proposed technology, the **law of minimal learning** should be pursued. It is preferable to implement an approach that can be used with little or no learning (Quist and Lloyd, 1997, p.121). This implies that when an iconic encoding technique like Minspeak™ is implemented the icons and the vocabulary coded with these icons should not inflict high demands on the user in terms of learning. Trying to memorize different icon codes and icon sequences may contribute to increased cognitive demands leading to high levels of fatigue that may interfere with the speed and accuracy of communication.

The **law of minimal energy** proposes that any activity should be carried out with as little effort as possible, so that it can be sustained for longer periods of time. If learning and recalling the codes to retrieve prestored messages requires too much mental energy from the user, the effectiveness of the rate enhancement technique is undermined. When the skill and output requirements are too high AAC users tend to use their technology options less (Quist and Lloyd, 1997, p.123). The **law of minimal interference** postulate that the approach that is implemented should not divert the user's attention from ongoing activities (Quist and Lloyd, 1997, p.123). These activities might include interactional, communicative, vocational, educational or other activities, where the user is required to focus his attention on various other (more important) issues. It follows that if a user has to focus too much attention on remembering codes for retrieval of prestored messages, it might impede his participation in other activities. Interventionists need to investigate the different strategies used to enhance the rate of communication and the demands that these strategies inflict on the user.

2.3 RATE ENHANCEMENT TECHNIQUES (RETs)

One of several factors contributing to the slow rate of communication of AAC users, is that these communicators are often required to compose their messages by selecting symbols, words, pictures or letters one at a time (Beukelman and Mirenda, 1998, p.74). The process of for instance spelling out words - letter by letter - is time consuming and makes it difficult for the user to keep the communication partner interested and remember how far the message is composed. Often the effectiveness of communication is compromised and the main purposes of communication are not fulfilled. These purposes were identified by Light (1988) as social

closeness, transfer of information, making needs and wants known, as well as social etiquette. When the rate of communication is slow, it might induce various social, cognitive, and probably physical demands on the AAC user and/or his communication partner. With regard to the laws for implementing technology, the laws of minimal learning, minimal energy and minimal interference are all violated. According to these laws, the rate of communication should be enhanced and at least some of the demands lessened, but it can only be done if *effective* rate enhancement techniques are implemented.

Rate enhancement techniques refer to those techniques implemented by AAC users, that result in "the number of characters generated being greater that the number of selections the individual makes" (Cook and Hussey, 1995, p.488). It follows that the user has to make fewer selections, and subsequently the overall rate of communication is increased. A substantial body of research on rate enhancement techniques has been accumulated over the last 3 decades. Table 2-1 is a summary of some research on rate enhancement techniques.

Research, using both disabled and able-bodied persons, has centred around both encoding and prediction techniques, focussing on factors influencing the effectiveness of implementing rate enhancement techniques. These factors included the cognitive demands inflicted upon the user, the average number of *selections* required to communicate a *message*, the average number of *keystrokes* required to make a *selection*, the duration of message production, etc. Theoretical studies on rate enhancement techniques typically examined the number of keystrokes needed for composing a message when making use of different encoding techniques. Factors that are influenced by human characteristics are often not heeded, as these might seem more subjective and more difficult to measure reliably. These characteristics include the user's motor and sensory skills, the style of learning, and fatigue levels. Few studies pertaining to the influence of the user's culture on the use of RETs, could be located. These studies typically emphasise that keeping the individual's culture in mind is a fundamental principle for clinical practice, but few provide guidelines on how to make assessment and intervention practices more culturally congruent. Huer (2000) investigated three aided graphic symbol sets to determine the impact of participants' culture on how they perceive graphic representations. The results of her study, albeit preliminary, suggested that manufacturers of commercially available AAC graphic representational sets and systems should keep the effect of culture in mind when developing products, as perceptions of symbol meanings are likely to vary as a function of culture (Huer, 2000, p.184).

Table 2-1: Summary of research on rate enhancement techniques

Researcher(s)	Year	Title	Main aims of research	Participants	Method	Results
Light et al	1990	The effects of message encoding techniques on recall by literate adults using AAC systems	To determine the effectiveness of code recall using 3 encoding techniques, as well as the probable cognitive processing demands inflicted when using 3 different message encoding techniques and the influence of imageability or concreteness on recall accuracy	6 nonspeaking, functionally literate, physically disabled adult AAC-users	Within-subjects design with repeated measures required participants to learn and recall codes of messages using 3 different encoding techniques, including salient letter codes, letter category codes and iconic encoding	Too many methodological problems were identified by the authors (Light et al., 1990, p.196) and their peers (Williams, 1990, pp.290-293) to make any conclusive claims.
Light & Lindsay	1992	Message-encoding techniques for augmentative communication systems: The recall performances of adults with severe speech impairments.	To investigate the effect of different factors on the ease of learning and the accuracy and speed of recall, including the type of encoding technique, level of personalization and the level of abstractness of the message involved.	12 non-speaking, physically disabled adults	6 counter-balanced experimental conditions were used. Every subject was subjected to six sessions, consisting of an introductory session, 4 learning sessions and a final probe session. Subjects had to learn the codes for 80 messages including both abstract and more concrete messages. The accuracy and speed was recorded during the 4 learning sessions.	Subjects were more accurate in recalling the codes by letter encoding techniques, than by using iconic encoding techniques. Code recall improved consistently across the series of learning sessions and there were no significant differences in the rate of learning across the encoding techniques.
Goossens', Elder & Bray	1990	Validity of the semantic compaction competency profile in normally developing preschool children.	To determine whether the Semantic Compaction Competency Scale was an effective and valid instrument for screening potential semantic compaction users' potential	Normally developing preschool children	Individuals were asked to recognise a small set of coloured objects by name and various questions were asked requiring different types of associations.	Although some problems were identified, it seems that the scale provides the intervention team with a reliable idea of the person's associational abilities and enables them to make predictions as to the appropriateness of VOCAs based on the semantic compaction principle.
Huer	2000	Examining perceptions of graphic symbols across cultures: Preliminary study of the impact of culture/ethnicity	To study the impact of culture/ethnicity on graphic symbol recognition and to describe implications for the practice of AAC across cultures	147 participants between the ages of 30 – 64 years who identified themselves as African-American, Chinese, European-American or Mexican	Graphic symbols from a 41-item lexicon, with translated referents, were rated on a 7-point scale of iconicity. Three graphic representation systems were used, including Blissymbols, Dynasyms and Picture Communication Symbols.	Results indicated that individuals from different cultures perceive graphic representations differently. Even though there were differences found, there were also similarities, as there were a tendency of participants to find Bliss more difficult than the other systems.
Vanderheiden & Kelso	1987	Comparative analysis of fixed-vocabulary communication acceleration techniques	To provide a presentation of the basic concepts, issues and data, regarding the impact of various types of "acceleration word sets" (rate enhancement techniques). The above-mentioned discussions are used as a basis for an analysis of several abbreviation-expansion approaches as well as the relationship of fixed-vocabulary spelling prediction techniques.	None - theoretical analysis	Theoretical analysis of the percentage of keystrokes that would be saved through the use of various encoding techniques	Depending on the kind of encoding, keystroke savings might range between 20 and 50 % compared with letter-by-letter typing. Word length had to be considered as the longer the word, the greater the key stroke savings, since long words require more letters. The research has suggested that the keystroke savings for message prediction systems would not likely exceed those achieved through encoding.

Table 2-1: Summary of research on rate enhancement techniques (continued)

Researcher(s)	Year	Title	Main aim of research	Participants	Method	Results
Higginbotham	1992	Evaluation of keystroke savings across five assistive communication technologies.	To compare keystroke efficiency for different encoding and prediction techniques over 20 randomly selected essays from students from the local county	Essays were typed, using each of the following strategies: • EZ Keys (Words+) • Words Strategy (Prentke Romich Company) • Predictive Linguistic Program (Don Johnson) • Write 100 (Goodenough-Trepagnier et al., 1982) • Generic Encoding Technology software (Vanderheiden, 1988)	Twenty 500-word text passages were typed using each of the techniques and the number of keystrokes were analysed in several ways	Keystroke savings of between 35 and 50 % are possible with most rate enhancement software available for both MS-DOS and AAC systems
Venkatagiri	1994	Window size in lexical prediction	To examine the effect of the size of the menu offered in word prediction programmes, including menu size of 5, 10 and 15 words.	Participants without disabilities	A writing task had to be completed with the different menu window sizes	The message preparation time in the 15-word menu was equal to that in the 5-word menu. The rate of prediction was the highest and the amount of keystrokes required the lowest in the 15-word menu. This indicated that larger menus could have clear advantages, especially where fatigue impacts negatively on a particular individual's communication.
Venkatagiri	1995	Techniques for enhancing communication productivity in AAC: A review of research	Six approaches were reviewed and rated, using seven criteria: learning needs, cognitive-linguistic processing requirements, motor requirements, perceptual requirements, size of vocabulary, rate increase potential and availability	Six approaches were reviewed (efficient keyboard layouts, reduced keys keyboards, Minspeak with Words Strategy, enlarged keys keyboards, abbreviation expansion, and lexical prediction)	Theoretical analysis	For literate adults, the alternative keyboards offered a simple and cost-effective technique that rated high on all 7 of the criteria. The other approaches were found to have both significant advantages and drawbacks, that need to be considered for every user individually.
Koester & Levine	1996	Effect of a word prediction feature on user performance	To determine the impact of the word prediction feature on user performance in terms of rate, accuracy and frustration of users.	6 men with cervical spinal cord injuries and 8 able-bodied men	All participants were given comparable sentences to transcribe with a standard keyboard and a mouthstick using either letter-only or letter-plus-word prediction, in which 6 numerically coded words appeared on the screen when letters were typed	The benefits of any keystroke savings for the word prediction system were generally offset or even exceeded by the keystroke cost of making each selection. Much time was spent searching the menus and both groups of participants rated the letters-plus-word prediction strategy as more difficult than the words-only strategy. The former strategy might have placed more cognitive demands on the participants.

There are at least two broad categories of rate enhancement techniques (RETs), namely encoding techniques and prediction techniques (Cook and Hussey, 1995, p.488).

Encoding refers to the way in which certain codes are associated with specific messages and encoding techniques could include any technique where the AAC user selects multiple symbols to transmit the desired message (Vanderheiden and Lloyd, 1986; Beukelman and Mirenda, 1998, p.78). Encoding is generally defined as the formulation of language when the communicator formulates his message by recalling and retrieving symbols or a combination of symbols from the brain and arranging them in semantic categories in "syntactical rule-governed order" (Quist and Lloyd, 1997, p.117). The entire encoding process is typically carried out with little or no conscious thought about the process and is usually completed instantaneously (Quist and Lloyd, 1997, p.117). However, this process seems to be different for AAC users, as an additional process is included, by which messages are stored in association with a specific symbol or symbol sequence for later retrieval (Beukelman and Mirenda, 1992; Musselwhite and St. Louis, 1988; Silverman, 1995). These symbols need to exist both in the brain's linguistic areas and in an external location like a computer's memory, on an ETRAN, or on a communication board.

Prediction techniques refer to techniques that decrease the options available to the user, i.e. predicting what is available and thus increasing rate of communication, as the user does not have to select from that many options. Prediction techniques include both word prediction and techniques like icon prediction. Word prediction is a specialised technique that presents menus of possible words each time the AAC user types a letter. These lists are based on words that are frequently used by the general population and are often adjusted to include the individual's most frequently used words (Quist and Lloyd, 1997, pp.120-121). For instance if the individual type "ro", a menu of five different options appears on the liquid crystal display, e.g. *roly-poly, rope, rose, rough,* and *round.* The user has to select the desired choice, by for instance selecting the item's number. A distinct advantage of word prediction strategies is that the user is not required to memorize any codes. Icon prediction is a feature that aids the recall of stored messages, using a light connected to each symbol in the selection set. Only those symbols which form the beginning of an icon sequence are lighted initially, thus the user knows which symbols are possible first icons. When an icon is selected, only those lights which are part of a sequence beginning with the selected icon are illuminated. This process continues until a complete icon sequence has been selected. Icon prediction is a further rate

enhancement technique which increases selection accuracy and reduces errors as the allowed selection set is decreased for any given choice.

Both encoding and prediction techniques are generally employed to address problems like poor message composition (e.g. spelling or grammatical errors) or poor timing (e.g. an interjection expressed three minutes after the occurrence, causing it to be inappropriate and causing breakdowns in communication). Therefore encoding and prediction techniques are primarily implemented for three main purposes: to enhance timing, to assist grammatical formulation of messages and to enhance communication rates (Beukelman and Mirenda, 1998, p.85). Timing of messages can be enhanced if the code for a certain message is easy to recall and easy to select, thus achieving rate enhancement and ensuring that a message is transmitted while it is still relevant to the situation. Often grammatical correctness of messages composed in a hurry is compromised due to timing requirements. The selection of prestored messages or messages from a word prediction programme could alleviate this problem. Encoding techniques are more widely used in the South African context than prediction techniques, and will now be discussed in more detail.

2.4 ENCODING STRATEGIES AS RATE ENHANCEMENT TECHNIQUE

Various authors have written at length about different types of encoding strategies (Lloyd, Fuller and Arvidson, 1997; Beukelman and Mirenda, 1998; Cook and Hussey, 1995; Silverman, 1995; Musselwhite and St. Louis, 1988; Vanderheiden and Lloyd, 1986). Five broad categories can be identified based on retrieval methods: visual-motor encoding, memory-based encoding, chart-based encoding, display-based encoding, and semantic and conceptual encoding.

Visual-motor encoding is a form of conceptual encoding that makes use of diagrams or visual representations that illustrate hand movements. These visual representations are related to motor components of gestures that represent meaning (Quist and Lloyd, 1997, p.117). It is based on "significant parameters of manual sign production", viz. location, movement and handshape, as opposed to conceptual associations that have specific relevance in a signing context. For example, a system like VoisShapes™ - a hi-tech visual-motor encoding system - implements a three-hit sequence of the above-mentioned parameters to retrieve prestored words corresponding to manual signs (Quist and Lloyd, 1997, p.120).

Memory-based encoding requires the AAC user to memorise the codes associated with specific messages. This can be accomplished by rote learning e.g. for numeric encoding, or through using mnemonic strategies that aid recall, e.g. salient letter encoding or letter-category encoding (Beukelman and Mirenda, 1998, p.79). In some cases both the user and the communication partners should know the codes by memory, e.g. auditory scanning, eye movements, hand signs, etc. (Cook and Hussey, 1995, p.489). Examples of encoding strategies that are memory-based are:

- *Colour coding* where colour is used to encode messages, usually in conjunction with specifiers like numbers or symbols - especially useful for eye-pointing communication systems (Goossens' and Crain, 1986, 1987);
- *Salient letter encoding/Logical letter encoding* which makes use of the initial letters of the primary words in a sentence to construct the code, e.g. OW for "please **o**pen the **w**indow";
- *Letter-category encoding* where the initial letter of a code is determined by an organizational scheme that categorises messages, e.g. initial letter E for a category "eating" would include messages like "please cut my meat, I need some salt, yummy, I'm done";
- *Alpha-numeric encoding* which uses a selection of codes that include both letters and numbers. The letter-part is used to code category, e.g. G for greetings, and the number-part is used arbitrarily to specify individual messages;
- *Numeric encoding* which makes use of a completely arbitrary code for a corresponding message. The code can be used to represent a word or even a complete phrase or sentence. The user merely enters one or more numbers, and the device outputs the complete stored vocabulary item. The advantage of numeric encoding is that it requires fewer selections and the codes can be memorised, a display is not required. The disadvantage is that it is very arbitrary, which increases the memory load.

Chart-based encoding includes techniques that have an index of the codes and what each code represents e.g. an organised chart on the wall or a key of reference in the form of a paper next to a communication board/device (e.g. look up = yes) for explaining codes during communication (Cook and Hussey, 1995, p.489; Quist and Lloyd, 1997, p.117).

Display-based encoding is similar to chart-based techniques, but the individual responds to the display without any reference to a code i.e. responding to the selection set to enter a code, e.g. a 2-way switch when using Morse code (left = dash; right = dot) (Quist and Lloyd, 1997, p.117; Cook and Hussey, 1995, p.489).

Semantic and conceptual encoding/iconic encoding makes use of symbols that have a natural and/or taught association with their referents and it typically involves associating multiple meanings with graphic symbols, called icons (Quist and Lloyd, 1997, p.117). Iconic encoding is widely used with VOCAs around the world and is available in a number of aided communication products, including the DigiVox™ (Sentient Systems Technology Inc.); the ChatBox™ (Saltillo); the Macaw (Zygo Industries Inc.); the AlphaTalker™ (Prentke Romich Company); Ke:nx™ (Don Johnson Inc.); the DeltaTalker™ (Prentke Romich Company); Talking Screen™ (Words+ Inc.); the Liberator II™ (PRC); the Vanguard™ (PRC); the Pathfinder™ (PRC), as well as previously manufactured devices like the IntroTalker™, LightTalker™ and TouchTalker™ (Prentke Romich Company). The last three devices are mentioned here as they are frequently imported to South Africa as refurbished devices, making them more affordable. The iconic encoding technique that is most often found when viewing all of the above-mentioned options, is semantic compaction or Minspeak™. This type of encoding will be discussed in more detail due to its relevance to the present study.

2.5 ICONIC ENCODING

Baker (1982, 1986) proposed an iconic encoding technique referred to as semantic compaction, or Minspeak™ as it is known commercially. "Minspeak" is an acronym for minimum effort speech (Bruno, 1989, p.89). The techniques uses multi-meaning icons (i.e. pictorial symbols) in sequences which code words, phrases and sentences on the basis of their meanings (Cook and Hussey, 1995, p.490; Van Tatenhove, 1993). Sequences of icons are combined to store word, phrase or sentence messages in one of the voice-output devices constructed to incorporate this technique. Icons used for this type of encoding are deliberately selected for their rich semantic associations. Using iconic encoding, messages can be semantically organised by activities, topics, locations or other categories to enhance retrieval (Beukelman & Mirenda, 1998, p.77). This system was designed to represent large vocabularies (Baker, Schwartz and Conti, 1990).

Minspeak™ uses a closed set of multi-meaning icons in sequences to code language as the manufacturers anticipated that single-meaning iconic systems require many hundreds of different pictures to represent even the "barest lexicon" (Baker et al., 1990). The use of icons with multiple meanings allows for the expansion of programmed messages with regard to flexibility and richness of associations (Quist and Lloyd, 1997, p.120). Each icon links to

certain elements of the English language. The different icons included in Minspeak™ relate to each other in ways that are understood when viewing the associations made with certain icons. The icons are used as the shortest possible means to represent, syntactically and semantically, the content of the user's native language (Baker et al., 1990). The semantic compaction approach includes the use of similes, metaphors and categories of a language for "consistent, mnemonic and representational purposes" (Baker et al., 1990). The different messages that are prestored, are analysed to identify a maximum of three different concepts and an appropriate sequence of icons is selected to represent or code these concepts (Light et al., 1990, p.186).

Very little material has been formally presented to describe the sequencing procedures used with icons, although this work has always been viewed as important in semantic compaction (Baker et al., 1990). How individual icons and icon sequences relate to different language elements within the semantic compaction approach, has been the subject of much discussion and formal presentation. The different order of certain icon sequences allows semantic compaction to clarify the meaning represented either directly, or indirectly through association, on the other icon. This potential to clarify or "disambiguate" is a powerful tool for brevity (Baker et al., 1990).

Central to semantic compaction is the principle that any icon is embedded in a range of metaphors, relationships and categories, which are then used for representational purposes. When this range of metaphors, relationships and categories are unknown to the user, it may have a negative impact on the ease with which the messages coded by the icons are learnt and recalled. This might also inflict a much higher memory load on the user, which may in turn decrease the rate of communication, thus undermining the purpose of the rate enhancement technique. The effectiveness of any encoding technique relies heavily on the speed, accuracy and ease of learning and recalling codes for message retrieval (Light et al., 1990, p.184). When the ease of learning and recalling of the message codes are decreased, the effectiveness of the rate enhancement technique is also diminished.

However, unknown metaphors, categories and relationships are not the only potential cognitive demands facing users wanting to learn the principles of semantic compaction. Using more sophisticated VOCAs makes various demands on memory (Oxley and Norris, 2000, p.79; Levelt, 1995, pp.18-20; Light and Lindsay, 1991, pp.186-187). In order to use

Minspeak-based VOCAs effectively, the AAC user is required to, amongst other things (a) memorise the available vocabulary for future use; (b) understand and learn how the programmer has associated each vocabulary unit with an icon; (c) memorise the necessary vocabulary; (d) make effective use of this information during spontaneous interaction; and (e) select an appropriate retrieval strategy and execute it successfully to elicit the desired messages during interaction (based on Oxley and Norris, 2000, p.79). The cognitive processing demands associated with the encoding technique and the time consumed in selecting a specific code are crucial elements in effective rate enhancement. The potential rate enhancement of an AAC-user's communication can only be realised if the afore-mentioned demands are not present in excess (Light et al., 1990, p.184).

In iconic encoding strategies, the semantic associations with icons assist with retrieval, as do the icon prediction lights available on some electronic communication systems (e.g. Liberator™, PRC) to diminish the cognitive demands inflicted on the user. Despite advantages of recall provided by the Minspeak™ technique, when large numbers of sentences, words and phrases are stored the icon sequences can become difficult to remember, thus diminishing memory performance (Cook and Hussey, 1995, p.493).

Different variables influence memory performance as can be seen from the processes involved in interactional demands, where the user has to divide his attention between listening and watching the communication partner, processing the message, formulating a response, staying in a correct, upright position, and accessing the VOCA. Other variables include the amount of cognitive effort available for the task, the structure and organisation of the individual's memory (for children episodic memory and for adults semantic memory), the individual's knowledge of the importance and the use of strategies to enhance memory tasks). In addition, the need for executing a deliberate action inflicts more cognitive demands than perfoming an automatic action (Oxley and Norris, 2000, p.80-81). If children cannot remember whether a VOCA contains a certain message, they might be able to use a graphic representational overlay as an aid to memory, i.e. using the cues present on the overlay to remind them of the message information (Oxley and Norris, 2000, p.89). This does not only apply to children but virtually any person and to most AAC users.

There are two possibilities pertaining to the underlying cognitive processes of retrieving prestored messages using an iconic encoding technique like Minspeak (Light et al., 1990,

p.194). The first possibility suggests that iconic techniques relies primarily on recognition of the different code elements rather than on the recall of such elements. This might simplify or alleviate the cognitive demands on the user (Baker, 1985). The second possibility suggest that retrieval relies on recall, where the overlay on the VOCA serves as a retrieval cue for the recall of the correct icon sequence (Light et al., 1990, p.194). It is not clear whether the use of iconic encoding techniques requires recall of message content on an auditory level or if the user is able to recall the code based on the visual images and associations, thus directly from the contextual cue. However, expertise in specific area seem to affect memory performance positively (Chi, 1985; Rabinowitz and Glaser, 1985). Therefore, when people are familiar with certain aspects of activities, objects or more abstract concepts represented by an icon, the cognitive demands might be less and memory performance might increase. Similarly, if the user is unfamiliar with the specific concepts represented, the user is required to first learn these concepts and try to understand and remember the various relationships with the specific icon's meaning, and thus form a forced association. The cognitive demands inflicted when trying to learn something of which you have no experience whatsoever, is very high. Considering the other factors impacting on the user's memory, interventionists working with AAC systems based on graphic representational encoding systems – like the Minspeak-based VOCAs – need to ensure that the graphics and the associations used and learnt in connection with those graphics are familiar to the user. Thus, we need to determine whether the user has experience and therefore the relevant information in their semantic and/or episodic memory.

Although there is no "typical" AAC-user, people with severe speech and physical disabilities often have two areas of impairment affecting these areas of development significantly, viz. they lack the rich interactional experiences including the "fast, novel, self-initiated stream of expressive utterances" that is possible through speech; and their world knowledge could either be limited or cognitively differently organised, because of their different motor and sensory abilities (McNaughton and Lindsay, 1995, p.213). Thus, no interventionist can simply assume that a specific graphic representation is familiar and meaningful to a specific user.

Although more information is required, it seems possible that both recall and recognition might be active. It depends on the recall for retrieval of the correct code whilst the icon set acts as a cue for retrieval during recall. Simultaneously, recognition is used for selecting the specific relevant visual features of the icons that are available for message composition. The

process thus includes the following: the AAC-user composes a message cognitively; thinks of the potential message content and categorises the message (e.g. food-related = APPLE-icon, interaction-related = SENTENCE-icon) and cognitively starts eliminating irrelevant icons with the aid of icon prediction. The user now selects the specific category's icon (e.g. the APPLE-icon) and carefully studies the remaining icons' visual features (the remaining icons are illuminated according to icon prediction) to make appropriate associations based on information from his semantic and episodic memory. The next icon is now selected and this procedure continues until the full icon sequence has been selected.

The iconicity of a graphic representation seems to be a predictive factor in facilitating recall of symbols and thus retrieving the prestored messages coded by the symbol (Paivio, 1986). Thus, iconicity could influence the learnability of an icon as well as the cognitive demands inflicted on the user who is trying to learn the associations and the codes for storing and retrieving prestored messages (Luftig, 1983; Blau, 1983; Schlosser, 1994). Iconicity has long been a subject of discussion and research in the field of AAC. It refers to the apparent relationship existing between a symbol and its meaning (Luftig and Bersani, 1985, p.32). The continuum of iconicity is well established within the field of AAC. This continuum has poles of transparency and opaqueness. In this context, transparency refers to the highly guessable relationship between a symbol and its meaning and opaqueness refers to situations where the relationship between the symbol and its meaning is not understandable even if both are presented.

Translucency is a point between transparency and opaqueness on the iconicity continuum (Luftig and Bersani, 1985, p.32) as translucent symbols' meanings are typically not guessable, but the relationship between the symbol and its meaning become evident when both are presented. Translucency has been found to facilitate symbol learning for both Blissymbols and manual signs (Luftig and Bersani, 1985, p.36) and therefore seems to be an important factor in the learning of visual, non-speech systems (the law of minimal learning). Thus, a large number of icons that are either transparent or translucent are desired so that users can either guess the meanings associated with the icon or they can learn it easily. Translucency has at least two underlying processes: firstly, speculating about possible meanings of an icon and then, after presentation of the referent, understanding the connection, which implies a deep learning activity.

The degree of translucency prevailing for a specific graphic representation or icon is influenced by aspects like the user's language, culture, world knowledge, personal experience, age, gender, etc. These aspects also influence the way in which the icon is perceived and thus the types of associations made with the icon. Considering the many cognitive demands facing AAC-users wishing to use more sophisticated VOCAs, it is an essential part of accountable service delivery to optimise their AAC-systems, in terms of comprehensiveness and ease of learning (laws of minimal learning, minimal energy, and the law of parsimony). It is therefore necessary to determine whether present users attach the same meanings to the different Minspeak™ icons in Unity™ and whether they describe the associated meanings with the same words, phrases and sentences as in the current Unity™ vocabulary. This information could guide interventionists in designing AAC systems engineered to lessen the cognitive demands connected to learning the encoding system optimally (law of minimal learning and minimal energy).

In order for an encoding system, like Minspeak™, to be used effectively, icons need to be either transparent or translucent as the efficient use of codes depends on the user's ability to make functional associations between the icons and their meanings (Bruno and Goehl, 1991, p.70). Iconic encoding depends heavily on a "network of personal associations" (Light et al., 1990, p.196). An investigation into the different types of possible associations is warranted.

2.6 ASSOCIATIONS AND MENTAL REPRESENTATIONS

At any given point in time, the meaning of each icon is influenced by the context in which it is used as well as by the user's ability to associate multiple meanings with it, i.e. association performance (Bruno, 1989, p.89). Association performance is typically influenced by the person's cognitive and language abilities, as well as his prior personal experience (Nelson, 1977, pp.93,95,103; Petry, 1977, pp.69-70). It seems probable that when the user's language, culture and world experience differ from that of the creators, association performance might be compromised (law of minimal learning and minimal energy).

In augmentative communication systems, efforts have centred around enhancing understanding of different symbolic representations by making them more simple and direct (overemphasizing the law of parsimony). A picture, e.g. of an apple, designed to represent the concept "food" is not usually intended to represent other conceptually unrelated meanings

such as "red" or "round". Such other meanings are usually regarded as "noise", something to be avoided (Barry and Baker, 1990, p.4).

The work of the German structuralist E.B. Titchner (1910) on the structure of consciousness is seen as a precursor of modern schema theory. Titchner observed that subjects often committed what he called stimulus error, i.e. when observing objects or events, they reported previous knowledge rather than the attributes of the objects or events themselves. What to Titchner was error to be avoided and an irritating invasion of prior knowledge, is seen by cognitive scientists today as the basic nature of perception and comprehension (West, Farmer and Wolff, 1991, p.5).

A revolution in our understanding of the possibilities for language representation takes place when we begin to treat the "noise" in graphic representation as meaningful information. When we systematically stop disregarding other visual and conceptual material on an icon, a whole new world opens up. This same phenomenon is evident in the following example from Prentke Romich Company:

> *A shoe is not just a shoe. It can have laces. It can be a tennis shoe, a dress shoe, a working shoe. It can be a man's shoe, a woman's shoe, a child's shoe, a baby's shoe. It can be one shoe or a pair of shoes. It can be an old shoe or a new shoe. It can even have a hole in its sole. It can be a leather, rubber of canvas shoe. It can be a brown, black, or red shoe, etc.*
>
> *(Baker et al., 1990).*

The production and manipulation of representations can be viewed as an essential and characteristic human activity. Rosenberg (1981, p.1) postulates that "except for babies and the profoundly brain-damaged, all humans, of whatever time and culture, engage in it, and, insofar as we can now say with any confidence (the verdict on dolphins and the data on Martians not yet having come in), only humans do". Individuals' representations of graphic symbols include representations of both things and states of affairs. Symbolic representation is, paradigmatically, seen as linguistic representation as it enables the individual to gain access to meaningful language units that could be implemented in transmitting information during communicative interaction.

All conventionalised linguistic expressions, including morphemes, words, idioms, phrases, etc., are connected with meaning potentials, which are seen as a person's memory of the previous uses of a particular expression and can be seen as the junction of all the information the person can associate with the expression. The semantic part of this information will

include episodic and semantic knowledge concerning the expression's referent or the different associations with it (Allwood, 1999, p.2). In the case of individuals who have little or no functional speech, these "expressions" can be viewed as output with any AAC system.

If the user makes associations with specific symbols (icons) that are in some way related to the meaning of the message, recall may be easier (Quist and Lloyd, 1997, p.119). West et al. (1991, p.9) pointed out that it is difficult to predict what schemata will be activated and, therefore what meaning will be derived as persons have many schemata and events have many attributes. Knowing what schemata will be activated in a person by attributes of events is a "low-probability prediction" (West et al., 1991, p.9). That is to say, we cannot always know what schemata will be activated and which parts of the event are together partially determining the meaning derived. During human perception schemata are often already active in our minds as we observe an event.

Meanings are "in the head" (Allwood, 1999, p.21). Thus the meaning a person assigns to a certain word or symbol is subjective. Since the cognitive structures in our heads are connected to our senses, directly or indirectly, it follows that meanings are, at least partly, based on our perceptions of the world, i.e. they are perceptually grounded. At this level, people with severe speech and physical disabilities might have a disadvantage, as their experience of the world and their episodic and semantic memory may be influenced by restricted access to the world. Their access is limited due to motor limitations which in turn, restricts their access to the various perceptual experiences to which typical children are exposed. However, Putnam (1988) has opposed this approach by stating that meanings are not merely subjective in nature. He proposed that every word the speaker uses is associated in his mind with a certain mental representation (Putnam, 1988, p.73). He added that two words could only be synonymous when they are associated with the same mental representation by the speakers. The individual's mental representation determines the meaning of the word. Putnam also claimed that these three conditions cannot be simultaneously satisfied as we "cannot individuate concepts and beliefs without reference to the environment" (Putnam, 1988, p.73). Therefore, meanings are subjective, but they also need to be *inter-subjective*, to be meaningful in communicative interactions. Thus, the same meaning should be communal to other individuals. It is essential to see the process of developing meaning as inter-subjective, thus an interaction between communal and subjective meaning.

Establishing meaning is essential in learning. Learning is virtually impossible without perception and very little perception is possible without the relevant schemata in place (West et al., 1991, p.9). Not only do these schemata allow perception, but recall is enhanced when schemata pave the way for comprehension and learning. Perception seems to go awry when a poor match exists between the event and the schema activated at the time.

West et al. (1991, p.9) proposed the following example: "Suppose that you knew nothing about stretching out before and after exercise. Suppose you see a woman pushing at the trunk of a large tree. It would seem a bizarre scene. You might assume that she was attempting to uproot a very large tree with her bare hands. Suppose you next see, sitting on the grass of a park, a man in shorts and canvas shoes apparently trying to tear off his leg". These two events were perceived in terms of the schemata available, which clearly didn't include comprehension of the visual perception in order for learning to take place. When no relevant schemata are in place, the relevance of associations might be compromised due to the impropriety of the referent, e.g. the man trying to tear his leg off, in stead of a jogger stretching. These concept schemata seem to be the "fundamental representation" of knowledge, attached to the individual's attitudes, beliefs and values (West et al., 1991, p.15). How we organise our vocabularies and how we attempt to convey normal language usage are both reliably linked to the categorisation systems we consciously and unconsciously use across our individual language structures. Concepts, which express themselves among other ways through language and metaphor, are based on category systems. The way knowledge is structured and the way vocabulary is categorised and organised on the grounds of meaning and metaphor, might both influence the associations individuals make with certain icons.

Attempts to categorise associational structures implemented by individuals differ significantly as each categoriser employs his or her internalised models about the world and language to establish such categories (Baker et al., 1990). Elder and Goossens (1989) outlined a series of 12 recognition strategies utilised by AAC users and their clinicians with the semantic compaction technique. These strategies relate to associational categories, viz. function, attribute, colour, shape, hierarchical category membership, coordinate category membership, shared substance, associated proximity, visible part, inferred part, homophony and similar appearance. The different types of possible associations will now be examined.

2.6.1 Different types of associations

Various researchers (Nelson, 1977; Pollio, 1964; Petry, 1977; and Palermo, 1971 amongst others) have postulated that there are mainly two general kinds of associations, naming syntagmatic and paradigmatic categories. Syntagmatic associations are responses that differ in grammatical class from the stimulus word and paradigmatic associations are responses that share the same grammatical class as the stimulus word (Bruno and Goehl, 1991, p.71). See Table 2-2 for a short description and examples of syntagmatic and paradigmatic associations.

Table 2-2: Short description of paradigmatic and syntagmatic associations

CATEGORY	DESCRIPTION	EXAMPLES
Paradygmatic	Associations are in the same grammatical class as the stimulus word	table - chair (noun - noun)
Syntagmatic	Associations differ in grammatical class from the stimulus word	eat - cookies (verb - noun)

Further sub-categorization of the two larger classes are specified in the literature. The subcategories describe and specify the subrelation between the stimulus and the response, thereby offer independent categories to define association performance. The subcategories for paradigmatic associations are all classified as nominal (Bruno and Goehl, 1991, p.73,79) including superordinate, subordinate, coordinate, contrast, part and location. The subcategories for syntagmatic associations include functional, perceptual and episodic associations (Bruno and Goehl, 1991, p.71). Table 2-3 is a summary of the subcategories based on the analyses by Bruno and Goehl (1991, p.79).

Table 2-3: Summary of subcategories for paradigmatic and syntagmatic associations (Based on Bruno and Goehl, 1991, p.79)

CATEGORY	DESCRIPTION	EXAMPLE
Functional	Associations describe the stimulus picture or word in terms of some *characteristic and specific* action, activity or use	book – read (noun – associated verb)
Nominal	Associations fall within the same grammatical class as the stimulus (i.e. noun - noun) and imply a specific subrelation to the stimulus picture or word. Associations can further be categorised as superordinate, coordinate, subordinate, part or location	stimulus pic/word: apple superordinate: fruit coordinate: banana subordinate: pie part: core location: fridge
Visual	Associations describe salient characteristics of the stimulus or reflect configurational similarity	(noun - adjective) ball - round, blue, plastic apple - round, red, etc
Auditory	Associations adds to the auditory dimension in terms of rhyming with stimulus, or indicating an associated sound	hammer - "ouch!" ice cream - "yum!" stone - moan
Episodic	Associations depicts a personal experience associated with the stimulus and are usually narrative descriptions in subject-verb-object format; describing an event, a location, an action or a learned behaviour	candle - at Christmas time there's lots of candles (event) hammer - you put in a tool box (location)
Extraneous	Responses that seem unrelated to the stimulus or inappropriate as association	

As there are different independent association categories, these categories could provide a basis for defining association performance and describing the association categories that could

be used to encode messages using icon sequences (Bruno and Goehl, 1991, p.71). The assessment of an individual's skill of association is generally included in assessment protocols to determine whether the individual would be able to use encoding systems that are based on association. Some of these assessment protocols, like those proposed by Elder, Goossens' and Bray (1989) and Glennen (1997) use certain questions to assess the individual's ability to make associations and to obtain information as to the content and types of such associations. The types of associations that could be cued by such questions could include the following (based on Beukelman and Mirenda, 1998, p.208):

- object function associations – e.g. What do you do with it?
- parts of the whole associations – e.g. What obvious parts does it have?
- similar item associations – e.g. What is similar?
- physical properties associations – e.g. How would you describe it in terms of colour, size, shape, texture, temperature, substance, etc.
- category associations – e.g. What group does it belong to?
- rhyming associations – e.g. What sounds the same?
- look-alike associations – e.g. What looks the same?

Similar questions were posed in the What is Minspeak™? book (Van Tatenhove, 1993) and it seems that these questions are a widely used and seemingly reliable method to cue different types of associations.

In order to provide accountable service to AAC users and their families, we need to investigate the types of associations they make with each of the icons used on the Minspeak-based VOCA. This should be done to determine whether the different multiple meanings associated with each icon could easily be learned and recalled with maintenance of the meanings over time. If the latter is not the case, the encoding strategy is not conducive to rate enhancement or effective communication, whereby accountability of intervention is undermined. Therefore the different associations that users make with the icons should be investigated, so that meanings can be added, omitted and adapted for use.

How schemata are formed, relies heavily on meanings derived during the individual's experiences in context. The subsequent words and their meanings employed by the individual therefore reflect the person's context, including amongst other things his culture, ideas, values, attitudes, and belief system (Thipa, 1980, p.1). This means that the context in which

people live (their culture, their ideas about the world, their values and beliefs on which they ground their existence and their attitudes towards different things, people, activities, ideas, disabilities) influences and is reflected by the associations they make and the different meanings they assign to words. It seems clear that culture is an important part of people's acquisition of world knowledge. Similarly, it impacts on how individuals perceive certain graphic representations and the types of associations they make with these graphic representations, which might impact on the ease of learning. Both nonsymbolic and symbolic forms of communication are dependent on the individual's culture (Huer, 1997, p.25). In order to understand the underlying dynamics of a culture it is important to understand the influence of culture on symbol learning.

2.6.2 The impact of culture on symbol learning

Culture is not acquired by any genetic hereditary process (Thipa, 1980, p.15), but it is learned and transmitted from parents to their children and is therefore a social process. Culture is dynamic as it changes with the ever-changing environment and it adapts to that environment or context (Herskovits, 1970, p.653). There seems to be two different schools of thought concerning the definition of culture. The first considers culture to be an inventory of items that separates one specific culture from another; and the other defines culture in terms of ideas. Collins (1975, p.203) defines culture as "that complex whole which includes knowledge, belief, art, morals, law, custom and any other capabilities and habits acquired by man as a member of society". This will also be the working definition when referring to culture in this study.

Light (1988) emphasised that a client's functional skills within his context should be a priority in intervention. Communication can only be functional if it is set within a specific set of cultural rules. Competency in communication is the sum of functionality and adequacy in four interrelated areas: social competence, operational competence, linguistic competence and strategic competence (Light, 1989). These areas should be seen against a cultural frame of reference, as a person's culture impacts on the level of competency required, the preferences of the user and significant others, what behaviours are expected and what is considered to be appropriate (Hetzroni and Harris, 1996, p.55).
A person with disabilities is essentially part of two cultures: those of a person with disability, and the "indigenous culture that the AAC user was born into" (Hetzroni and Harris, 1996,

p.55). These authors postulate that an AAC user is "by default bicultural" and that this phenomenon requires him to learn functionality in at least both these contexts. This might significantly impact how AAC systems are selected and engineered (law of best fit, law of practicality and use). Having said that, how does the "complex whole" of culture affect how people make associations with Minspeak icons?

People in Africa are generally viewed as inhabitants of a Third World continent where poverty, famine, crime, chronic disease, lack of resources and overpopulation are well-known phenomena. Their knowledge, and supposedly the world knowledge of people from other developing countries, may therefore vary from that of the creators of the Minspeak™ approach and Unity™. Even items viewed as fairly universal like a toilet, a house or even a mother, might conjure up different visual images in Africa, e.g. toilet might constitute a one square meter tin hut next to a tree; a house might be made of brick, of tin, of poles, of branches and leaves, or it may be a cave; a mother might be a teenager, a mature woman, a lady with several brass rings around her neck, a person who prepares food, etc. A specific culture is integrated with the different languages spoken by the members of that culture, and their language reflects those aspects that are important or have been important in the past (Lyons, 1976, p.248). Language and its use is a basic characteristic of both human behaviour and culture, as a large part of culture transmission takes place via language (Thipa, 1980, p.1). Whorf's Dissection Theory (the name taken from the opening line of the quotation presented below), summarises the important impact of language on culture and on the way we view the world.

> *"We dissect nature along lines laid down by our native languages. The categories and types that we isolate from the world of phenomena we do not find there because they stare every observer in the face; on the contrary, the world is presented in a kaleidoscopic flux of impressions which has to be organised by our minds - and this means largely by the linguistic systems in our minds. We cut nature up, organise it into concepts, and ascribe significances as we do, largely because we are parties to an agreement to organize it in this way - an agreement that ... is codified in the patterns of our language."*
>
> *Whorf, (1974:213)*

According to the Dissection Theory, the way in which people from different cultures conceptualise the world varies between languages. Language, and therefore words and their meanings, could be seen as reflecting the culture of its speakers and the circumstances or context in which they live (Thipa, 1980, p.1). Culture can further be viewed as being mirrored or indexed by semantic fields. The impact of semantic fields on culture and associations should be investigated.

2.6.3 Semantic fields

A semantic field (or a semantic domain) is a group of words, phrases or concepts closely related in meaning, that share certain semantic features, characteristics or components (Lehrer, 1974, p.1; Thipa, 1980, p.1). A semantic field defines an area of cultural experience that gives meaning to the different included words and concepts, and it can typically be grouped under a general term (Nida, 1975, p.229). The features denoting the particular semantic field's boundaries are defined by the specific features and components that are common to the different words and concepts included in the semantic field. Lehrer (1974, p.10) emphasizes that not all items in a semantic field have equal status and she distinguishes between basic and peripheral words, where the basic words determine the meaning represented in the specific semantic field.

A semantic field is typically composed of a "common conceptual domain" consisting of words that are related regarding either features of similarity or features of contrast (Lehrer, 1974; Kittay, 1987; Grandy, 1987). These attributes include language features like synonymy, subordinates, coordinates, superordinates, antonymy, et cetera. The features denoting the conceptual base of a specific semantic field were also highlighted in the discussion of the different types of associations, with specific reference to nominal associations. Semantic relations within semantic field theory are at least partly made up of word meanings – a phenomenon that was also mentioned in the discussion on associations.

In the literature, there are two basic tendencies: firstly the tendency to restrict the concept of semantic fields to labels belonging to the same syntactic class; and secondly, to include the study of semantically related words belonging to various parts of speech critical. Both these tendencies are in line with this study's theoretical slant, as associations from both the same and different syntactic classes are included, in order to select vocabulary associated with icons that represent all the different parts of speech. Semantic field theory further claims that word meanings can be understood when they are viewed in relation to other words denoting specific features (Lehrer and Kittay,1992, pp.3-4). The following excerpt from Lehrer and Kittay (1992) aims to explain this phenomenon.

> *"Thus to understand the meaning of the verb "to sauté" requires that we understand its contrastive relation to deep fry, broil, boil, and also to affinitive terms like cook and the syntagmatic relations to pan, pot and the many food items one might sauté."*
>
> *Lehrer and Kittay (1992, p.4)*

In order to understand what the meaning of a word is, we need to understand what it is not. This distinction might not be equally obvious for people with different ethniticity. The criteria for words to be included in a semantic field depend upon the specific relationships among words. E.g. green is a subordinate of colour and a coordinate of red and both red and green are part of the semantic field of colour (Lehrer and Kittay, 1992, p.4). This study's discussion of semantic fields will be limited to relationships denoted by:

- superordinates (vehicles = cars, kombi's, vans, trucks, etc.);
- subordinates (different physical forms of the word like *apple pie, apple juice, apple yoghurt, baked apple,* etc.);
- synonyms (words with similar word meanings, but nuance differences like *pretty* and *beautiful* or *jumping* and *leaping*). In defining a semantic field we would typically want to include synonyms of those terms included;
- coordinates (words specifying shared features like *banana, apple, grape, strawberry* and *pineapple* = fruit); and
- parts (parts of a car = *wheels, doors, seats, engine, lights*, etc.).

For each semantic field there should thus be a single general expression that covers all other items (Grandy, 1992, p.109). Yet, when selecting vocabulary to include on a specific individual's VOCA, different words from the same semantic field are included in order to add richness to the language available to the user. Resemblance among words from the same semantic field and even differences among different semantic fields, can add to the memory load inflicted on the user, when expected to remember the different codes of an encoding system. As mentioned earlier, there are various cognitive demands influencing the effectiveness of rate enhancement techniques and the implementation of semantic field theory should be employed to the AAC user's benefit.

As is currently seen in the Unity™ software, groups of words or concepts from the same semantic field are grouped under a certain icon. The icon then serves as the "general term" under which the other words are included. However, the icon is not only the general term, but also the user's aid for retrieval, as the user can associate a certain group of meanings (i.e. a semantic field) with a specific icon, select the icon and via icon prediction select other icons in the icon sequence. For instance, the APPLE-icon represents the food-related semantic field. When the AAC-user intends to communicate about a food-related subject, he selects

the APPLE-icon - setting the boundaries for the meaning of his message. He can now further select which word or phrase within the boundaries of this semantic field he wishes to use, by selecting the next icon in the icon sequence – based on the visual features, characteristics or components seen when viewing the relevant icons. This principle is the underlying basis of the Unity™ software package.

2.6.4 Unity™

Unity™ is a software programme of prestored messages, based on the semantic compaction or Minspeak approach of minimum effort speech and is used on VOCAs manufactured by the Prentke Romich Company. Historically, a variety of Minspeak Application Programs (MAPs) were developed based on the heterogeneity of the AAC user population. These MAPs were designed for specific purposes and populations. Although these MAPs are still available, they are not widely used due to significant differences in the icons used and the way in which these icons were organised (violations of the law of parsimony, law of minimal energy and law of minimal learning). Unity™ has now replaced these MAPs due to the necessity of meeting an AAC user's specific needs as he progresses through different stages of language and cognitive development.

There are different levels of Unity™ available in accordance with different stages of language development, including Unity™ AT (a 32-option version), Unity™ 128 (a version with 128 selection-options) and the newest addition, Unity™ 64 (a 64-option version), that is used with the Vanguard™. A version for a 16-option device like the Chatbox™ is also available commercially (UniChat™). The different versions make use of a closed set of icons that is placed in more or less the same location, in order to facilitate development to more sophisticated VOCAs as communication skill develops – just like normal (or "typical") children develop communication skills and become more sophisticated. Placing icons in the same location aids the development of automaticity - potentially a further advantage in terms of rate enhancement (adheres to the law of parsimony, the law of minimal energy and the law of minimal learning).

However, Unity™ was developed in the United States. Although there are versions available in other countries and languages, like Germany (German), France (French) and Great Britain (British English), none of the existing versions are guaranteed to be applicable for use in the

South African context. No two languages or cultures are so similar that translation can be done directly and that such a translation can be viewed as representing the same ideas and concepts as the original version. The complexity of factors that can impact on the applicability of a specific version of Unity™ in South Africa, makes adaptation of this software a prodigious task.

In the development of a comprehensive AAC system that is based on iconic techniques, the user and interventionist are faced with two options: they can either develop their own set of graphic representations and assign their own list of prestored messages to each representation; or they can make the assumption that there is a common underlying similarity in the associations that are made by different people and use existing programmes, including a range of possible graphic representations and a range of possible associations with these icons. It seems clear that the former is more individualised and therefore more applicable to the specific user, but the skill, time and cost required for the development of such a system, renders it economically not feasible.

The second option includes the development and/or use of a general programme, like Unity™, that is based on common associations to enable users and interventionists to implement certain icons and their associations for communicative purposes. This option, however, is not problem-free, as the programme might need to be adapted for future use in a particular context. Yet, when viewing the intersubjectiveness of meanings, the researcher would suggest making use of a combination of these two options: implementing general icons and vocabulary as a basis for developing a customised AAC system, but adapting these icons and vocabulary items for the individual.

The current study is a preliminary investigation into the applicability of some of the Minspeak™ icons for South African VOCA users, with recognition of the multitude of factors that might influence the results. These factors include amongst others the user's world knowledge, beliefs, values, culture, attitudes, language, gender, age and area of expertise. However, interventionists working with individuals with little or no functional speech in the South African context (and other developing countries) need a culturally congruent set of common icons and associations on which they could base their selections and concomitantly, possibly improve the level of accountability of service delivery. Hence, the aim of the current study is to determine which words tertiary education students use, to describe associations

with selected Minspeak™ icons and to compare these words with the current Unity™ vocabulary. This will be done to provide interventionists and users with a preliminary basis of possible icons and associations that might be common to South Africans.

2.7 SUMMARY

Chapter 2 gave an overview of literature relevant to this study. The use of iconic encoding, and specifically the Minspeak™ approach, was discussed along with other rate enhancement techniques, followed by a discussion of the associations made with graphic symbols (icons) used in this encoding technique and the impact of culture on the use of these icons.

CHAPTER 3
RESEARCH METHODOLOGY

3.1 INTRODUCTION

In the previous chapter, an overview of the literature relevant to this study was provided. Chapter 3 describes the research methodology of the study in terms of aims, sub-aims, and research design. It includes a description of the participants selected for the study and the material developed and used during this study. A discussion of the pilot study is provided with specific reference to the results and recommendations. This is followed by a description and discussion of the data collection procedure and data analysis process.

3.2 AIMS OF THE STUDY

3.2.1 Main aims

The main aim of this study was to investigate which associations tertiary students in the South African context make with selected Minspeak™ icons.

3.2.2 Sub-aims

The sub-aims of this study were to:

- Elicit associations from South African tertiary education students using the 12 common icons from UniChat™ programme
- Analyse elicited associations and determine their frequency of occurrence
- Compare elicited associations with current vocabulary implemented in Unity™

3.3 THE RESEARCH DESIGN

3.3.1 The research design

The study used a descriptive survey design (Denzin and Lincoln, 2000; Neuman, 1997) and included a single group of 480 tertiary education students from diverse backgrounds. Participants were required to complete a self-administered, open-ended questionnaire. This design was selected to obtain qualitative information regarding the associations that young

adults made with Minspeak™ icons, as a foundation for using these icons in the South African context.

3.3.2 The phases of research

The research was conducted in 2 different phases:

3.3.2.1 Phase 1: Preparation

- Icons were selected (based on criteria as set out in 3.5.1);
- An open-ended questionnaire was developed to elicit associations with Minspeak™ icons;
- A pilot study was carried out using the devised questionnaire and participants who complied with the selection criteria. A critical review of the material and procedure was conducted, and subsequent changes were made.

3.3.2.2 Phase 2: Fieldwork

- Specific groups of students were selected (including students from diverse areas of study) and data was collected;
- Data was analysed; and
- Elicited associations were compared with the current Unity™ vocabulary.

3.4 DESCRIPTION OF PARTICIPANTS

3.4.1 Selection criteria

A set of criteria was formulated in order to select participants for this study. Table 3-1 summarises the selection criteria and the rationale for including them in the selection process.

Table 3-1: Summary of selection criteria and motivation for inclusion

CRITERIA	MOTIVATION FOR INCLUSION
Participants had to be tertiary students at the University of Pretoria between the ages of 17 and 25 years	This age group is known to have rich, creative language, with features of a mature language (Louw, 1990)
Subjects had to have a high level of mastery of the English language and were therefore required to have English prescribed books on tertiary level	The original associations in the US and UK versions of Unity are in English; the questionnaires are also in English
Subjects' vision should be normal or aided to such an extent that it does not inhibit functioning	Subjects need to read cueing questions and make visual associations with a full-colour icon presented to them

3.4.2 Description of participants

All participants in this study were students at the University of Pretoria. This group was not homogenous but, being University students, could be regarded as having average or above average cognitive abilities.

The heterogeneity of the participants was evident. Participants' ages ranged between 17 and 25 years, with the majority between 19 and 21 years of age (see Table 3-4 for details). The majority of participants were male (58,7%), which is in accordance with local and international statistics of the gender ratio for people with disabilities (World Health Report, 2000). Table 3-4 summarises participants' ages and gender.

The multi-lingual nature of the South African context was palpable as 14 different first languages were recorded amongst the participants, including IsiZulu, SiSwati, SeTswana, TshiVenda, Cantonese, IsiNdebele, IsiXhosa, Malayalam, German and XiTsonga. The majority of participants spoke Afrikaans, English and Sepedi (the African language that is most prevalent in the area). In addition to this, nine different second languages (including Bengali, SePedi, German, Greek, Shona and Dutch) were recorded, although the majority of participants indicated their 2nd language to be either English or Afrikaans. This is significant as an important selection criterion was that participants should have a high level of mastery of the English language. Only 9,6 % of participants were English first language speakers, but 89,4 % were English second language speakers. However, as all the participants stated that they had English prescribed books and that it was the language of instruction on a tertiary education level, the assumption of an adequate level of mastery of the English language was made. Tables 3-2 and 3-3 summarise participants' first and second languages respectively.

Tertiary students studying in 21 different degree courses at the University of Pretoria were represented (Table 3-5 portrays the participants' area of study), as the area of study and/or knowledge in a certain field might have influenced the associations made with symbols. Participants from a variety of courses were therefore selected, including students from Social Sciences, Natural Sciences and Economic and Management Sciences. The largest percentage of participants were engineering students, followed by students in Communication Pathology and Psychology. Participants' length of study varied from one to four years, with the majority of participants being either 1st or 2nd year students.

Table 3-2: A summary of participants' first languages

	Afrikaans	English	SePedi	German	XiTsonga	TshiVenda	Cantonese	IsiZulu	SeTswana	SiSwati	IsiNdebele	IsiXhosa	Luganda	Malayalam
Number of participants	381	46	10	5	2	4	4	9	9	1	4	2	1	2
% of participants	79,4	9,7	2,1	1,0	0,4	0,8	0,8	1,9	1,9	0,2	0,8	0,4	0,2	0,4

Table 3-3: A summary of participants' second languages

	Afrikaans	English	German	Bengali	SePedi	Dutch	Malayalam	Greek	Shona
Number of participants	42	429	2	1	1	1	2	1	1
% of participants	8,8 %	89,4 %	0,4 %	0,2 %	0,2 %	0,2 %	0,4 %	0,2 %	0,2 %

Table 3-4: A summary of participants' ages and gender

	Sex		**Age**								
	Male	**Female**	**17 years**	**18 years**	**19 years**	**20 years**	**21 years**	**22 years**	**23 years**	**24 years**	**25 years**
Number of participants	282	198	8	15	300	89	35	18	6	5	4
Total number of participants	480		480								
% of participants	58,7	41,3	1,7	3,1	62,5	18,5	7,3	3,8	1,3	1,0	0,8
Total % of participants	100 %		100 %								

Table 3-5: Summary of participants' area of study

Course	Number of participants	% of participants
B.Com	5	1,0
B.Communication Pathology	56	11,7
Human Movement Sciences	2	0,4
B.Educational Psychology	2	0,4
B Psychology	7	1,5
BSc(Information Technology)	28	5,8
B.Social Sciences	42	8,8
BA	10	2,1
B.Engineering	23	4,8
B.Engineering(Industrial)	23	4,8
B.Engineering(Civil)	25	5,2
B.Engineering(Computer science)	110	22,9
B.Engineering(Electrical)	56	11,7
B.Ed	15	3,1
B.Sc	24	5,0
B.Sc (Financial Maths)	34	7,1
B.Engineering(Mining)	4	0,8
LLB	2	0,4
B.Engineering(Metallurgic)	3	0,6
B.Engineering(Mechanical)	7	1,5
B.Engineering(Chemical)	2	0,4
TOTAL:	480	100 %

3.5 MATERIAL USED

The first sub-aim of this study was to elicit associations from South African tertiary education students. To achieve this goal two steps were followed: i) the selection of Minspeak™ icons with which associations could be made; and ii) the development of a questionnaire to elicit associations.

3.5.1 Icon selection

The selection of icons to be included in this study proved to be an arduous task, as there are more than a hundred different icons in Unity™ alone. To ensure that the selection procedure was more unbiased, compliance with the following selection criteria was required:

Table 3-6: Selection criteria for icons

CRITERIA	MOTIVATION FOR INCLUSION
Icons had to be used for representing common vocabulary of AAC-users	As a first study, it is important to start with icons that were frequently used
Icons had to be used on both beginning communication VOCAs and more sophisticated VOCAs	Icons should cater for development and growth in an AAC-user's communication abilities and needs, e.g. move from single hit messages to multiple hit messages
Icons had to be used on a VOCA that was widely used by AAC-users in SA	The icons need to be relevant for use on an affordable VOCAs within the South African context

Beginning communication VOCAs making use of Minspeak™-icons were investigated. The Minspeak™-based beginning communication VOCA that was most widely used in South Africa, was the Chatbox™. The UniChat™ programme was typically used with the Chatbox™ where fixed overlays were available, with 12 of the 16 options per overlay consisting of common icons, i.e. these icons appeared on each of the fixed UniChat™ overlays provided. The icons used as core icons on the Chatbox's UniChat™ overlays formed part of icon sequences in Unity™/AT and Unity™ 128 and the icons therefore had articulation possibilities with the AlphaTalker™, DeltaTalker™, Liberator™, and Pathfinder™ amongst others. Each of the 12 *core icons* used in the UniChat™ programme was therefore selected as it complied with all the selection criteria. See Appendix A for a list of icons that were included in this study.

3.5.2 Development and description of questionnaires

A questionnaire was subsequently created for each of the 12 icons, keeping the questionnaire constant, but varying the icon and thus creating 12 different questionnaires. See Appendix B for examples of the questionnaires. Literature searches for association cueing questionnaires presented insightful ideas from the areas of Cognitive Science (Nelson, 1977; Petry, 1977) and AAC (Bruno and Goehl, 1991), including associations made with verbal prompts, and visual representations. However, little information was found on self-administered questionnaires developed to elicit associations with visual representations like pictures or icons.

A questionnaire was developed by formulating cueing question to elicit different types of associations. As discussed in Chapter 2, there are two different levels of association categories, including paradigmatic and syntagmatic associations (refer to Table 2-1 for details). These associations are further sub-categorised into functional, nominal, visual, auditory, episodic and extraneous associations (refer to Table 2-2 for details and examples). The individual's ability to make associations are frequently assessed by asking questions to cue the types of associations mentioned above. The cueing questions used for eliciting associations in this study were based on questions found in assessment protocols (Elder et al., 1989; Glennen, 1997). These questions also complied with the questions posed in the *What is Minspeak™?* book (Van Tatenhove, 1993). Table 3-7 presents a summary of the association categories included and the subsequent cueing questions that were included in the self-administered questionnaire.

Table 3-7: The cueing questions included to elicit associations

Question number	The cueing questions	Possible association categories elicited by the cueing question
1	What do you see?	Nominal
2	What do you do with it?	Functional
3	What group/category does it belong to? (e.g. transport, furniture, etc.)	Nominal (superordinate)
4	Who uses it?	Functional; Episodic
5	How would you describe it? (e.g. size, shape, colour, substance, etc.)	Visual
6	Where do you find it?	Nominal (location)
7	What sounds and obvious utterances would you use with it?	Auditory; Episodic
8	Why would you use it?	Functional
9	What obvious parts does it have?	Nominal (part)
10	Name other things that are similar	Nominal (subordinate)
11	In which forms do you find it?	Nominal (coordinate)
12	What goes with it?	Episodic
13	How do you feel using it?	Episodic

3.5.3 Data recording sheets

Two different data recording sheets were developed for Phase 1 of the data capturing procedure. The first was an Excel spreadsheet developed to record all the responses. A separate table was created for every icon with separate columns created for the following (see Appendix C for an example):

- a different column for each of the responses per question
- a column for the number of questions eliciting no response whatsoever;
- a list of the question numbers eliciting no response whatsoever;
- the number of questions only eliciting comments on the question, but no associations;
- a list of the question numbers only eliciting comments on the question, but no associations;
- a column for each of the two most prevalent prepositions;
- the most prevalent article used in relation to concept identified in question 1 of the questionnaire;
- a column for the most prevalent pronoun used in conjunction with concept identified in question 1;
- a column for generic utterances;
- idioms; and
- moral judgements.

The other recording sheet was developed to record the different common associations per question per icon, with their frequencies and the words included in each common association category. See Appendix D for examples.

3.5.4 The compilation of the Unity vocabulary list for comparison

A list of Unity™ vocabulary items was compiled for comparison with the elicited associations. This list was a culmination of the current Unity vocabulary as suggested by two sources: the Vocabulary sort on the "Look who's really talking" CD-ROM (Prentke Romich Company, 1998); and the Unity 128 version of the BUILLD™ customised vocabulary sort (Valot Klotz et al., for Prentke Romich Company, 1997). The compiled list was compared with both these sources to ensure that the final list included all vocabulary cited. The developers of these sources emphasise that these vocabulary items are *not* the only ones that can be used, and the

use of customised vocabulary is encouraged. However, these vocabulary items are included in Unity software packages that are distributed worldwide and are included in this investigation.

3.6 PILOT STUDY

A pilot study was done to review the effectiveness of the material and procedures to elicit the associations. The pilot study was carried out using randomly selected participants that complied with all the selection criteria. The results are summarised in Table 3-8:

Table 3-8: A summary of the findings of the pilot study

AIMS	PROCEDURES	RESULTS	RECOMMENDATIONS
1. To determine whether the instructions are easily understandable	Participants had to complete the questionnaire, followed by a discussion	Most participants conveyed that they understood the instructions well. This was confirmed by the responses derived. Two participants revealed that they did not read the instructions.	No alterations to instructions are necessary, except to block and bold them, to ensure that participants read the instructions.
2. To evaluate the ease with which the participants understand the language and specific terminology used in the questionnaire	Participants completed the questionnaires and a group discussion was held about the difficulties experienced in completing the questionnaires	Participants reported that they found the questionnaire "easy", except for four questions - numbers 3, 5, 7 and 9. Students affirmed that they understood the instructions well. This statement was confirmed by their responses	The questions that were difficult to understand were rephrased and, where necessary, highlighted with an example.
3. To determine the amount of time required for completing a questionnaire	As for the main study each participant had to complete one questionnaire and the amount of time required to complete a questionnaire was determined	Participants completed the questionnaires in between 7 and 10 minutes	At least 12 minutes need to be allocated in the data collection procedure for every participant to complete his/her questionnaire
4. To determine feasibility of the data collection procedure proposed	A short introduction to the aims of the research was given to the students, they had to complete the questionnaire independently, the questionnaires were collected and an incentive was handed to each student	It seems that data collection will be easier with the aid of at least 2 research assistants to aid in collecting questionnaires from students around the lecture hall. Students reacted favourably to the small incentive	At least two research assistants need to be recruited to help with the data collection procedure
5. To test the efficiency of the computerised system that is to be used in data capturing	Data was captured in Excel, creating a column for every response	The data capturing procedure proved to be efficient in terms of time and reliability	MS Excel will be used for capturing data
6. To determine the effectiveness of the questionnaire in eliciting associations from South African young adults	The aims of the study were briefly explained to students and students had to complete the questionnaire.	Creative associations were elicited from the participants. They were excited to be part of the research.	This questionnaire seems to be effective in eliciting associations from South African tertiary students and, when adjusted according to the recommendations mentioned above, could be used for determining their associations with icons and pictures.
7. To determine whether the analytic framework will be effective in interpreting results	The data analysis procedure was followed as described for the main study, looking at the effect of the different icons on association performance.	Data analysis and interpretation seem to be effective, but more information is needed on the impact of the different questions on association performance.	Clear guidelines need to be established, with the interrater, for pruning to ensure reliability

3.7 DATA COLLECTION PROCEDURE (MAIN STUDY)

3.7.1 Preparation for fieldwork

The following procedure was used while preparing for the fieldwork:

a) Groups of potential participants were selected (see Table 3-1 for selection criteria), including students from the Social Sciences, Natural Sciences as well as the Economic and Management Sciences
b) The respective lecturers were approached to request assistance. Upon compliance, time slots were discussed. These time slots were scheduled for the first 20 minutes of a 50 minute lecture period in every instance
c) Questionnaires were reproduced in colour, to preserve the icons' colour and print quality
d) 40 copies of each of the 12 questionnaires were made. The 480 questionnaires were sorted, alternating the icons to ensure adjacent participants who complete the questionnaires supplied original answers

3.7.2 Fieldwork (Data collection)

The following procedure was used for data collection:

a) The researcher introduced herself and the research assistants and briefly explained the aims of the research
b) The researcher explained what would be expected of participants and requested students who were not willing to participate to leave the room. Care was taken during the introduction not to influence the participants in any way and to put them at ease. No names were attached to the questionnaires to ensure confidentiality. All participants had the right **not** to participate in the study or to exit at any particular point in time during the fieldwork (See Appendix E for verbatim instructions)
c) Questionnaires were distributed to participants and a time frame for completion (approximately 10 minutes) was suggested, but no time limit was given
d) On completion, participants handed their questionnaires to one of the research assistants who checked the questionnaires for completeness
e) Questionnaires were sorted according to the depicted icon and were numbered to ensure that the intra-rater and inter-rater could refer back to the different questionnaires if needed
f) Pruning of responses were done according to the guidelines provided in 3.8.1
g) Responses were captured on MS Excel spreadsheets and common associations were established

3.7.3 Research assistants

Two research assistants were recruited to assist the researcher in handing out and collecting questionnaires from students during the data collection procedure. These research assistants were students in the Honours in AAC programme at the University of Pretoria.

3.8 DATA CAPTURING PROCEDURES

As the questionnaires only included open-ended questions, responses had to be recorded accordingly. Responses were pruned and captured on Excel spreadsheets (see Appendix C for example), according to guidelines based on the work of McBurney (1998), the type of associations/concepts used in the current Unity™ software, discussions with the other students and the supervisor in the Masters programme in AAC and the researcher's experience with analysing the data during the pilot study. See Appendix F for an example of a pruned questionnaire.

Table 3-9: Guidelines for pruning and data capturing

Data capturing procedure	Example
The "golden rule" is to focus on the concept portrayed and not simply the words. Implied concepts are also included	*man behind bars* can be recorded as: man/ behind/ bars/ man-behind-bars (i.e. convict)/ behind bars (i.e. convicted)/ in jail
Record only root words - modifications pruned	"round" in stead of roundish, etc.
Basic concepts were recorded, whilst pruning articles	recording "eat", "watch" and "communicate" in stead of "eat it", "watch it" and "communicate with it"
A generic utterance was only recorded when it was a full sentence, while it was pruned if it was only an introduction to or an insignificant part of the response	"I don't know" as opposed to "The fact that …"
Multiple words in response to the same question, from the same semantic field were coded separately, as this might provide information to facilitate learning or enhance richness of vocabulary	"jumping" and "leaping"; "pretty" and "beautiful"
Prepositions denoting a specific element were coded *with* the specific element	"behind bars" can be any one or more of the following elements: behind/bars/behind bars (i.e. convicted)
Record the number of questions that did not elicit an association, but only a comment on the question or were omitted intentionally (i.e. line drawn in/across the response area of questionnaire)	2 questions were consciously omitted (by means of drawing a line in the response area) - questions number 7 and 11
Those prepositions that were most prevalent in every questionnaire and used in connection with the concept provided in question 1 (i.e. "What do you see?"), were recorded separately. The two most prevalent prepositions were recorded	"behind" and "under"

The second rater was involved in the development of the pruning guidelines to ensure applicability. See section 3.9.4 for more details.

3.9 DATA ANALYSIS AND STATISTIC PROCEDURES

The data analysis procedure consisted of two phases, namely the primary phase where the percentage of occurrence of an association was calculated, and the secondary phase that included determining the impact of the icons and cueing questions on the association performance, and comparing elicited associations with the current vocabulary found in Unity.

3.9.1 Phase 1

After responses were computerised, the percentage at which the associations occurred was calculated. These associations were further categorised, in order to determine what the common associations elicited for each icon were. For this purpose, words/phrases/concepts from the same semantic field were grouped together under a general term describing the relationship between the lexical units (see Chapter 2 for a detailed description of semantic fields), e.g. the APPLE-icon elicited associations like banana, peach, strawberries, grapes, pears, et cetera, and a common association was recorded as "Other fruit".

An arbitrary **minimum frequency of 15%** had to be achieved in order for an association to be regarded as a meaningful **common association**. This was done in compliance with the current Unity™ format, where there are different categories of associations connected with the first icon in these icon sequences; and more specific items defined by the second and third icon in the different icon sequences. These association categories were created in conjunction with the second rater (see section 3.9.4 for more details).

3.9.2 Phase 2

The second phase of the data analysis procedure had three parts: (i) analysing data to determine what the effect of the icons were on association performance; (ii) analysing data to determine the impact of the cueing questions on association performance; and (iii) using the common associations and the words/phrases/concepts included under each of them to compare them with the associations used in the current Unity™ 128 software. A recording sheet was developed for every question, in order to record the three common associations with the highest frequencies and the words/concepts/phrases that were included under each common association (see Appendix D for examples).

Only those **common associations** occurring at a percentage of **more than 15 %** were included. Common associations that did not occur at a frequency of 15 % or more, were

categorised under the "Other associations" category and the percentage of occurrence per question per icon was calculated. The common association per icon with the highest percentage was coined the first level association, with the subsequent associations called the second and third level associations. An average percentage of occurrence of the three common associations per question per icon was established, as well as the percentage of the first level association per question per icon.

3.9.2.1 The cueing questions' impact on association performance

Calculations were done to determine whether there were significant differences in association performance as elicited by every question across icons. The average of commonality was determined for every question across all 12 icons by calculating the average of the top three common associations' percentage of occurrence per question per icon. These figures were analysed in terms of meaningful differences in association performance.

3.9.2.2 The icons' impact on association performance

Other calculations were done to determine whether there were significant differences in association performance across the different questions for every icon. The average of the three common associations' percentage of occurrence was calculated across questions for every icon, as well as an average of every question's first level association across questions for every icon. Once again, these figures were analysed in terms of meaningful differences and patterns of association performance that might have been evident.

3.9.2.3 Comparison of elicited responses and current Unity™ vocabulary

The list of words used to describe associations was compared with the compiled list of current Unity™ vocabulary (see 3.5.4 for a description of the compilation process). The comparison was made on two levels. Firstly, the actual Unity™ vocabulary was compared with the words used to describe concepts elicited in this study. For this purpose the percentage of agreement was calculated *for every icon*, using the following formula:

$$\frac{\textit{The total number of communal words}}{\textit{Total number of words included in Unity}} \times \frac{100}{1}$$

The second comparison made was to describe the commonalities between the lists in terms of the concepts used and similarities in the semantic fields used and elicited. This was done as a comparison of only the words might misrepresent conceptual commonality.

3.9.3 Intra-rater reliability

The researcher recorded the responses according to the aforementioned guidelines and after a period of 10 days the responses were re-recorded. Intra-rater reliability was calculated at 94,3 %, according to the formula proposed by McReynolds and Kearns (1983):

$$\frac{\textit{total amount of similarities}}{\textit{total amount of similarities and differences}} \quad X \quad \frac{100}{1}$$

It was decided that, based on the high level of intra-rater reliability, the questionnaires and recording sheets could be handed to the second rater.

3.9.4 Interrater reliability

The second rater was a PhD-student in the field of AAC, at the University of Pretoria. The interrater involvement in the data capturing and analysis procedures of this study was fourfold. See Table 3-10 for a summary of interrater involvement, the nature of involvement and the results of procedures. For procedure 2 and 3 the interrater reliability was calculated according to the previously mentioned formula (McReynolds and Kearns, 1983). High levels of interrater reliability was calculated (see Table 3-10) and the researcher could proceed.

Table 3-10: Summary of second rater involvement

#	Procedures where second rater was involved	Nature of interrater involvement	Results of interrater involvement
1	Establish guidelines for pruning and capturing of responses on Excel spread sheets	A set of guidelines were developed following a discussion between the students in the Masters programme in AAC at the University of Pretoria and their supervisor. These guidelines were used during the pilot study to obtain further details. This set of guidelines was submitted to the second rater together with a random sample of questionnaires to obtain feedback on the applicability of the guidelines. A discussion of what the aims of the guidelines were, followed.	After the discussion about the aims of the guidelines and the interrater investigation, some clarification was needed on the guidelines submitted to the interrater. Changes were subsequently made to the guidelines and the set of guidelines was seen as applicable to the response pruning of this study.
2	Recording responses on the Excel spread sheets	The researcher recorded the responses according to the guidelines (also see intra-rater reliability in section 3.9.3). Recording of responses had to be checked for reliability and 14 % of response sets (questionnaires and recording sheets) were submitted to the second rater to obtain data for interrater reliability. The second rater had to check the responses the researcher recorded and mark differences.	Making use of the formula suggested by McReynolds (1983), it was established that interrater reliability for this procedure was 97,9 %, which was considered high enough to proceed. See Appendix G for more detail.
3	Deciding on the minimum percentage of commonality that would be expected of an association in order to be considered a common association	Discussions were held with both the supervisor and second rater respectively, as to what percentage of commonality (i.e. what percentage of responses were a specific association) would be high enough to regard as significant.	A preliminary minimum of 10 % commonality was suggested, but further data analysis indicated that 15% commonality would be more desirable.
4	Further categorisation of responses into semantic fields to establish common associations	The responses per question per icon were grouped for synonyms, co-ordinates, parts, sub-ordinates; and different semantic fields were identified by the researcher. The results of this subcategorisation was submitted to the second rater to check and record changes where necessary.	The amount of similarity between the researcher and second rater was initially 91,2 %. This was followed by a discussion of differences. Another 14 % of categorisation sets were analysed and interrater reliability was now established on 97 %, which was considered high enough to proceed.

3.10 SUMMARY

This chapter described the research methodology of the study. It included the aims, sub-aims and research design for the study. The pilot study was discussed with specific focus on the results and recommendations for the main study. The different criteria for selection, and a description of participants were provided. Finally, the data collection and analysis procedures were discussed with specific attention to interrater reliability.

CHAPTER 4
RESULTS AND DISCUSSION

4.1 INTRODUCTION

Chapter 3 described the research methodology of the study. This chapter describes the results obtained, which are discussed against the background of the sub-aims as stated in the previous chapter. The responses elicited for each icon will be discussed in terms of the different common associations and the percentage of commonality with which these associations occurred. The influence of the different cueing questions on the types and percentage of occurrence of the elicited associations is reviewed. Finally, the results of a comparison between the elicited associations and the current Unity™ vocabulary are described and discussed.

4.2 RESPONSE RATE

As described in Chapter 3, a self-administered questionnaire was used to elicit associations from tertiary education students. A high average response rate of 97 % was achieved, which indicates that on average 97 % of respondents provided associations across the different questions, ranging between 96 and 99 % for different icons. Table 4-1 is a summary of the response rate per question per icon.

Table 4-1: Summary of response rate per question per icon

Icon	Percentage of responses per question (%)													Average response rate (%) per icon
	1	2	3	4	5	6	7	8	9	10	11	12	13	
apple	100	100	100	100	100	100	95	100	98	100	98	98	98	99
wanted	100	95	98	98	98	98	90	93	100	98	93	95	90	96
thumbs up	100	100	93	100	95	100	98	98	100	88	83	95	98	96
thumbs down	100	98	98	100	98	98	93	100	100	95	90	98	100	98
frog	100	95	100	100	100	100	98	85	98	90	93	100	85	96
interjection	100	100	93	100	100	100	98	98	98	93	93	95	98	97
sentence	100	98	98	100	95	100	95	95	100	95	90	100	100	97
knot	100	98	93	100	100	100	88	98	98	98	100	95	100	98
stop	100	100	100	100	100	100	93	98	100	100	100	95	100	99
return	100	98	100	95	100	95	88	93	98	98	98	95	93	96
medical	100	100	100	100	100	98	98	98	100	100	98	95	90	98
music	100	100	98	100	95	100	95	95	95	85	93	93	95	96
Average response rate (%) per question	100	99	98	99	98	99	94	96	99	95	94	96	96	97

Table 4-1 indicated that there were marginal differences among some of the questions of some of the icons, with only 5 questions across all the icons achieving a response rate of below 90%. However, all questions across all 12 icons achieved a response rate of 85 % or more. Table 4-1 also provides the average response rate *per question,* and the average response rate *per icon.* These results indicate that there were no significant differences in response rate between icons, with all the *icons* achieving a response rate of above 96 % and all the *questions* achieving a response rate of above 94 %.

4.3 ASSOCIATION PERFORMANCE

The elicited associations were pruned, computerised and analysed to determine the extent of commonality that occurred in the elicited associations per question per icon. In collaboration with the second rater, associations were grouped into semantic fields and the percentage of commonality calculated. An arbitrary percentage of 15 % was required of a specific association in order to be regarded as a common association. All the common associations (i.e. those with a percentage of more than 15 %) were recorded unto recording sheets - one for every question of every icon. The common association with the highest percentage of commonality were designated the 1st level association, with the 2nd and 3rd level associations as the subsequent most common associations. In all cases there were a maximum of three common associations (> 15 %), but sometimes only one or two. Associations that did not achieve a percentage of commonality of more than 15 % were grouped together as "other associations". These associations were not discarded, as they might prove to be useful once a vocabulary list for South African VOCA users is compiled.

The recording sheets completed for every question of every icon included the different areas of commonality (1st, 2nd and 3rd level common associations), the percentage of commonality, the percentage of "other associations", the average of commonality across the different levels of common associations, as well as the words included in every area of commonality (see Appendix D for an example). Table 4-2 is a summary of all the percentages of commonality calculated for every level of commonality per question per icon, as well as the averages achieved for each of these per icon. Refer to Table 2-6 for a list of the cueing questions.

Table 4-2: Percentages of common associations (%) per question

Icon and level of common association	Number of cueing question																
	1	2	3	4	5.1	5.2	5.3	5.4	6	7	8	9	10	11	12	13	Average
	Percentages of common associations (%)																
APPLE 1ST	80	89	61	57	48	59	76	50	54	56	42	64	94	52	72	92	65
APPLE 2ND	18	-	39	19	26	24	-	25	33	31	29	36	-	20	-	-	27
APPLE 3RD	-	-	-	19	21	-	-	25	-	-	-	-	-	17	-	-	21
OTHER ASSOCIATIONS	2	11	-	5	5	17	24	-	13	13	29	-	6	11	28	8	13
Common associations' average	49	89	50	32	32	41	76	33	44	44	36	50	94	30	72	92	54
FROG 1ST	43	25	42	47	72	33	77	87	64	59	16	89	40	33	27	53	50
FROG 2ND	34	20	25	33	-	33	18	-	26	16	16	-	22	26	18	24	24
FROG 3RD	-	-	17	19	-	33	-	-	-	-	-	-	-	-	-	21	23
OTHER ASSOCIATIONS	23	55	16	-	28	-	5	13	10	25	68	11	38	41	55	2	29
Common associations' average	39	23	28	33	72	33	47	87	45	38	16	89	31	30	21	32	42
INTERJECTION 1ST	60	43	45	35	79	40	70	63	31	58	45	25	51	37	34	28	47
INTERJECTION 2ND	27	22	24	24	-	33	30	-	25	27	37	19	19	22	26	25	26
INTERJECTION 3RD	-	16	17	22	-	27	-	-	24	-	-	18	18	-	19	18	20
OTHER ASSOCIATIONS	13	19	14	19	21	-	-	37	20	15	18	38	12	41	21	29	23
Common associations' average	43	27	29	27	79	33	50	63	27	42	41	22	29	29	26	23	37
KNOT 1ST	57	60	55	55	52	68	80	50	39	32	44	40	49	37	41	77	53
KNOT 2ND	40	33	38	45	28	-	-	40	35	26	28	39	24	29	33	19	33
KNOT 3RD	-	-	-	-	-	-	-	-	26	19	-	-	-	17	-	-	21
OTHER ASSOCIATIONS	3	7	7	-	20	32	20	10	-	23	28	21	27	17	26	4	18
Common associations' average	49	46	45	50	40	68	80	45	33	26	36	39	37	28	37	48	44
MEDICAL 1ST	84	47	58	63	77	50	36	75	45	62	69	51	83	60	36	69	60
MEDICAL 2ND	16	31	23	27	-	25	36	-	24	17	25	32	-	-	23	24	25
MEDICAL 3RD	-	22	19	-	-	-	21	-	17	-	-	16	-	-	19	-	19
OTHER ASSOCIATIONS	-	-	-	10	23	25	7	25	14	21	6	1	17	40	22	7	17
Common associations' average	50	33	33	45	77	38	31	75	29	39	47	33	83	60	26	46	47
MUSIC 1ST	91	27	56	68	47	38	71	33	44	57	39	35	16	46	37	81	49
MUSIC 2ND	-	24	-	-	40	-	-	33	30	23	33	23	-	25	26	-	29
MUSIC 3RD	-	16	-	-	-	-	-	17	-	-	-	-	-	-	-	-	17
OTHER ASSOCIATIONS	9	33	44	32	13	62	29	17	26	20	28	42	84	29	37	19	33
Common associations' average	91	22	56	68	43	38	71	28	37	40	36	29	16	35	32	81	45
RETURN 1ST	62	26	33	33	50	86	41	17	27	28	32	30	24	16	17	57	36
RETURN 2ND	21	23	28	33	43	-	41	-	22	16	17	19	21	16	15	19	24
RETURN 3RD	-	21	21	24	-	-	-	-	-	-	-	-	-	-	-	-	22
OTHER ASSOCIATIONS	17	30	18	10	7	14	18	83	51	56	51	51	55	68	68	24	39
Common associations' average	42	23	27	30	46	86	41	17	25	22	24	24	22	16	16	38	31
SENTENCE 1ST	48	72	45	89	60	50	50	44	82	30	87	31	36	27	34	78	54
SENTENCE 2ND	46	-	43	-	20	25	25	28	16	30	-	29	22	-	-	-	28
SENTENCE 3RD	-	-	-	-	20	25	-	22	-	21	-	19	17	-	-	-	21
OTHER ASSOCIATIONS	6	28	12	11	-	-	25	6	2	19	13	21	25	73	66	22	24
Common associations' average	47	72	44	89	33	33	38	31	49	27	87	26	25	27	34	78	47
STOP 1ST	76	58	88	75	38	71	64	85	82	54	70	37	52	47	35	61	62
STOP 2ND	17	23	-	20	25	29	36	15	-	26	26	25	30	26	25	31	25
STOP 3RD	-	-	-	-	-	-	-	-	-	-	-	16	-	17	16	-	16
OTHER ASSOCIATIONS	7	19	12	5	38	-	-	-	18	20	4	22	18	10	25	8	16
Common associations' average	47	40	88	47	31	50	50	50	82	40	48	26	41	30	25	46	46

Table 4-2: Percentages of common associations (%) per question (cont.)

Icon and level of common association	Number of cueing question																
	1	2	3	4	5.1	5.2	5.3	5.4	6	7	8	9	10	11	12	13	Average
	Percentages of occurrence of common associations (%)																
THUMBS UP 1ST	63	59	34	63	25	42	20	53	63	50	70	40	52	32	53	72	49
THUMBS UP 2ND	32	28	25	33	25	25	20	21	-	-	-	20	36	-	17	-	26
THUMBS UP 3RD	-	-	16	-	19	-	20	-	-	-	-	16	-	-	-	-	18
OTHER ASSOCIATIONS	5	13	25	4	31	33	40	26	37	50	30	24	12	68	30	28	29
Common associations' average	47	44	25	48	23	33	20	37	63	50	70	25	44	32	35	72	42
THUMBS DN 1St	44	33	40	100	20	56	18	27	44	51	44	49	39	32	65	37	44
THUMBS DN 2Nd	34	32	19	-	20	22	82	20	31	24	30	37	24	16	18	33	29
THUMBS DN 3Rd	16	25	19	-	20	-	-	20	-	-	-	-	-	16	-	-	19
OTHER ASSOCIATIONS	6	10	22	-	40	22	-	33	25	25	26	14	37	36	18	31	25
Common associations' average	31	30	26	100	20	39	50	22	38	37	37	43	31	21	41	35	38
WANTED 1ST	38	28	30	58	50	73	25	60	49	42	34	39	24	48	37	41	43
WANTED 2ND	30	28	23	16	31	20	22	20	20	29	34	36	24	-	-	28	26
WANTED 3RD	22	-	-	-	-	-	19	20	20	16	-	22	20	-	-	-	20
OTHER ASSOCIATIONS	10	44	47	26	19	7	33	-	11	13	32	3	32	52	63	31	28
Common associations' average	30	28	26	37	41	47	22	33	30	29	34	32	23	48	37	23	32

From Table 4-2 it appears that there were two basic patterns of association performance for different questions of different icons. The first pattern was where there was one common association with a high percentage of commonality (>60 %), with (in some cases) one other association with a much lower percentage of commonality (<25%). The second pattern was where there were two or three common associations elicited, all with moderately high percentages of commonality (26 - 59%). Each of these patterns have value when looking at the laws of minimal learning and minimal energy. If an icon elicited one major common association (commonality of >60%), with another minor common association (commonality of <25 %) a high level of agreement is indicated, which might suggest that more participants were familiar with the referent in terms of the major common association. If an icon elicited two or three associations per question (commonality between 26 and 45 %), common associations with a wider range might be obtained, but because of a lower percentage of commonality might be less familiar to some users and might therefore need additional support in learning. Both these patterns are quite important when an attempt is made to adapt a system like Unity™ for the South African context. It is necessary to establish a common association that is familiar to a large group of people, but with the added richness of other common associations albeit of moderate commonality (26 - 45 %), to cater for different users with different characteristics, world knowledge and experience. Thus, it is not only the associations with high percentages of commonality that are usable, but associations that were elicited less frequently might require more effort to learn for some people. This does not

necessarily comply with the laws of minimal learning and minimal energy.

4.3.1 Association performance per question

Table 4-3 summarizes the averages derived from Table 4-2 including data for every question across all the icons.

Table 4-3: Average percentages of common associations per question (%)

	Number of cueing question															
	1	2	3	4	5.1	5.2	5.3	5.4	6	7	8	9	10	11	12	13
	Average percentages of common associations (%)															
Average of common associations per question	47	40	40	51	45	45	48	43	42	36	43	37	40	32	34	51
Average of "other" associations per question	8	22	18	10	20	18	17	21	19	26	29	21	30	41	38	9

Table 4-3 indicates that all the questions elicited common associations with average percentages ranging between 32 and 51 %. The results indicated that cueing questions 1, 4 and 13 elicited slightly higher average percentages (>47 % commonality) than the rest, with cueing questions 7, 9, 11 and 12 eliciting slightly lower average percentages (<37 % commonality). These results were confirmed by the averages of "other" associations elicited. It is interesting to note that the response rate *per question* (see Table 4-1) indicated that questions 7 and 11 had slightly lower response rates (94 %), in addition to having lower average percentages. The response rate for questions 1 and 4 were very high (100% and 99% respectively) and these questions elicited slightly higher average percentages. However, the response rate for question 9 is high (99 %) and yet its average percentage is among the lowest, indicating that almost all the participants responded with associations, but that the elicited associations were substantially diverse. There are a number of possibilities that could explain this phenomenon: (i) the question might not have been clear to some of the participants, where culture, gender, language and/or age could have had an effect; (ii) these question depended heavily on world knowledge and frame of reference, and elicited a wide variety of responses retrieved from each person's episodic memory, where variety undermined commonality; (iii) interaction between these and other factors could have influenced the association performance.

However, with regards to the averages of common associations elicited by every cueing question, the range is quite narrow (with a difference of less than 20 %), suggesting that the

cueing questions might have been effective in eliciting a number of common associations. The "other associations" elicited cater for a variety and diversity across cultures, languages, sexes, ages and genders and this might prove to be a positive aspect once a list of probable words to include in Unity™ for South Africans is compiled, as the South African population is heterogeneous in many aspects.

4.3.2 Association performance per icon

Table 4-4 provides a summary of the average percentages of commonality derived from Table 4-2 (calculating the average of commonality across the 1st, 2nd and 3rd level common associations), as well as the average percentage of commonality achieved by the 1st level association per icon across questions and the range of these percentages.

Table 4-4: Average percentages of commonality per icon (highest to lowest %)

ICON	AVERAGE OF COMMONALITY AVERAGES ACROSS QUESTIONS (%)	AVERAGE OF THE PERCENTAGES OF THE 1ST LEVEL COMMON ASSOCIATIONS (%)	RANGE OF HIGHEST PERCENTAGES OF 1ST LEVEL COMMON ASSOCIATIONS (%)
APPLE	54	65	42 to 94
STOP	47	62	35 to 88
MEDICAL	47	60	36 to 84
SENTENCE	47	54	27 to 89
MUSIC	45	49	16 to 81
KNOT	44	53	32 to 80
FROG	42	50	16 to 89
THUMBS UP	42	49	20 to 72
THUMBS DOWN	38	44	20 to 100
INTERJECTION	37	47	25 to 79
WANTED	32	43	24 to 73
RETURN	31	36	17 to 86

Table 4-4 indicates that for the average percentage of commonality (calculated from the percentages of the 1st, 2nd and 3rd level common associations across questions per icon), marginal differences were found between the icons. The APPLE icon achieved the highest percentage of commonality as well as the highest average percentage for all the 1st level common associations, followed by the STOP, MEDICAL and SENTENCE icons (>47%). The INTERJECTION, WANTED, and RETURN icons achieved the lowest average percentages of commonality (<37%). The variance between these icons is evident and it seems that some icons achieved better in terms of the percentages of commonality they elicited. This might be a reflection of the applicability of these icons' associations to the South African population.

4.3 DISCUSSION OF EACH ICON'S ASSOCIATION PERFORMANCE AND A COMPARISON OF THE ELICITED ICONS WITH UNITY™

Every icon will now be discussed in terms of its average percentage of commonality, and the average percentage of the 1st level common associations. The elicited associations will be compared with the current Unity™ vocabulary on two levels (as described in Chapter 3). Firstly, the percentage of agreement between the *words* used to describe associations in this study and the current Unity™ vocabulary was scrutinized. When less than 15 % of the current vocabulary items were communal to both lists, the agreement was seen as restricted; when 16 - 30 % words were found to be communal, agreement was rated as limited; moderate agreement was constituted by between 31 and 50 % communal words, and above 50 % was deemed an acceptable percentage of agreement for compliance with the law for minimal learning. This requirement was established arbitrarily and clinicians might want to increase the required percentage, as this implies that 50 % of the vocabulary would still have to be learnt - probably with some effort. Table 4-5 is a summary of the percentage of agreement between the two lists for all the icons.

Table 4-5: Summary of agreement between compared lists

Icon	Amount of similarities	Percentage of agreement (%)
Apple	41 communal words out of 149	28
Stop	6 communal words out of 10	60
Medical	5 communal words out of 25	20
Sentence	3 communal words out of 57	5
Music	8 communal words out of 39	21
Knot	1 communal word out of 14	7
Frog	3 communal words out of 11	27
Thumbs up	7 communal words out of 20	35
Thumbs down	3 communal words out of 23	13
Interjection	1 communal word out of 40	3
Wanted	4 communal words out of 10	40
Return	6 communal words out of 27	22

Table 4-5, the results of the 1st level of comparison (comparing words), revealed that in most cases the percentage agreement between the two lists was below 35 %, with only two exceptions (for the STOP and WANTED icons), which achieved agreement of 60 % and 40 % respectively. This indicated that for the majority of icons there were more than 60 % of *vocabulary* items that were not similar. The second level of comparison entailed a comparison in terms of *communal concepts*. This was necessary since investigating the agreement between words only might have been misleading. These results will be discussed for every icon, with focus on recommendations for implementation of these icons for the South African population.

4.3.1 Associations with the APPLE icon

The APPLE icon obtained a 99 % response rate (see Table 4-1), suggesting that participants easily related to this icon. The average for the 1st level common association for the APPLE icon across questions, was the highest of all the icons (65 %), and ranged between 42 % and 94 % (see Tables 4-2 and 4-3). The average for the APPLE icon's first three common associations was 54 % that was also the highest average (see Table 4-2 for a summary of each level's percentage of commonality per question per icon). The different common associations for the APPLE icon are summarized in Appendix F. Table 4-6 portrays a comparison of the elicited associations and current Unity™ vocabulary.

The comparison of the elicited associations with the current Unity™ vocabulary indicated that there was an agreement of 28 %, where 41 of the possible 149 vocabulary items were communal (see Tables 4-5 and 4-6). There were some differences that could be related to differences in contexts and cultures, as well as world knowledge that could have an impact on the learnability of the APPLE icon. As this icon has a high percentage of commonality, it seems that it might be relatively easy to learn, as most of the participants were able to relate to the icon and make associations similar to the current associations included in Unity™ (Luftig and Bersani, 1985; Paivio, 1986, Schlosser, 1994).

A comparison of communal concepts indicated that, as in the current Unity™ vocabulary, the associations elicited in this study mostly referred to food-related items. It follows that South Africans wanting to use Unity™ might be able to expand their vocabulary to include the vocabular adopted in Unity™ with relatively little effort, adhering to the laws of minimal learning and minimal energy. However, culturally appropriate food-items might need to replace items in the current Unity™ vocabulary - like *ketchup, rigatoni, tortellini, refried beans, burrito, salsa, taco, enchilada, ravioli, linguini, bologna, cracker, pretzel* - as many of these items and/or their labels are unknown to the average South African. Items like *pap, potjiekos, atjar, chakalaka, chips, bunny chow, vetkoek, tomato sauce, braai, kebab,* and *stirfry*, might replace the said items. Many of the suggested words are taken from different South African languages, but - as in other parts of the world - these have become commonly used across the range of cultures and languages in the country.

Table 4-6: Comparison of associations with APPLE icon elicited in this study and the current Unity™ vocabulary

Associations elicited in this study only			Communal words		Associations included in the current Unity versions only		
construct the theory of gravity	munch	chopped*	apple	peach	egg	pasta	order*
peel*	crack	baked*	bite*	pear	butter	snack	set*
use as weapon	ah	grated*	chew*	pineapple	cracker	bagel	plow*
mothers	nice	rotten*	eat*	strawberry	crisp(UK)/potato chip(US)	bread	teatime
Newton	smacking lips	squashed*	taste*	tomato	nut	cereal	tractor
people on a diet	eeeuuu worm!	small blocks	ice cream	candy	popcorn	oatmeal(US)/porridge(UK)	broccoli
healthy^	"I'm hungry"	cut*	pie	sauce	pretzel	rice	brussels sprout
herbivores	"An apple a day keeps the doctor away"	ice cream	food	anyone	sandwich	toast	cabbage
round^	nutrition	fruit salad	fruit	salad	biscuit(UK)/cookie(US)	waffle	carrot
sphere	nourishment	cinnamon	delicious^	cheese	cake	angel hair	cauliflower
circle	essential vitamins	apple tart	hungry*	pork	cupcake	fettucini	celery
heart-shaped	minerals	toffee	sour^	salt	custard(UK)/pudding(US)	linguini	chips(UK)/french fries (US)
oval	balanced diet	syrup	vegetable	pancake	doughnut	macaroni	corn
off-round	tasty^	refreshments	sweet^	red	bacon	noodle	cucumber
voluptuous	thirsty^	cream	apple	yum	beef	pizza	lettuce
fibre	portable^	pie	banana	sugar	bologna	ravioli	mushroom
water	common	worm	cherry	yogurt	cheeseburger	rigatoni	onion
tree	juicy^	content	grape	chocolate	chicken	shell	pea
grow*	fruity^	satisfied	grow*	horse	ham	spaghetti	potato
shops	pips	energised	lemon		hamburger	tortellini	spinach
Pick 'n Pay	twig	enjoy	anybody		hot dog	honey	any time
cafeteria	branch	fulfilled	orange		pepperoni	jam(UK)/jelly(US)	anyhow
market	leaves	good^			sausage	ketchup	anymore
green grocers	naartjie	great^			steak	mayonnaise	anything
fruit markets	mango	happy^			turkey	mustard	anyway
kitchen	juice	refreshed*			butterscotch	oil	anywhere
fridge	canned*	relieved*			vanilla	peanut butter	crisp
crunch	puree	non-fattening			cereal and grain	pepper	lime
					condiment	salad dressing	kiwi
					dairy product	vinegar	berry
					flavour	bean	melon
					meat	drool	plum
					Mexican food	enchilada	pumpkin
					refried beans	taco	burrito
					salsa	beet	nacho
					menu	cheek	
					letter		

*** word is found in all the different verb-forms, including "verb", "verb + s", "verb + ed", "verb + en", "verb + ing", "to + verb"**
^ word is found in all the different adjective forms, including "adjective", "adjective + er", "adjective + est"

4.4.2 Associations with the STOP icon

The STOP icon's percentages for the 1st level common associations ranged between 35 % and 88 %, with an average percentage of 62 % (see Tables 4-2 and Table 4-3). The average percentage of commonality was among the highest (47 %). Table 4-7 is a summary of the similarities and differences between the elicited association list and the current Unity™ vocabulary.

Table 4-7: Comparison of associations with STOP icon elicited in this study and those in the current Unity™ vocabulary

Associations elicited in this study only	Communal words	Vocabulary included in the current Unity vocabulary only
♦ road sign ♦ traffic ♦ brake ♦ slow down ♦ regulate traffic ♦ prevent disasters ♦ road users ♦ cyclists ♦ motorists ♦ octagonal ♦ white ♦ metal ♦ steel ♦ traffic department	♦ red ♦ stop ♦ wait ♦ stop sign ♦ word ♦ letter	♦ bleed ♦ spell ♦ embarrass ♦ dictionary

*** word is found in all the different verb-forms, including "verb", "verb + s", "verb + ed", "verb + en", "verb + ing", "to + verb"**
^ word is found in all the different adjective forms, including "adjective", "adjective + er", "adjective + est"

Table 4-7 indicates that 6 of the 10 Unity™ vocabulary items were communal, thus 60 % agreement (also see Table 4-5). The concept of stopping and waiting featured in both lists, but the elicited list focused more on traffic-related concepts. The stop sign (referent) is a widely used and well-known item in all parts of the country and this icon could therefore be familiar to most South Africans. As this icon included 60 % of the vocabulary suggested in the current Unity™ vocabulary list, this icon seems to be highly relevant to the South African context. As the suggested vocabulary lists from Unity™ for the STOP-icon were limited in comparison with other icons, one could assume that the creators meant for this icon to be largely customized in terms of the different activities that a VOCA-user might want stopped. However, this icon might be used in the South African context to encode vocabulary that is relevant to traffic and transport, in addition to messages that enables the VOCA-user to stop or delay activities.

4.4.3 Associations with the MEDICAL icon

The MEDICAL icon achieved among the top three icons in terms of the average percentage of commonality for the 1st level association, with 60 %, ranging between 36 % and 84 % (see Tables 4-2 and 4-3). The MEDICAL icon's average percentage of commonality was 47 %.

Table 4-8 depicts the comparison of the current Unity™ vocabulary and the elicited associations.

Table 4-8: Comparison of associations with the MEDICAL icon elicited in of this study and the current Unity™ vocabulary

Associations elicited in this study only			Communal words	Vocabulary included in the current Unity vocabulary only
♦ ambulance	♦ injured*	♦ urgent^	♦ ill^	♦ breath
♦ hospital	♦ emergencies	♦ hurry*	♦ sick*	♦ breathe
♦ Medicross	♦ accidents	♦ rescue*	♦ help*	♦ sunburn*
♦ vehicle	♦ patients	♦ paramedic	♦ hurt*	♦ healthy^
♦ car	♦ need assistance	♦ transport	♦ medicine	♦ drool*
♦ emergency vehicle	♦ transport to hospital	♦ steering wheel		♦ burn*
♦ doctor	♦ ouch!	♦ tyres		♦ ache*
♦ nurse	♦ Oh no!	♦ windows		♦ sneeze*
♦ clinic	♦ crash*	♦ hooter		♦ throat lozenge
♦ square	♦ rapid^	♦ oxygen tank		♦ aspirin
♦ red^	♦ pain*	♦ stretcher		♦ therapist
♦ white^	♦ save lives	♦ first-aid		♦ therapy
♦ blue^	♦ rush*	♦ bed		♦ delicious^
♦ metal	♦ curiosity	♦ Audi		♦ pasta
♦ steel	♦ brakes	♦ BMW		♦ please get my mommy
♦ roads	♦ doors	♦ undertaker vehicle		♦ I need a tissue
♦ heart attack	♦ engine	♦ police car		♦ I need help
♦ siren	♦ seats	♦ Ford		♦ cough syrup
♦ whaling	♦ aeroplanes	♦ fire truck		♦ bandage (US)/plaster (UK)
♦ alarm	♦ army	♦ tow truck		♦ bleed
♦ Volkswagen	♦ helicopters	♦ kombi		
♦ Venture	♦ light house tower	♦ racing car		
♦ taxi	♦ bakkie	♦ van		
♦ Ferrari	♦ afraid^	♦ drip		
♦ bus	♦ depressed*	♦ resuscitation		
♦ uniform	♦ assured^	♦ calm^		
♦ anxious^	♦ heroic	♦ curious^		

*** Word is found in all the different verb-forms, including "verb", "verb + s", "verb + ed", "verb + en", "verb + ing", "to + verb"**
^ Word is found in all the different adjective-forms, including "adjective", "adjective + er", "adjective + est"

Table 4-8 indicates that 5 of the 25 vocabulary items were communal, thus a 20 % agreement (see Table 4-5). The MEDICAL icon elicited concepts that were mostly automobile-related, but also included some medical-related concepts. However, the elicited associations focused more on acute medical emergencies, like those handled by an ambulance (see Table 4-8). The automobile-related concepts did not feature so strongly in Unity™ vocabulary, possibly due to the difference in the icons: on the UniChat overlay the MEDICAL icon is a representation of the medical sign printed on an ambulance, where the Unity™ 128 overlay makes use of the medical sign only. It does, however, seem that the ambulance is conducive to more medical-related associations, as the comparison clearly indicates. The researcher postulates that, as the medical sign is not that familiar in the South African context, making use of the medical sign printed on the ambulance might be more association-rich than using only the medical sign.

4.4.4 Associations with the SENTENCE icon

The SENTENCE icon's percentages of commonality for the 1st level association ranged between 27 and 89 % , averaging at 54 % (see Table 4-2 and 4-3). The SENTENCE icon's average percentage of commonality was 47 % . Table 4-9 provides a summary of

associations elicited for the SENTENCE icon in this study as well as the associations included in the current Unity™ vocabulary.

Table 4-9: Comparison of associations with the SENTENCE icon elicited in this study and the current Unity™ vocabulary

Associations elicited in this study only			Communal words	Vocabulary included in the current Unity only	
◆ conversation	◆ tongue	◆ hair	◆ hello	◆ {jokes}	◆ What did you do last night?
◆ communication	◆ eyes	◆ hand	◆ how do you do?	◆ I want to play a game	◆ What do you want to do now?
◆ talking*	◆ fingers	◆ head	◆ good-bye	◆ I'm fine	◆ Who asked you?
◆ speaking*	◆ body language	◆ legs		◆ I'm not so good	◆ You tell one
◆ speech	◆ thoughts	◆ limbs		◆ Is that cool or what?	◆ You're crazy
◆ boy	◆ throat	◆ lips		◆ Isn't that special	◆ Are you busy right now?
◆ girl	◆ social clubs	◆ lungs		◆ Leave me alone	◆ Bug off
◆ man and woman	◆ universities	◆ mammary glands		◆ May I have a drink please	◆ Can I get out of my chair?
◆ two	◆ airports	◆ mind		◆ My … hurts	◆ Excuse me
◆ swearing*	◆ argument	◆ mouth		◆ My address is …	◆ Get it?
◆ socialise*	◆ greetings	◆ mumbling		◆ My name is …	◆ Get off my back
◆ build relationships	◆ I love you	◆ e-mail		◆ My phone number is …	◆ See you later
◆ laugh*	◆ cool conversation	◆ SMS		◆ Nice meeting you	◆ Hi, how are you?
◆ relate*		◆ smoke signals		◆ Oh brother!	◆ Hi, what's up?
◆ interact*		◆ telephonic conversations		◆ Please get my mommy	◆ I am so happy
◆ interpret*	◆ exclamation	◆ letters		◆ Please let me know if you don't understand my voice	◆ I don't get it
◆ convince*	◆ groans	◆ sign language			◆ I don't feel well
◆ humans	◆ damn baby	◆ body language			◆ I don't know
◆ people	◆ alphabet	◆ speeches			◆ I don't like that
◆ literature	◆ phonetics	◆ senses			◆ I don't think so
◆ social skills	◆ consonants	◆ telepathy		◆ Pledge of Allegiance	◆ I don't want to
◆ listeners	◆ vowels	◆ questions		◆ Tell another one	◆ I need a tissue
◆ cartoonists	◆ diphthongs	◆ good^		◆ That's a good one	◆ I need help
◆ homosexual	◆ cocktail noise	◆ great^		◆ That's dumb	◆ I want to play a game
◆ big^		◆ nice		◆ That's not what I meant	◆ I'm feeling …
◆ small^	◆ music	◆ satisfied*		◆ That's ridiculous	◆ sentence
◆ teenager	◆ whistles	◆ relaxed*		◆ This device let's me speak like anyone else	
◆ faces	◆ express*	◆ wonderful		◆ This is so boring	
◆ words	◆ request*	◆ O.K.		◆ Wanna hear a secret?	
◆ oval	◆ story	◆ important		◆ What are we going to do?	
◆ square	◆ speech bubble	◆ worthwhile			
◆ sentence		◆ fulfilled			
◆ white	◆ paragraph	◆ comfortable			
◆ black	◆ joke	◆ cheered up			
◆ sounds	◆ nouns	◆ at ease			
◆ percentages	◆ syllables	◆ appreciative			
◆ tones	◆ arms	◆ ears			
	◆ body				
	◆ alive				

*** word is found in all the different verb-forms, including "verb", "verb + s", "verb + ed", "verb + en", "verb + ing", "to + verb"**
^ word is found in all the different adjective forms, including "adjective", "adjective + er", "adjective + est"

Table 4-9 indicates that 3 of the 57 Unity™ vocabulary items were communal to both lists, thus 5 % agreement. However, this might be a misrepresentation, as the there were similarities between the semantic fields of the two lists, e.g. the elicited associations mentioned only a few interactional phrases, but they responded to the cueing questions with words from the same semantic fields (e.g. *communicate, conversation, talking, interact, build relationships*, etc.). One might deduce that although the South African participants did not provide the actual interactional phrase as in the current Unity™ vocabulary, they might be able to learn more of the interactional phrases with relatively little effort, as they do associate this icon with interaction and communication. The elicited associations also included concepts like different types of communication (*smoke signals, body language, speech, e-*

mail, SMS, telephonic conversations, sign language), body parts *(mouth, face, tongue, eyes, ears)*, places where communication is frequently seen and heard *(social clubs, airports, universities)*, different functions of communication and interaction *(request, convince, relate, interact, build relationships)* and so forth.

The South African users of Minspeak™-based VOCAs might be able to easily learn the vocabulary included in the current Unity™, as the majority of concepts in Unity™ would probably be familiar to them, so that the laws of minimal learning and minimal effort would not be violated. However, some of the vocabulary items might need to be replaced with context and/or culturally congruent words, e.g. items like the Pledge of Allegiance is not applicable to the South African context.

4.4.5 Associations with the MUSIC icon

The 1st level associations' commonality for the MUSIC icon ranged between 16 % and 91 %, with an average of 49 % (see Table 4-1). The average percentage of commonality for the MUSIC-icon was 45 %. The elicited associations resembled the current Unity™ vocabulary to some extent, in terms of the types of concepts associated with the MUSIC icon (see Table 4-10 for more details).

Table 4-10 indicates that there was 21 % agreement (8 of the 39 vocabulary items were communal). A comparison of the two lists with regard to communal concepts reveals that various music-related concepts were communal, including songs and musical instruments. The South African participants identified various musical instruments (e.g. *accordian, organ*), different kinds of music (e.g. *jazz, disco, hip-hop, rap, rave, techno*), as well as some perceived functions of music (including *dance, relax, listen, compose, buy, sing*). No song name was elicited, contrary to the current Unity™ vocabulary. However, as the elicited associations were from the same semantic field, the researcher suggests that the titles of typical South African songs might be learnt in connection with and encoded by the MUSIC icon, with relatively little effort.

Table 4-10: Comparison of associations with the MUSIC icon elicited in this study and current Unity™ vocabulary

Associations elicited in this study only			Communal words	Vocabulary included in the current Unity only
♦ symbols	♦ clubs	♦ rap	♦ sing	♦ more^
♦ buy*	♦ compositions	♦ rave	♦ music	♦ cassette tape
♦ compose*	♦ concerts	♦ techno	♦ piano	♦ album
♦ dance*	♦ keyboard	♦ wood	♦ musical instrument	♦ CD
♦ enjoy*	♦ MTV	♦ iron	♦ music synthesizer	♦ cymbal
♦ listen*	♦ radio	♦ organ	♦ guitar	♦ drum
♦ interpret*	♦ stationary	♦ golf club	♦ song	♦ bell
♦ masterpiece	♦ tape recorders	♦ accordian	♦ sound	♦ tambourine
♦ play*	♦ 16th to 19th century pictures and posters	♦ decibels		♦ triangle
♦ write*		♦ hieroglyphics		♦ mostly
♦ art	♦ clapping hands	♦ hockey sticks		♦ Twinkle twinkle little star
♦ culture	♦ bravo!	♦ lollypop		
♦ entertainment	♦ bird songs	♦ poems		♦ What child is this?
♦ musicians	♦ do re me fa so la ti do	♦ spears		♦ We wish you a merry Christmas
♦ fans	♦ encore!	♦ stories		
♦ choirs	♦ orchestra	♦ G-key		♦ drum
♦ ad companies	♦ opera	♦ metal		♦ cymbal
♦ ministers	♦ tadatadatada	♦ chocolates		♦ rest
♦ singers	♦ voices	♦ conductor		♦ anymore
♦ pianists	♦ whistling	♦ natives		♦ repeat*
♦ song writers	♦ calm* nerves	♦ parties		♦ beat
♦ small^	♦ excite*	♦ treble and bass cleft signs		♦ no more
♦ circles	♦ hobby			♦ Angels we have heard on high
♦ lines	♦ relax*	♦ Mozart		
♦ black	♦ alphabet letters	♦ poetry in music		♦ Away in a manger
♦ paper	♦ classical	♦ peaceful		♦ Baa baa black sheep
♦ ink	♦ disco	♦ inspired*		♦ Bingo
♦ soothing	♦ jazz	♦ happy		♦ Jingle bells
♦ books	♦ electronic	♦ great^		♦ Joy to the world
♦ stores	♦ hip-hop	♦ sophisticated		♦ London Bridge
♦ church hymn books	♦ depressed	♦ stimulated*		♦ Mary had a little lamb
	♦ memorized*	♦ wonderful		♦ Oh holy night
♦ jarring	♦ reminiscing*	♦ competent		♦ Old McDonald had a farm
♦ modern		♦ pop		♦ Silent night

* word is found in all the different verb-forms, including "verb", "verb + s", "verb + ed", "verb + en", "verb + ing", "to + verb"
^ word is found in all the different adjective forms, including "adjective", "adjective + er", "adjective + est"

4.4.6 Associations with the KNOT icon

The average percentage of commonality for the KNOT icon's 1st level associations, was calculated at 52 % with a range of between 32 % and 80 % (see Tables 4-2 and 4-3). The percentage of commonality for the KNOT icon averaged at 54 %. Table 4-11 is a summary of the comparison between the elicited association list and the current Unity™ vocabulary.

Only one word (of a possible 14 vocabulary items) was found to be communal, thus 7 % agreement between the compared lists. When the current Unity™ vocabulary list for the KNOT icon was investigated, the list consisted of only a few concepts - specifically the concept of negation or "not-ness". This concept is, however, used in a wide variety of phrases like *I/you/he/she/they will not, would not, cannot, could not, have not, had not, has not, do not, did not, should not, might not, must not,* etc. Yet, in the elicited association set, concepts related to the different uses and users of a rope were prominent (see Table 4-11).

Table 4-11: Comparison of associations with the KNOT icon elicited in this study and those in the current Unity™ vocabulary

Associations elicited in this study only			Communal words	Vocabulary included in the current Unity only
♦ rope	♦ long^	♦ cry of distress	♦ brown	♦ not
♦ knot	♦ cylindric	♦ fasten		♦ did not
♦ tied*	♦ fibre	♦ tow		♦ should not
♦ bind* together	♦ cotton	♦ end		♦ could not
♦ pull*	♦ nylon	♦ beginning		♦ would not
♦ drag*	♦ art shop	♦ number 8 keys		♦ do not
♦ hoist*	♦ stationary shop	♦ loop		♦ will not
♦ equipment	♦ hardware store	♦ sewing cotton		♦ shall not
♦ mountain climbing gear	♦ tree house	♦ wool		♦ might not
	♦ ships	♦ ribbons		♦ must not
♦ tools	♦ harbour	♦ elastic		♦ have not
♦ hardware	♦ garden	♦ chain		♦ has not
♦ materials	♦ playgrounds	♦ hose pipe		♦ had not
♦ campers	♦ garages	♦ leather strips		
♦ farmers	♦ workshops	♦ riempies		
♦ mountaineers	♦ death row	♦ wire		
♦ executioner	♦ groan*	♦ fishing line		
♦ killers	♦ grunting	♦ sticks		
♦ rescue workers	♦ grrr	♦ horse		
♦ Voortrekkers	♦ uhh	♦ nets		
♦ transport companies	♦ out of breath	♦ wood		
♦ fishermen	♦ scream	♦ thick^		
	♦ thin^			

*** word is found in all the different verb-forms, including "verb", "verb + s", "verb + ed", "verb + en", "verb + ing", "to + verb"**
^ word is found in all the different adjective forms, including "adjective", "adjective + er", "adjective + est"

The necessity of this icon in Unity™ is questioned with regards to its use on a more advanced overlay with limited space, as it does not seem space effective. The prestored messages coded by the KNOT icon could, for instance, be coded by another icon like the WRONG-icon (an icon not included in this study), thus making more effective use of the already limited space on an overlay.

4.4.7 Associations with the FROG icon

The average for the FROG icon's 1st level associations was 50 %, ranging between 16 % and 89 %. The average percentage of commonality for the FROG icon was 42 % (see Tables 4-2 and 4-3). Table 4-12 is a summary of the comparison between the elicited associations and the current Unity™ vocabulary. As can be seen in Table 4-12 the elicited association list had a 27 % agreement with the current Unity™ vocabulary list, viz. 3 of the 11 possible vocabulary items (also see Table 4-5). Comparing the two lists on a conceptual level, relatively little similarities were found, as the elicited association list revolved around body parts (*e.g. arms, legs, throat, eyes, tongue, head, etc.)*, disgusted utterances *(e.g. yuck!, eek!, etc.)* and amongst others, animals and aspects of nature *(e.g. reptiles, herbivores, snakes, amphibians, etc.)*. The suggested Unity™ vocabulary for this icon is limited in relation to icons like APPLE or SENTENCE, as it only includes concepts of rushing, length, and going. It is suggested that this vocabulary list be expanded substantially, to make efficient use of space on the overlay.

Table 4-12: Comparison of associations with the FROG icon elicited in this study and the current Unity™ vocabulary

Associations elicited in this study only			Communal words	Vocabulary included in Unity only
♦ leap*	♦ marine systems	♦ nose	♦ frog	♦ belong
♦ admire*	♦ mud	♦ nostrils	♦ jump*	♦ sudden^
♦ watch*	♦ near moist areas	♦ eyes	♦ green^	♦ excited^
♦ leave it alone	♦ pools	♦ ears		♦ stretch*
♦ let it be	♦ veldt	♦ brains		♦ long^
♦ avoid*	♦ outside	♦ intestines		♦ go*
♦ pet	♦ lush green surroundings	♦ reptiles		♦ hurry*
♦ animals		♦ snakes		♦ rush*
♦ amphibians	♦ creeks	♦ newts		
♦ toads	♦ vlei	♦ gecko's		
♦ nature	♦ croaking	♦ crocodiles		
♦ French	♦ blurb	♦ bull frog		
♦ little boys	♦ yuck!	♦ platanna		
♦ veterinarians	♦ screaming	♦ terrapin		
♦ witches	♦ aaah!	♦ eggs		
♦ biology teachers	♦ disgusted	♦ tadpole		
♦ snakes	♦ eek!	♦ French cuisine		
♦ storks	♦ biological experiments	♦ chips		
♦ herbivores		♦ fruits		
♦ birds	♦ anatomy	♦ garlic		
♦ arrow head	♦ dissect*	♦ butter		
♦ frog-shaped	♦ arms	♦ sauce		
♦ round	♦ body	♦ salt		
♦ green	♦ butt	♦ mayonnaise		
♦ slimy	♦ head	♦ mushrooms		
♦ wet lands	♦ throat	♦ bad		
♦ ponds	♦ tongue	♦ contempt		
♦ rivers	♦ toes	♦ dirty		
♦ swamps	♦ warts	♦ disgust		
♦ dams	♦ legs	♦ dislike		
♦ freshwater lakes	♦ mouth	♦ gross		
♦ feet	♦ skin	♦ neck		

*** word is found in all the different verb-forms, including "verb", "verb + s", "verb + ed", "verb + en", "verb + ing", "to + verb"**
^ word is found in all the different adjective forms, including "adjective", "adjective + er", "adjective + est"

4.4.8 Associations with the THUMBS UP icon

The average percentage of commonality 1st level common associations for the THUMBS UP icon was 49 % and ranged between 20 % and 72 % (see Tables 4-2 and 4-3). This icon's average percentage of commonality was 42 %. A summary of the comparison between the elicited associations and the current Unity™ vocabulary is provided in Table 4-13. Table 4-13 indicates that there was 35 % agreement between the two words lists, where 7 of the possible 20 vocabulary items were communal. When comparing the lists on a conceptual level, it appears that the main concepts of the icon, i.e. positive/affirmative/"up-ness", did feature in the elicited association list. This icon might be used to encode words from the same semantic field for South African VOCA users, as these vocabulary items might be more familiar and subsequently might be learnt with relatively little effort. However, words from different African languages that are generally used across cultures, genders and languages should be included, like *yebo, yes, êê, lekker, sharp, yebo gogo*, etc.

Table 4-13: Comparison of associations with the THUMBS UP icon elicited in this study and the current Unity™ vocabulary

Associations elicited in this study only			Communal words	Vocabulary included in Unity only
♦ hand	♦ air force personnel	♦ fingerprints	♦ good^	♦ true^
♦ fist	♦ flesh	♦ tentacles	♦ great^	♦ tight^
♦ all right	♦ white	♦ thumb	♦ agree*	♦ win*
♦ affirmative	♦ green	♦ nails	♦ lift*	♦ loud^
♦ excellent^	♦ bone	♦ palm	♦ smile*	♦ tall^
♦ approve*	♦ blood	♦ jacket	♦ thumbs up	♦ near^
♦ praise*	♦ arm	♦ upwards	♦ correct^	♦ open*
♦ write*	♦ limb	♦ feet		♦ accept*
♦ work*	♦ yebo	♦ leg		♦ warm^
♦ hitch hike*	♦ yes	♦ toes		♦ suck*
♦ precision hand work	♦ êê	♦ goodbye		♦ sweet
♦ body parts	♦ O.K.	♦ signaling a taxi		♦ pudding
♦ signs	♦ fine	♦ claws		♦ expensive^
♦ symbols	♦ sharp	♦ mutated		
♦ body language	♦ wonderful	♦ brain		
♦ visual communication	♦ compliment	♦ skin		
♦ pedestrians	♦ encourage*	♦ gratitude		
♦ scuba divers	♦ well done	♦ lekker		
♦ people without transport	♦ fingers	♦ happy		
	♦ content	♦ positive		
		♦ comfortable		

*** word is found in all the different verb-forms, including "verb", "verb + s", "verb + ed", "verb + en", "verb + ing", "to + verb"**
^ word is found in all the different adjective forms, including "adjective", "adjective + er", "adjective + est"

4.4.8 Associations with the THUMBS DOWN icon

The THUMBS DOWN icon's average percentage of commonality for the 1st level association was 48 % and ranged between 20 % and 100 % (see Tables 4-2 and 4-3). The THUMBS DOWN icon's average percentage of commonality was 38 %. Table 4-14 is a summary of the comparison between the elicited associations and the current Unity™ vocabulary. This comparison was done to determine the probable familiarity of participants with concepts and vocabulary, and to which extent they would have to exert energy to learn it (compliance with laws of minimal learning and minimal energy).

Table 4-14 indicates that an agreement of 13 % prevailed for this icon, where only 3 of the 23 possible vocabulary items were communal (also see Table 4-5). An investigation into communal concepts revealed that the concepts of negativity and the status of "down-ness" were common to both lists. However, the elicited associations also included different body parts, a list of race-related colours, hand-users and a multitude of hand-uses and activities where hands are involved.

Table 4-14: Comparison of associations with the THUMBS DOWN icon elicited in this study and the current Unity™ vocabulary

Associations elicited in this study only			Communal words	Vocabulary included in the current Unity only
◆ thumbs down	◆ rugby	◆ chopping	◆ bad^	◆ naughty^
◆ hand sign	◆ sport coaches	◆ clapping hands	◆ disagree*	◆ ugly^
◆ no	◆ Roman Emperors	◆ wave*	◆ frown*	◆ false^
◆ bad luck	◆ colloquial communicators	◆ finger snap		◆ loose^
◆ low value	◆ humans	◆ I need a lift please		◆ difficult^
◆ wrong	◆ big	◆ taxi please		◆ quiet^
◆ hitch-hiker	◆ hand-sized	◆ decrease*		◆ short^
◆ kettle	◆ small	◆ disgust*		◆ far^
◆ disapprove	◆ fist	◆ fingers		◆ close*
◆ criticise*	◆ flesh	◆ fingerprints		◆ drop*
◆ dislike*	◆ other race-related colours (including black, brown, white, red, etc.)	◆ thumb		◆ reject*
◆ press a button		◆ knuckles		◆ cool^
◆ pick up		◆ palm		◆ blow*
◆ point*		◆ wrist		◆ empty^
◆ wave*	◆ skin	◆ sleeve		◆ sour^
◆ write*	◆ bone	◆ arm		◆ dirty^
◆ hitch-hike	◆ nail	◆ forearm		◆ inexpensive^
◆ change my luck	◆ blood	◆ feet		◆ disappoint*
◆ body parts	◆ muscles	◆ big toe		◆ disappointment
◆ limbs	◆ hair	◆ toes		◆ lie*
◆ gestures	◆ cells	◆ gloves		
◆ sign language	◆ arm	◆ angry^		
◆ hand signs	◆ hand	◆ mad^		
◆ non-verbal	◆ no mercy	◆ sad^		
◆ transport	◆ boo	◆ negative		
◆ no thanks		◆ catch		
◆ not good		◆ Gladiators		

*** word is found in all the different verb-forms, including "verb", "verb + s", "verb + ed", "verb + en", "verb + ing", "to + verb"**
^ word is found in all the different adjective forms, including "adjective", "adjective + er", "adjective + est"

The THUMBS DOWN icon's elicited associations were also compared with those of the THUMBS UP icon as found in Unity™, where the THUMBS UP icon constitutes the positive version of words and concepts, while the THUMBS DOWN icon is used for encoding of the negative version. This phenomenon also appeared in the elicited association list to some extent, including words like *approve/disapprove, yes/no, correct/wrong, praise/criticise, positive/negative, agree/disagree, good/bad, smile/frown, thumbs up/thumbs down,* etc. (compare Tables 4-13 and 4-14). It seems likely that the THUMBS DOWN icon's vocabulary might be learnt with relative ease, as the concepts might be familiar to South African VOCA users.

4.4.10 Associations with the INTERJECTION icon

According to Tables 4-2 and 4-3, the average for the 1st level associations for the INTERJECTION icon was 47 %, ranging between 25 % and 79 %. The INTERJECTION icon's average percentage of commonality was 37 %. The elicited association list and the current Unity™ vocabulary are compared in Table 4-15.

Table 4-15: Comparison of associations with INTERJECTION icon elicited in this study and those in the current Unity™ vocabulary

Associations elicited in this study only			Communal words	Vocabulary included in Unity only	
◆ Fire works	◆ star-like	◆ smoke	◆ fine	◆ yum	◆ chill out
◆ party	◆ colourful^	◆ sparks		◆ excuse me	◆ oh
◆ city	◆ multi-coloured	◆ cherry bombs		◆ thank you	◆ hi
◆ buildings	◆ neon colours	◆ flares		◆ Happy Valentine's Day	◆ hello
◆ stars	◆ beautiful^	◆ crackers		◆ Happy Hanukah	◆ let's
◆ explosion	◆ pretty^	◆ jack-in-a-box		◆ Happy Thanksgiving	◆ eek!
◆ amaBokoBoko winning	◆ dazzling	◆ nuclear explosion		◆ Happy Easter	◆ surprise
◆ amaze*	◆ bang	◆ 21st parties		◆ Happy Fourth of July	◆ yeah
◆ celebrate*	◆ fuse	◆ radio		◆ Merry Christmas	◆ awesome
◆ crash*	◆ magic	◆ party hats		◆ Happy Birthday	◆ ha ha ha
◆ festivity	◆ gunpowder	◆ ship at sea		◆ Happy New Year	◆ yuck
◆ Guy Fawkes	◆ whistles	◆ amazement		◆ Happy Halloween	◆ okay
◆ New Year	◆ extravagant^	◆ amusement		◆ ouch	◆ good-bye
◆ special occasion	◆ Disneyland	◆ cake		◆ well	◆ please
◆ entertain*	◆ birthdays	◆ danger		◆ of course	◆ oops
◆ express* joy	◆ festivals	◆ drink		◆ yikes	◆ boo
◆ look*	◆ outside	◆ fire		◆ congratulations	◆ you're welcome
◆ adventurous^	◆ night	◆ laughter		◆ sorry	◆ whoa
◆ Chinese	◆ shops	◆ merriness		◆ ah	
◆ entertainment	◆ sky	◆ little black number			
◆ pyrotechnics	◆ sport events	◆ Olde Lange Sine			
◆ weapons	◆ holidays	◆ excited^			
◆ Western world	◆ wow!	◆ exhilirated^			
◆ bombs	◆ ooooh	◆ great^			
◆ explosives	◆ pop	◆ happy^			
◆ adults	◆ Christmas	◆ like a child			
◆ little boys	◆ impressive^	◆ scared^			
◆ students	◆ fun	◆ uneasy^			
◆ theme parks	◆ flint	◆ cautious^			
◆ big	◆ warning in English, Spanish and Chinese	◆ enjoy*			
◆ flower-shaped		◆ energised*			
◆ round		◆ in			
◆ square	◆ headaches	◆ ecstatic^			
◆ above	◆ matches				

*** word is found in all the different verb-forms, including "verb", "verb + s", "verb + ed", "verb + en", "verb + ing", "to + verb"**
^ word is found in all the different adjective forms, including "adjective", "adjective + er", "adjective + est"

The percentage of agreement was limited for the INTERJECTION icon, as only 1 of a possible 40 vocabulary items were communal to the two compared lists, thus 3 % agreement (see Tables 4-5 and 4-15). When comparing the two lists on a conceptual level, however, there were many communal concepts, thus indicating that the percentage of agreement calculated for words only is a misrepresentation. The elicited concepts for the INTERJECTION icon included concepts like special occasions and celebrations, as well as fireworks-related concepts. The current Unity™ vocabulary list consists of interjections that could be used during interaction. So while the current Unity™ vocabulary list includes messages like "Happy Birthday" and "Happy New Year", the concepts *birthday* and *New Year* were elicited in this study. This might suggest that as concepts from **the same** semantic fields were elicited, this icon could be used to encode similar concepts for South African VOCA users, probably without excessive cognitive demands in terms of learning and recalling icon codes and icon sequences. However, words like "Happy Thanksgiving" and "Happy Fourth of July" might have to be replaced by culturally congruent messages like

"Laduma" and "Let's make a wave", "Happy Freedom Day", according to the AAC user's culture.

4.4.11 Associations with the WANTED icon

The average percentage of commonality for the 1st level associations for the WANTED icon was established at 42 %, ranging between 24 % and 73 % . The average percentage of commonality for the WANTED icon was 32 % (see Table 4-2 and 4-3). Table 4-16 reviews the resemblance between the associations elicited in this study and the current Unity™ vocabulary.

Table 4-16: Comparison of associations with the WANTED icon elicited in this study and those in the current Unity™ vocabulary

Associations elicited in this study only			Communal words	Vocabulary included in Unity only
♦ jail	♦ cement	♦ jail	♦ describe*	♦ want*
♦ prison	♦ stone	♦ fences	♦ glue	♦ abuse*
♦ cells	♦ public places	♦ body parts	♦ ashamed	♦ mean^
♦ convict	♦ shops	♦ tattoo	♦ mean	♦ west
♦ criminal	♦ movies	♦ torso		♦ pay*
♦ robber	♦ police station	♦ fire department		♦ I want to play a game
♦ murderer	♦ cities	♦ clinic		
♦ wanted poster	♦ towns	♦ town hall		
♦ notice	♦ Johannesburg	♦ pamphlets		
♦ fugitive	♦ iron doors	♦ banners		
♦ advertisement	♦ lock	♦ television		
♦ photograph	♦ regret	♦ bandits		
♦ arrest*	♦ huh	♦ embezzlers		
♦ catch*	♦ oh no	♦ thief		
♦ lock* up	♦ phew	♦ Nelson Mandela		
♦ law enforcement	♦ not again	♦ flyers		
♦ justice	♦ help needed	♦ on-line		
♦ law	♦ find*	♦ news papers		
♦ correctional services	♦ locate*	♦ radio		
	♦ consequences	♦ milk cartons		
♦ police	♦ reward	♦ armed		
♦ crime	♦ warn*	♦ security		
♦ square	♦ poster	♦ badge		
♦ block	♦ caption	♦ hand cuffs		
♦ rectangle	♦ wanted sign	♦ prosecution		
♦ frame	♦ pasted	♦ punishment		
♦ black	♦ bars	♦ guilty		
♦ white	♦ blue	♦ paper		

*** word is found in all the different verb-forms, including "verb", "verb + s", "verb + ed", "verb + en", "verb + ing", "to + verb"**
^ word is found in all the different adjective forms, including "adjective", "adjective + er", "adjective + est"

An agreement of 40 % were calculated for the WANTED icon, as 4 of the 10 possible vocabulary items were communal (see Tables 4-5 and 4-16). When comparing the lists on a conceptual level, it became apparent that there were few communal concepts in comparison with other icons like APPLE and INTERJECTION. The current Unity™ vocabulary for the WANTED icon includes the concept of "wanting" , with very few ideas related to the visual features of this icon. This seems contrary to one of the basic Unity™ principles which requires icons to make use of the icons' visual features, allowing the icon to serve as a cue for message recall. The elicited association list included concepts, words and phrases

connected with the visual features of this icon, including body parts, colours, shapes, public places, different types of criminals, different types of media and means of advertising, etc. (see Table 4-16 for more details).

Ideas for teaching VOCA-users the different vocabulary for this icon, include options like obtaining an actual wanted poster (something that is not very common or easily obtainable in South Africa), and working from there on the whole language approach, making laws, visiting jails, setting and paying fines, etc. - giving users experience of the concepts they have to learn. However, the researcher - although a strong believer in the whole language approach and experience-based learning - is not fully convinced that the users would learn the idea of "wanting" in connection with this icon. Experience with significant others teaching (especially) children the vocabulary for the icon, indicated that they often turn to other pictures to teach the concepts - which, admittedly, often include food items, like ice cream. The results obtained for this icon on all the different levels of the data analysis procedure indicate that users learning the vocabulary and concepts coded with the WANTED icon, might require additional support. This does not necessarily comply with the laws of minimal effort and minimal learning.

4.4.12 Associations with the RETURN icon

The average percentage of commonality for the RETURN icon's 1st level associations, was the lowest of all the icons (36 %) with 1st level associations percentages ranging between 17 % and 86 %. This icon's average percentage of commonality was calculated at a low 31 % (see Tables 4-2 and 4-3). These statistics indicate that this icon elicited a wide range of associations with very little commonality. Table 4-17 is a comparison of the associations elicited in this study and the current Unity™ vocabulary. Table 4-17 indicates that there was 22 % agreement, with 6 communal words out of a possible 27 (also see Table 4-5).

A comparison of the concepts included in the lists, revealed that the concepts of turning, roundness and repetition were communal. The RETURN icon elicited common associations with lower average percentages from a wide range, with little commonality in relation to other icons. Learning and teaching this icon's associations might require additional support material and strategies and would not necessarily comply with the laws of minimal learning and energy.

Table 4-17: Comparison of associations with the RETURN icon elicited in this study and the current Unity™ vocabulary

Associations elicited in this study only			Communal words	Vocabulary included in the current Unity only
♦ aeroplanes circling	♦ children	♦ bolts	♦ repetition	♦ usual^
♦ arrows	♦ Formula 1 drivers	♦ cement	♦ repeat*	♦ common^
♦ circle	♦ Green Peace	♦ figure 8 race track	♦ turn*	♦ again
♦ ellips	♦ gymnasts	♦ tar	♦ return*	♦ mayonnaise
♦ eternity	♦ lights	♦ tartan	♦ oval	♦ egg
♦ hoola hoop	♦ mathematicians	♦ wings	♦ track	♦ wrist
♦ moths around a light	♦ pedestrians	♦ ball		♦ knickers (UK)/panties (US)
♦ rotation	♦ pilots	♦ birds		♦ crazy
♦ wheel	♦ teachers	♦ butterflies		♦ helicopter
♦ air shows	♦ traffic department	♦ cylinder		♦ tornado
♦ dance*	♦ women	♦ fighterplanes		♦ bend*
♦ calculate* volume	♦ small^	♦ fire trucks		♦ spoon
♦ drive*	♦ round^	♦ flies		♦ pillowcase
♦ follow*	♦ black	♦ grammaphone		♦ answering machine
♦ indicate* direction	♦ plastic	♦ hang gliders		♦ video (UK)/VCR(US)
♦ recycle*	♦ lamp shades	♦ mosquitos		♦ fair
♦ rhythmic gymnastic routine	♦ cul-de-sac	♦ parachutes		♦ warm
♦ run*	♦ Kayalami	♦ pogo stick		♦ change*
♦ travel*	♦ containers	♦ recipe		♦ yo-yo
♦ walk*	♦ Reggie's	♦ rings		♦ answer*
♦ wear* around neck	♦ Toys 'R Us	♦ river		♦ upside-down
♦ abstract object	♦ Welkom	♦ sun		
♦ action group	♦ shops	♦ t-junction		
♦ environment	♦ PC symbol	♦ traffic lights		
♦ games	♦ Go!	♦ water		
♦ jewelry	♦ breathing athletes	♦ brass		
♦ motion	♦ cheering	♦ BMX bikes		
♦ nature	♦ oh no	♦ Gold		
♦ road maps	♦ rotate*	♦ Silver		
♦ small flying animals	♦ siren	♦ mountain bikes		
♦ sport	♦ vroom	♦ stickers		
♦ transport	♦ I'm lost	♦ steel		
♦ athletes	♦ adrenalin rush	♦ calculators		
♦ drivers	♦ entertainment	♦ earrings		
♦ exhilarated	♦ leisure	♦ helmet		
	♦ u-turn	♦ ropes		
	♦ open-minded	♦ eternal		

*** word is found in all the different verb-forms, including "verb", "verb + s", "verb + ed", "verb + en", "verb + ing", "to + verb"**
^ word is found in all the different adjective forms, including "adjective", "adjective + er", "adjective + est"

4.5 SUMMARY

This chapter described the results of the study, with focus on the percentages of the different associations made with each icon. A list of associations that were elicited was presented for each icon and results of a comparison between the elicited word list and the current Unity™ association list were discussed.

CHAPTER 5
SUMMARY AND CONCLUSION

5.1 INTRODUCTION

Chapter 5 offers a summary and an integrated discussion of the study's findings. This is followed by a critical evaluation of the study and a discussion of the clinical implications. Finally, recommendations for further research are made.

5.2 SUMMARY AND INTEGRATION OF RESULTS

Successful implementation of technology can be regarded as compliant with the laws for applying technology (Quist and Lloyd, 1997, pp.121-123). These laws assert that technology should not be too elaborate (law of parsimony); not inflict disproportionate demands on learning or energy (laws of minimal learning and minimal energy); not interfere with everyday activities (law of minimal interference); be suitable for the user's needs and personality (law of best fit); and should be practical to use and implement (law of practicality and use). When the Minspeak™ approach is imported for use on South African AAC users' VOCAs, it should be critically reviewed to ensure that it complies with the laws for implementation and that it is relevant for the local context.

The laws of particular interest for the purpose of this study, are the laws of minimal energy, learning and interference. The Minspeak™ approach is engineered to use icons with multiple meanings based on associations with the icons. These associations can be influenced by a number of factors, including amongst others the user's culture, language, gender, age and area of expertise. When the meanings assigned to icons by the developers are unfamiliar to AAC users, the previously mentioned laws can be compromised. The user might have to invest more time and cognitive energy in memorising meanings and icon sequences, and in recalling codes to retrieve vocabulary. The user's rate of communication might be jeopardised and therefore the use of icons that are familiar to the user is preferred.

The aim of the current study was to investigate which meanings tertiary education students attached to selected Minspeak™ icons used in different Unity™ versions. The meanings were derived in the form of associations with the icons. Words to describe these associations were used as a basis for comparison with the vocabulary in the current Unity™ 128 version. This comparison enabled description of the agreement between the meanings conveyed in this study and in the current Unity™ 128 version.

The percentage of commonality per icon was calculated and the associations were subcategorised, where groups of words from the same semantic field were compiled to form common associations. However, only some associations were investigated, as an arbitrary minimum of 15 % commonality was required to qualify as a common association. The average percentage of commonality was calculated for every question for every icon and the results for the different icons were compared. The list of vocabulary items describing the meanings based on the elicited associations was compared with a compiled list of current Unity™ vocabulary.

Meanings were derived through eliciting associations from tertiary education students using a self-administered cueing questionnaire. The results indicated that the participants made different associations with varying degrees of commonality to the icons. The APPLE, MEDICAL and SENTENCE icons achieved the highest average commonality and the INTERJECTION, WANTED and RETURN icons achieved the lowest average commonality. However, an investigation of the commonality of associations revealed that in some cases there was only one dominant association, and in other cases two or three associations with a lesser degree of commonality were elicited (see Table 4-2 for more detail). The implication of this phenomenon for learnability of the icons and their meanings was discussed. A single dominant association suggests that the icon's meaning might be familiar to most users in the context. Two or three less common associations provide a wider range of meanings, but these meanings might not be as familiar to users as in the former instance. Further research is needed to establish a minimum required degree of commonality for meanings to be regarded as enhancing learnability.

The suggestion was made that meanings derived from South Africans would differ from the meanings implemented in the current Unity™ 128 version. This notion was investigated by comparing the two lists on two levels: comparison of the *vocabulary* (i.e. the words used to

describe the associations underpinning the meanings); and a comparison of the *concepts* which form the basis for the vocabulary lists per icon. The first level of comparison (comparing words) revealed that for the majority of icons more than 60 % of the *vocabulary* items varied. However, one cannot assume that this is a true reflection of the participants' familiarity with the vocabulary as there were conceptual agreements not reflected in the comparison. For some icons there was agreement on both word and conceptual levels (e.g. the APPLE, STOP, MEDICAL icons), while for others there were few similarities on a word level, but some conceptual agreement (e.g. INTERJECTION, THUMBS UP, SENTENCE, WANTED icons). For other icons there were minor word or concept agreement found (e.g. RETURN, FROG icons).

The majority of icons' conceptual agreement indicated that the vocabulary used in the Unity™ software package might be useful as a basis for customising a user's vocabulary (notably the APPLE, STOP, MEDICAL, SENTENCE, MUSIC, THUMBS UP and THUMBS DOWN icons). The vocabulary for some of the icons, like the KNOT icon, could rather be coded under another icon (e.g. the WRONG icon) to optimally use every space on the overlay. The use of the RETURN icon is also questioned in terms of effectiveness on an overlay with limited space.

Icons need to be either transparent or translucent as the efficient use of codes depends on the user's ability to make functional associations with the icons and their meanings (Bruno and Goehl, 1991, p.70). The translucency of icons was argued to be an important variable in determining the ease of learning of AAC systems. The more familiar the relationship between an icon, its referent and the associations used during teaching, the easier it should be to learn (Luftig and Bersani, 1985; Paivio, 1986; Schlosser, 1994). A higher percentage of commonality, and possibly a higher degree of familiarity, might be more conducive to learning. When an associated meaning has a lower percentage of commonality, the learning and energy requirements might be increased.

In most cases the vocabulary included in the current Unity™ software packages should be reviewed for appropriateness in the local context and culturally congruent words should be included in this list. Providing culturally appropriate intervention is a basic principle underlying accountable service delivery to AAC users (Soto, Huer and Taylor, 1997). If the selected icons are not congruent with the user's cultural context the vocabulary and codes

selected in such an AAC system could hamper communicative effectiveness due to the slower communication rate and a higher memory load. The results of this study confirm the findings of Huer (2000, pp.180–185), that indicated that individuals from diverse cultural and linguistic backgrounds perceive graphic symbols differently. The results of this research project raise the same issue: When an AAC user and his clinician attach different meanings to a graphic representational system, how does it impact on the acquisition process and later generalisation and maintenance of the learnt symbols?

This study's results emphasised that encoding strategies like the Minspeak™ approach cannot simply be imported to South Africa without carefully reviewing their compliance with the laws for implementing technology. These results should, however, be viewed against the limitations of this study.

5.3 CRITICAL EVALUATION

As this study only used 480 participants, 40 participants per icon, the results should be seen as preliminary findings to encourage further research and to caution clinicians to carefully consider the use of each icon and its associations. The participants in this study represented a range of cultures and languages, in order to obtain general information about the associations provided by South African communicators. However, ideally a more representative sample for each of the 11 official languages should be obtained. For this purpose the current study should be expanded to the greater South Africa, as this sample was confined to a specific context in the Gauteng Province only (the University of Pretoria). Furthermore, all the participants were tertiary education students, and this sample cannot be regarded as representative of South African adults. This aspect obviously limits the potential for generalisation.

This study included 12 Minspeak™ icons used as core icons in the UniChat™ programme. Although these icons were selected to have articulation possibilities with more sophisticated Minspeak™-based VOCAs, there are obviously more icons that need to be investigated.

The elicited associations were responses to open-ended questions, which made direct comparison impossible, as almost every participant approached the questionnaire differently. A pruning system was developed to extract the dominant meanings for use in subsequent

analytical procedures. This pruning system proved to be valuable, and was used reliably by both the intra-rater and interrater.

Although the current study compared associated meanings made by South African tertiary education students to meanings used in the current Unity™ software, it is important to point out that the applicability of the Minspeak™ approach to the UK and US populations has not been formally researched.

5.4 IMPLICATIONS FOR CLINICAL PRACTICE

- Albeit preliminary, the list of elicited associations might be used by AAC users and their clinicians, to compile an individualised vocabulary list for South African users. This list is based on associations with visual features of icons. Teaching these associations should be related to such visual features in order to enhance learnability. The list could provide a useful basis from where to investigate associations of other populations for use in intervention.
- The comparison between the elicited list and the current Unity™ vocabulary list revealed substantial differences. This finding strengthens the notion that iconic encoding systems cannot merely be imported and used in other countries without adaptation to the context and culture of the user.
- The questionnaire that was developed might be used in South Africa and other developing countries to determine which associations potential users would probably make with Minspeak™ icons. The results could be used as a basic list of words to include in an individualised vocabulary and for obtaining rationales for selecting and using specific icon sequences. This procedure could enhance the ease of teaching and learning. The questionnaire's utility is not necessarily limited to Minspeak™ icons, but could also be used for any other iconic encoding system that is based on associations.
- The elicited association list revealed that some of the icons' traditional use (i.e. how they are used in Unity™) might be inefficient in terms of space management on the overlay. For instance, the KNOT and WRONG icons code ideas that share the same semantic field. The icons' codes and vocabulary might be merged, using either of the icons' to code the vocabulary.

5.5 RECOMMENDATIONS FOR FURTHER RESEARCH

- Subsequent research should include more participants from diverse backgrounds to obtain a more representative sample of the South African adult population.
- This study included only 12 icons, but the list of elicited associations should be expanded to include all the icons used in the Unity™ software package.
- Formal research is needed to determine whether the Unity™ icons and vocabulary, adopted in the UK and US versions are indeed appropriate for those populations.
- The usefulness of the developed questionnaire for eliciting associations using another iconic encoding system (e.g. *LINKS-icon*™, Zygo Industries) could be investigated.
- The impact of the percentage of commonality of a common association on the learnability of set vocabulary packages like Unity™ needs to investigated.
- The use of language activity monitoring (LAM) could provide useful additional information to determine which icons are more frequently used for encoding and retrieving prestored messages. This might enhance our understanding of which icons are possibly less useful or more difficult to learn. It might be worthwhile to establish when AAC users switch to spell-mode and the reason why they switch to spell-mode.
- When elicited association lists have been compiled for all the icons, the development of a vocabulary sort could be done. This could be a useful tool for teaching and using Minspeak™-based VOCAs in South Africa.

5.6 SUMMARY

This chapter summarised the study's results, followed by a critical evaluation. Furthermore, it viewed the study in the light of its clinical implications. Finally, recommendations for further research were made.

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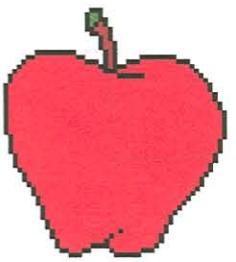
APPENDIX A

THE ICONS INCLUDED IN THIS STUDY

APPLE



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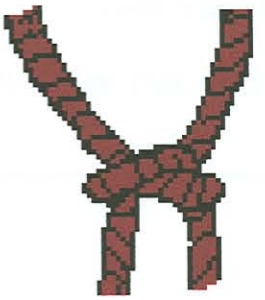

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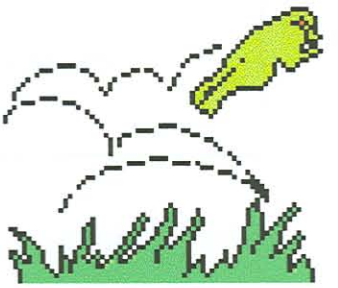
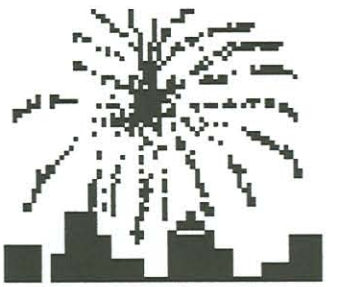


WANTED

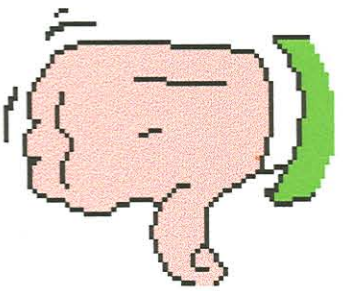
MUSIC

INTERJECTION



MEDICAL

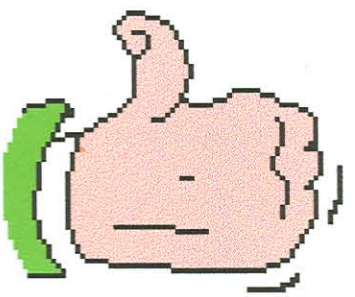
THUMBS DOWN



STOP

SENTENCE

THUMBS UP



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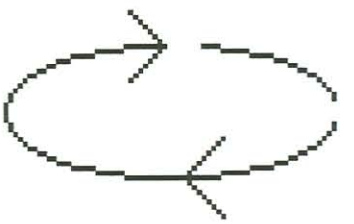


APPENDIX B

EXAMPLES OF THE QUESTIONNAIRES

Date of birth: _____ Sex: ☐ Male ☐ Female

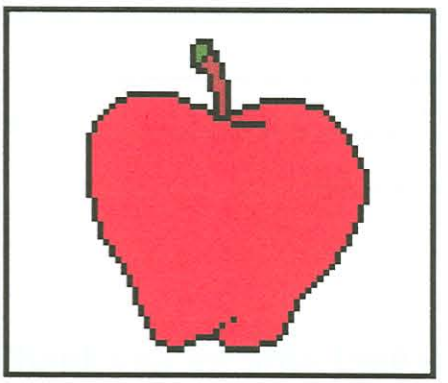
Are any of your prescribed books in English? ☐ Yes ☐ No

Are you staying in a residence? ☐ No ☐ Yes, which one? _____

1st language: _____ 2nd language: _____

Which course are you doing: _____ Year no. _____

INSTRUCTIONS: This questionnaire is part of research into the cognitive associations made by South African young adults. Please answer all the questions below by writing down the first words that come up when reading each question, pertaining to the picture below.



1. What do you see? _____
2. What do you do with it? _____

   _____
3. What group (category) does it belong to? (e.g. transport, furniture, etc.)

   _____
4. Who uses it? _____

   _____
5. How would you describe it? (e.g. size, shape, colour, substance, etc.)_____

   _____

   _____
6. Where do you find it? _____

   _____
7. Which sounds and obvious utterances would you use with it? _____

   _____

8. Why would you use it? _____

_____

9. What obvious parts does it have? _____

_____

_____

10. Name other things that are similar _____

_____

11. In which forms do you find it? _____

_____

12. What goes with it? _____

_____

13. How do you feel using it? _____

_____

Thank you for your time - it is highly appreciated!

Date of birth: _____ Sex: ☐ Male ☐ Female

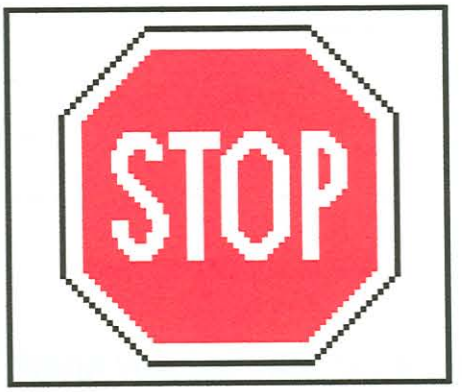
Are any of your prescribed books in English? ☐ Yes ☐ No

Are you staying in a residence? ☐ No ☐ Yes, which one? _____

1st language: _____ 2nd language: _____

Which course are you doing: _____ Year no. _____

INSTRUCTIONS: This questionnaire is part of research into the cognitive associations made by South African young adults. Please answer all the questions below by writing down the first words that come up when reading each question, pertaining to the picture below.



1. What do you see? _____
2. What do you do with it? _____

   _____
3. What group (category) does it belong to? (e.g. food, furniture, etc.)

   _____
4. Who uses it? _____

   _____
5. How would you describe it? (e.g. size, shape, colour, substance, etc.)_____

   _____

   _____
6. Where do you find it? _____

   _____
7. Which sounds and obvious utterances would you use with it? _____

   _____

8. Why would you use it? _____

_____

9. What obvious parts does it have? _____

_____

_____

10. Name other things that are similar _____

_____

11. In which forms do you find it? _____

_____

12. What goes with it? _____

_____

13. How do you feel using it? _____

_____

Thank you for your time - it is highly appreciated!

Date of birth: _____ Sex: ☐ Male ☐ Female

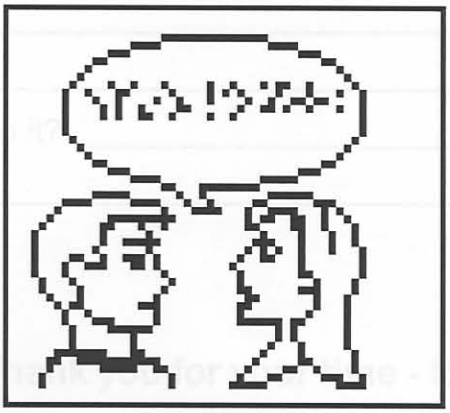
Is any of your prescribed books in English? ☐ Yes ☐ No

Are you staying in a residence? ☐ No ☐ Yes, which one? _____

1st language: _____ 2nd language: _____

Which course are you doing: _____ Year no. _____

INSTRUCTIONS: This questionnaire is part of research into the cognitive associations made by South African young adults. Please answer all the questions below by writing down the first words that come up when reading each question, pertaining to the picture below.



1. What do you see? _____
2. What do you do with it? _____

_____

3. What group (category) does it belong to? (e.g. transport, furniture, etc.)

_____

4. Who uses it? _____

_____

5. How would you describe it? (e.g. size, shape, colour, substance, etc.)_____

_____

_____

6. Where do you find it? _____

_____

7. Which sounds and obvious utterances would you use with it? _____

_____

8. Why would you use it? _____

8. Why would you use it? _____

_____

9. What obvious parts does it have? _____

_____

_____

10. Name other things that are similar _____

_____

11. In which forms do you find it? _____

_____

12. What goes with it? _____

_____

13. How do you feel using it? _____

_____

Thank you for your time - it is highly appreciated!

Date of birth: _____ Sex: ☐ Male ☐ Female

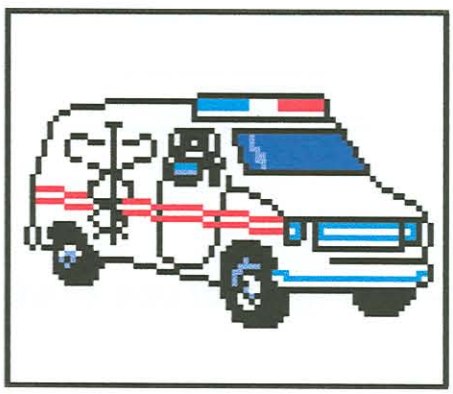
Are any of your prescribed books in English? ☐ Yes ☐ No

Are you staying in a residence? ☐ No ☐ Yes, which one? _____

1st language: _____ 2nd language: _____

Which course are you doing: _____ Year no. _____

INSTRUCTIONS: This questionnaire is part of research into the cognitive associations made by South African young adults. Please answer all the questions below by writing down the first words that come up when reading each question, pertaining to the picture below.



1. What do you see? _____
2. What do you do with it? _____

   _____
3. What group (category) does it belong to? (e.g. food, furniture, etc.)

   _____
4. Who uses it? _____

   _____
5. How would you describe it? (e.g. size, shape, colour, substance, etc.)_____

   _____

   _____
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   _____
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   _____

9. What obvious parts does it have? _____

10. Name other things that are similar _____

11. In which forms do you find it? _____

12. What goes with it? _____

13. How do you feel using it? _____

Thank you for your time - it is highly appreciated!

Date of birth: _____ Sex: ☐ Male ☐ Female

Are any of your prescribed books in English? ☐ Yes ☐ No

Are you staying in a residence? ☐ No ☐ Yes, which one? _____

1st language: _____ 2nd language: _____

Which course are you doing: _____ Year no. _____

INSTRUCTIONS: This questionnaire is part of research into the cognitive associations made by South African young adults. Please answer all the questions below by writing down the first words that come up when reading each question, pertaining to the picture below.

1. What do you see? _____
2. What do you do with it? _____

   _____
3. What group (category) does it belong to? (e.g. transport, furniture, etc.)

   _____
4. Who uses it? _____

   _____
5. How would you describe it? (e.g. size, shape, colour, substance, etc.)_____

   _____

   _____
6. Where do you find it? _____

   _____
7. Which sounds and obvious utterances would you use with it? _____

   _____

9. What obvious parts does it have? _____

10. Name other things that are similar _____

11. In which forms do you find it? _____

12. What goes with it? _____

13. How do you feel using it? _____

Thank you for your time - it is highly appreciated!

Date of birth: _____ Sex: ☐ Male ☐ Female

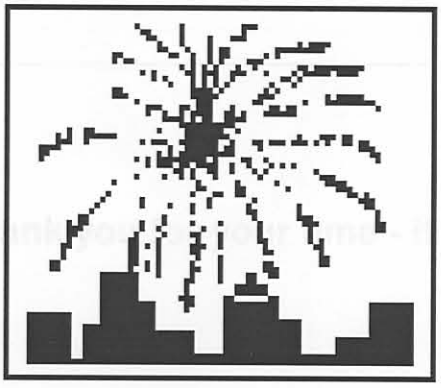
Are any of your prescribed books in English? ☐ Yes ☐ No

Are you staying in a residence? ☐ No ☐ Yes, which one? _____

1st language: _____ 2nd language: _____

Which course are you doing: _____ Year no. _____

INSTRUCTIONS: This questionnaire is part of research into the cognitive associations made by South African young adults. Please answer all the questions below by writing down the first words that come up when reading each question, pertaining to the picture below.



1. What do you see? _____
2. What do you do with it? _____

_____

3. What group does it belong to? _____
4. Who uses it? _____

_____

5. How would you describe it? (e.g. size, shape, colour, substance, etc.)_____

_____

_____

6. Where do you find it? _____

_____

7. Which sounds and obvious utterances would you use with it? _____

_____

9. What obvious parts does it have? _____

10. Name other things that are similar _____

11. In which forms do you find it? _____

12. What goes with it? _____

13. How do you feel using it? _____

Thank you for your time - it is highly appreciated!

Date of birth: _____ Sex: ☐ Male ☐ Female

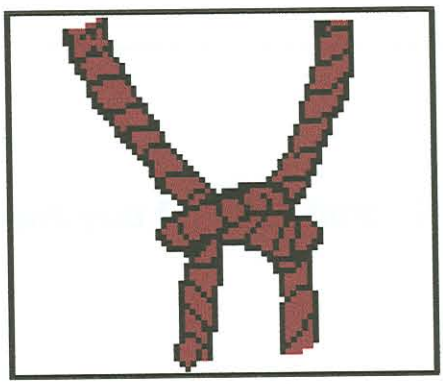
Is the language of your education English? ☐ Yes ☐ No

Are you staying in a residence? ☐ No ☐ Yes, which one? _____

1st language: _____ 2nd language: _____

Which course are you doing: _____ Year no. _____

INSTRUCTIONS: This questionnaire is part of research into the cognitive associations made by South African young adults. Please answer all the questions below by writing down the first words that come up when reading each question, pertaining to the picture below.



1. What do you see? _____
2. What do you do with it? _____

   _____
3. What group does it belong to? _____
4. Who uses it? _____

   _____
5. How would you describe it? (e.g. size, shape, colour, substance, etc.)_____

   _____

   _____
6. Where do you find it? _____

   _____
7. Which sounds and obvious utterances would you use with it? _____

   _____

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12. What goes with it? _____

13. How do you feel using it? _____

Thank you for your time - it is highly appreciated!

Date of birth: _____ Sex: ☐ Male ☐ Female

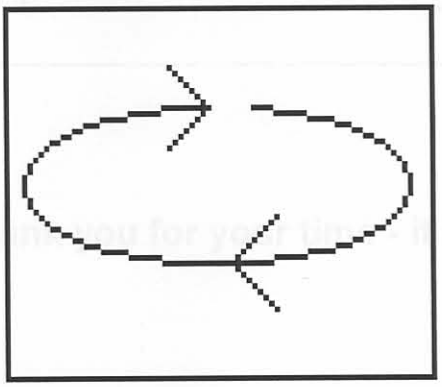
Are any of your prescribed books in English? ☐ Yes ☐ No

Are you staying in a residence? ☐ No ☐ Yes, which one? _____

1st language: _____ 2nd language: _____

Which course are you doing: _____ Year no. _____

INSTRUCTIONS: This questionnaire is part of research into the cognitive associations made by South African young adults. Please answer all the questions below by writing down the first words that come up when reading each question, pertaining to the picture below.



1. What do you see? _____
2. What do you do with it? _____

_____

3. What group (category) does it belong to? (e.g. transport, furniture, etc.)

_____

4. Who uses it? _____

_____

5. How would you describe it? (e.g. size, shape, colour, substance, etc.)_____

_____

_____

6. Where do you find it? _____

_____

7. Which sounds and obvious utterances would you use with it? _____

_____

9. What obvious parts does it have? _____

_____

_____

10. Name other things that are similar _____

_____

11. In which forms do you find it? _____

_____

12. What goes with it? _____

_____

13. How do you feel using it? _____

_____

Thank you for your time - it is highly appreciated!

Date of birth: _____ Sex: ☐ Male ☐ Female

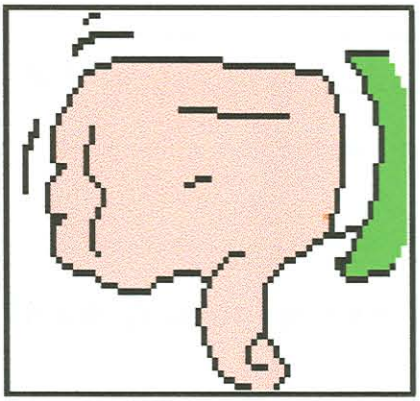
Are any of your prescribed books in English? ☐ Yes ☐ No

Are you staying in a residence? ☐ No ☐ Yes, which one? _____

1st language: _____ 2nd language: _____

Which course are you doing: _____ Year no. _____

INSTRUCTIONS: This questionnaire is part of research into the cognitive associations made by South African young adults. Please answer all the questions below by writing down the first words that come up when reading each question, pertaining to the picture below.



1. What do you see? _____
2. What do you do with it? _____

   _____
3. What group (category) does it belong to? (e.g. transport, food, furniture, etc.)

   _____
4. Who uses it? _____

   _____
5. How would you describe it? (e.g. size, shape, colour, substance, etc.)_____

   _____

   _____
6. Where do you find it? _____

   _____
7. Which sounds and obvious utterances would you use with it? _____

   _____

9. What obvious parts does it have? _____

10. Name other things that are similar _____

11. In which forms do you find it? _____

12. What goes with it? _____

13. How do you feel using it? _____

Thank you for your time - it is highly appreciated!

Date of birth: _____ Sex: ☐ Male ☐ Female

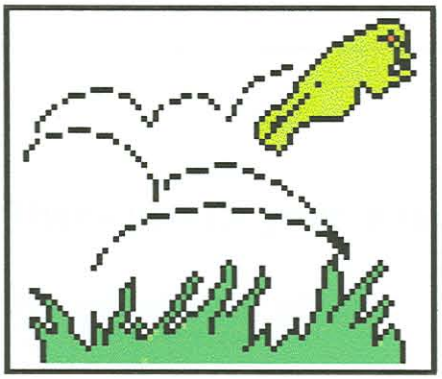
Are any of your prescribed books in English? ☐ Yes ☐ No

Are you staying in a residence? ☐ No ☐ Yes, which one? _____

1st language: _____ 2nd language: _____

Which course are you doing: _____ Year no. _____

INSTRUCTIONS: This questionnaire is part of research into the cognitive associations made by South African young adults. Please answer all the questions below by writing down the first words that come up when reading each question, pertaining to the picture below.



1. What do you see? _____
2. What do you do with it? _____

   _____
3. What group (category) does it belong to? (e.g. transport, furniture, etc.)

   _____
4. Who uses it? _____

   _____
5. How would you describe it? (e.g. size, shape, colour, substance, etc.)_____

   _____

   _____
6. Where do you find it? _____

   _____
7. Which sounds and obvious utterances would you use with it? _____

   _____

9. What obvious parts does it have? _____

10. Name other things that are similar _____

11. In which forms do you find it? _____

12. What goes with it? _____

13. How do you feel using it? _____

Thank you for your time - it is highly appreciated!

Date of birth: _____ Sex: ☐ Male ☐ Female

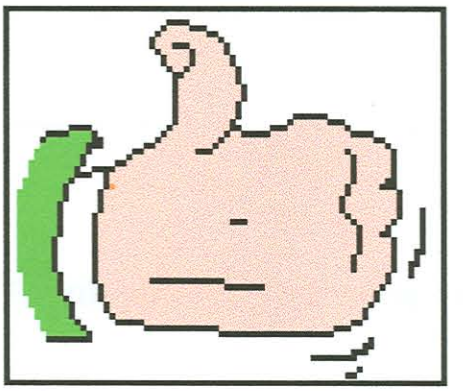
Are any of your prescribed books in English? ☐ Yes ☐ No

Are you staying in a residence? ☐ No ☐ Yes, which one? _____

1st language: _____ 2nd language: _____

Which course are you doing: _____ Year no. _____

INSTRUCTIONS: This questionnaire is part of research into the cognitive associations made by South African young adults. Please answer all the questions below by writing down the first words that come up when reading each question, pertaining to the picture below.



1. What do you see? _____
2. What do you do with it? _____

   _____
3. What group (category) does it belong to? (e.g. transport, food, furniture, etc.)

   _____
4. Who uses it? _____

   _____
5. How would you describe it? (e.g. size, shape, colour, substance, etc.)_____

   _____

   _____
6. Where do you find it? _____

   _____
7. Which sounds and obvious utterances would you use with it? _____

   _____

9. What obvious parts does it have? _____

10. Name other things that are similar _____

11. In which forms do you find it? _____

12. What goes with it? _____

13. How do you feel using it? _____

Thank you for your time - it is highly appreciated!

Date of birth: _____ Sex: ☐ Male ☐ Female

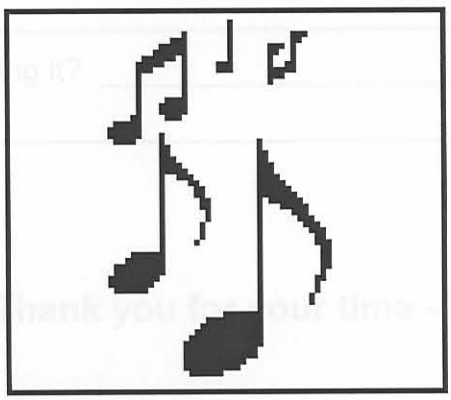
Are any of your prescribed books in English? ☐ Yes ☐ No

Are you staying in a residence? ☐ No ☐ Yes, which one? _____

1st language: _____ 2nd language: _____

Which course are you doing: _____ Year no. _____

INSTRUCTIONS: This questionnaire is part of research into the cognitive associations made by South African young adults. Please answer all the questions below by writing down the first words that come up when reading each question, pertaining to the picture below.



1. What do you see? _____
2. What do you do with it? _____

_____

3. What group (category) does it belong to? (e.g. transport, furniture, etc.)

_____

4. Who uses it? _____

_____

5. How would you describe it? (e.g. size, shape, colour, substance, etc.)_____

_____

_____

6. Where do you find it? _____

_____

7. Which sounds and obvious utterances would you use with it? _____

_____

9. What obvious parts does it have? _____

_____

_____

10. Name other things that are similar _____

_____

11. In which forms do you find it? _____

_____

12. What goes with it? _____

_____

13. How do you feel using it? _____

_____

Thank you for your time - it is highly appreciated!

APPENDIX C

EXAMPLE OF PRIMARY RECORDING SHEET (EXCEL SPREADSHEET)

Icon	Qr#	DOB	Sex	Abode	Course	Yr	Q1	Q2	Q3	Q4	Q5.1	Q5.2	Q5.3	Q5.4	Q6	Q7	Q8	Q9.1	Q9.2	Q10	Q11	Q12.1	Q12.2	Q13
apple	1	760907	F	D	MA(AAC)	2	apple	eat	food	people	small	round	red	juicy	trees	yum	hungry	Stem	pips	ball	green	salad	health	fulfilled
apple	2	800102	M	R	B.Eng	1	apple	bite	fruit	apes	small	heart-shaped	red		shop	yuck	snack	pips	Peel	pear	with dots	salt	cream	happy
apple	3	791203	M	D	LLB	2	apple	cut	food	moms	small	round	red	pips	salad	hmm	hungry	peel	stem	orange	red	cream	fruit	great
apple	4	810924	F	D	B.Sc	3	apple	eat	food	people	small	round	red	flesh	tree		hungry	stem	pips	ball	green	grapes	salad	good

APPENDIX D

EXAMPLE OF SECONDARY RECORDING SHEET

COMMON ASSOCIATIONS

ICON	QUESTION#	COMMON ASSOCIATIONS	SPREAD (%)
APPLE	1	1. Apple	80 (40/50)
		2. Red	18 (9/50)
		3.	
		Other	2 (1/50)
TOTAL:			100 %

Average over top 3 common associations	49 %	% of commonality for 1st level association	80 %

LIST OF WORDS INCLUDED IN EACH COMMON ASSOCIATION

1. Apple	2. Red	3.	Other
apple	red		

COMMON ASSOCIATIONS

ICON	QUESTION#	COMMON ASSOCIATIONS	SPREAD (%)
APPLE	2	1. Eat	88,89 (40/45)
		2.	
		3.	
		Other	11,11 (5/45)
TOTAL:			**100 %**

Average over top 3 common associations	**88,89 %**	**% of commonality for 1st level association**	**88,89 %**

LIST OF WORDS INCLUDED IN EACH COMMON ASSOCIATION

1. Eat	2.	3.	Other
eat			construct the theory of gravity
bite			decorate
			look
			peel
			use as weapon

COMMON ASSOCIATIONS

ICON	QUESTION#	COMMON ASSOCIATIONS	SPREAD (%)
APPLE	3	1. Fruit	60, 98 (25/41)
		2. Food	39,02 (16/41)
		3.	
		Other	-
TOTAL:			**100 %**

Average over top 3 common associations	**50 %**	**% of commonality for 1st level association**	**60,98 %**

LIST OF WORDS INCLUDED IN EACH COMMON ASSOCIATION

1. Fruit	**2. Food**	**3.**	**Other**
fruit	food		

COMMON ASSOCIATIONS

ICON	QUESTION#	COMMON ASSOCIATIONS	SPREAD (%)
APPLE	4	1. People	56,60 (30/53)
		2. Animals	18,87 (10/53)
		3. Everybody	18,87 (10/53)
		Other	
TOTAL:			100 %

Average over top 3 common associations	31,45 %	% of commonality for 1st level associations	56,60 %

LIST OF WORDS INCLUDED IN EACH COMMON ASSOCIATION

1. People	2. Animals	3. Everybody	Other
people	animals	everybody	
South Africans	elephants	everyone	
hungry people	horses	living organisms	
healthy people	herbivores		
humans	omnivores		
mothers			
Newton			
people on a diet			
people who eats it			
health-aware			
apple lovers			

COMMON ASSOCIATIONS

ICON	QUESTION#	COMMON ASSOCIATIONS	SPREAD (%)
APPLE	5.1	1. Size of fist	47,37 (9/19)
		2. Size of tennis ball	26,32 (5/19)
		3. Small	21,05 (4/19)
		Other	5,26 (1/19)
TOTAL:			100 %

Average over top 3 common associations	31,58 %	% of commonality for 1st level association	47,37 %

LIST OF WORDS INCLUDED IN EACH COMMON ASSOCIATION

1. Size of fist	2. Small	3. Size of tennis ball	Other
fist	small	tennis ball	different sizes
big	3 x 4 cm	medium	
large	4 x 5 cm		

COMMON ASSOCIATIONS

ICON	QUESTION#	COMMON ASSOCIATIONS	SPREAD (%)
APPLE	5.2	1. Round	58,82 (20/34)
		2. Heart-shaped	23,53 (8/34)
		3.	
		Other	17,65 (6/34)
TOTAL:			100 %

Average over top 3 common associations	41,18 %	% of commonality for 1st level association	58,82 %

LIST OF WORDS INCLUDED IN EACH COMMON ASSOCIATION

1. Round	2. Heart-shaped	3.	Other
round	heart-shaped		oval
sphere			off-round
circle			voluptuous
			no specific form

COMMON ASSOCIATIONS

ICON	QUESTION#	COMMON ASSOCIATIONS	SPREAD (%)
APPLE	5.3	1. Red	75,47 (40/53)
		2.	
		3.	
		Other	24,53 (13/53)
TOTAL:			100 %

Average over top 3 common associations	75,47 %	% of commonality for 1st level association	75,47 %

LIST OF WORDS INCLUDED IN EACH COMMON ASSOCIATION

1. Red	2.	3.	Other
red			brown
			green
			white
			yellow

COMMON ASSOCIATIONS

ICON	QUESTION#	COMMON ASSOCIATIONS	SPREAD (%)
APPLE	5.4	1. Fibre	50,0 (2/4)
		2. Sugar	25,0 (1/4)
		3. Water	25,0 (1/4)
		Other	
TOTAL:			100 %

Average over top 3 common associations	33,33 %	% of commonality for the 1st level association	50 %

LIST OF WORDS INCLUDED IN EACH COMMON ASSOCIATION

1. Fibre	2. Sugar	3. Water	Other
fibre	sugar	water	

COMMON ASSOCIATIONS

ICON	QUESTION#	COMMON ASSOCIATIONS	SPREAD (%)
APPLE	6	1. Tree	54,29 (38/70)
		2. Shops	32,86 (23/70)
		3.	
		Other	12,86 (9/70)
TOTAL:			100 %

Average over top 3 common associations	**43,57 %**	**% of commonality for 1st level association**	**54,29 %**

LIST OF WORDS INCLUDED IN EACH COMMON ASSOCIATION

1. Tree	2. Shops	3.	Other
apple tree	shops		bags
tree	supermarkets		fridge
grown	Pick 'n Pay		fruit bowl
	cafeteria		people's mouths
	any place that sells it		kitchen
	market		
	green grocers		
	fruit markets		

COMMON ASSOCIATIONS

ICON	QUESTION#	COMMON ASSOCIATION	SPREAD (%)
APPLE	7	1. Crunch	56,36 (31/55)
		2. Exclamations while eating	30,91 (17/55)
		3.	
		Other	12,73 (7/55)
TOTAL:			100 %

Average over top 3 common association	43,64 %	% of commonality for 1st level association	56,36 %

LIST OF WORDS INCLUDED IN EACH COMMON ASSOCIATION

1. Crunch	2. Exclamations	3.	Other
crunch	yummy		tummy growls
munch	hmmm		fresh
crack	aah		wind through tree
	delicious		an apple a day keeps the doctor away
	sweet		
	nice		
	smacking lips		
	eeeeuuuu worm!		
	I'm hungry!		

COMMON ASSOCIATIONS

ICON	QUESTION#	COMMON ASSOCIATIONS	SPREAD (%)
APPLE	8	1. Hungry	42,42 (28/66)
		2. Nutrition	28,82 (19/66)
		3.	
		Other	28,92 (19/66)
TOTAL:			100 %

Average over top 3 common associations	35,54 %	% of commonality for the 1st level association	42,42 %

LIST OF WORDS INCLUDED IN EACH COMMON ASSOCIATION

1. Hungry	2. Nutrition	3.	Other
hungry	nutrition		boredom
relieve hunger	nourishment		delicious
still hunger pains	supply essential vitamins		thirsty
fill my tummy	minerals		tasty
	vitamins		tired
	healthy		portable
	grow up healthy and strong		food
	maintain balanced diet		
	stay healthy		

COMMON ASSOCIATIONS

ICON	QUESTION#	COMMON ASSOCIATIONS	SPREAD (%)
APPLE	9	1. Apple	63,92 (62/97)
		2. Stem	36,08 (35/97)
		3.	-
		Other	-
TOTAL:			100 %

Average over top 3 common associations	50,0 %	% of commonality for 1st level association	63,92 %

LIST OF WORDS INCLUDED IN EACH COMMON ASSOCIATION

1. Apple	2. Stem	3.	Other
apple	stem		
core	twig		
centre	trunk		
body	stalk		
flesh	branch		
fruity part	leaves		
juicy part			
peel			
pips			
skin			
seeds			
red part			
taste			
sweet part			

COMMON ASSOCIATIONS

ICON	QUESTION#	COMMON ASSOCIATION	SPREAD (%)
APPLE	10	1. Fruit	93,90 (77/82)
		2.	
		3.	
		Other	6,10 (5/82)
TOTAL:			100 %

Average over top 3 common associations	**93,90 %**	**% of commonality for 1st level association**	**93,90 %**

LIST OF WORDS INCLUDED IN EACH COMMON ASSOCIATION

1. Fruit	2.	3.	Other
fruit			beach ball
banana			candy
orange			healthy things
pineapple			nothing
pear			
peach			
apple			
strawberry			
tomato			
naartjie			
mango			
cherry			
grapes			

COMMON ASSOCIATIONS

ICON	QUESTION#	COMMON ASSOCIATIONS	SPREAD (%)
APPLE	11	1. Different forms of apple	52,0 (52/100)
		2. Different shapes	20,0 (20/100)
		3. Different colours	17,0 (17/100)
		Other	11,0 (11/100)
TOTAL:			100 %

Average over top 3 common associations	29,67 %	% of commonality for1st level association	52,0 %

LIST OF WORDS INCLUDED IN EACH COMMON ASSOCIATION

1. Different forms	2. Different shapes	3. Different colours	Other
juice	circle	red	big
pie	heart-shaped	green	candy
canned	irregular	yellow	vegetables
puree	off-round	yellow with dots	small
sauce	oval		one
salad	pear-shaped		
yogurt	round		
chopped	circular		
baked	spheres		
grated			
rotten			
squashed			
small blocks			
cut			

COMMON ASSOCIATIONS

ICON	QUESTION#	COMMON ASSOCIATIONS	SPREAD (%)
APPLE	12	1. Food	71,67 (43/60)
		2.	
		3.	
		Other	28,33 (17/60)
TOTAL:			100 %

Average over top 3 common associations	71,67 %	% of commonality for 1st level associations	71,67 %

LIST OF WORDS INCLUDED IN EACH COMMON ASSOCIATION

1. Food	2.	3.	Other
food			branch
fruit			delicious taste
cheese			healthy diet
chocolate			leaf
ice cream			stick through it
fruit salad			worm
cinnamon			anything
banana			eat separately
apple tart			hunger
toffee			thirst
grapes			
pork			
syrup			
yogurt			
salt			
refreshments			
pineapple			
cream			
pie			
pancakes			

COMMON ASSOCIATIONS

ICON	QUESTION#	COMMON ASSOCIATIONS	SPREAD (%)
APPLE	13	1. Positive feelings	91,8 (56/61)
		2.	
		3.	
		Other	8,2 (5/61)
TOTAL:			100 %

Average over top 3 common associaitons	91,8 %	% of commonality for 1st level associations	91,8 %

LIST OF WORDS INCLUDED IN EACH COMMON ASSOCIATION

1. Positive feelings	2.	3.	Other
content			depressed
confident			easy to make
energised			filling
enjoy			fresh
fulfilled			not fattening
good			
great			
happy			
healthy			
nice			
pleasant			
perfect			
satisfied			
stronger			
wonderful			
refreshed			
relieved			
heavenly			
part of something wonderful			
safe			
I like it			

APPENDIX E

VERBATIM INSTRUCTIONS TO PARTICIPANTS

"Hello, my name is Elmarie and this is Elaine and that is Yasmin. We work at the Centre for AAC on campus and we work primarily with people who have little or no functional speech. That means that they have less than 15 words that they can use functionally. If you consider that young adults, like yourselves, have between 20,000 and 22,000 words in your vocabulary, you can imagine that 15 words does not go a very long way when you're trying to communicate your thoughts about the world. There are existing software packages that were developed for people with little or no functional speech, that are based on pictures. However, these packages were developed in the US and UK and are not necessarily appropriate for South Africans. We are doing a research project to gain information as to what will be appropriate for South Africans. We need you to make associations with pictures according to 13 questions on a questionnaire. I complete the questionnaire in about 6 minutes, so it should take you about 10 minutes to complete it. Those of you who choose not take part in this research project, are asked to please leave the room now. When you have completed the questionnaire, please hand it back to any of us."

APPENDIX F

AN EXAMPLE OF A PRUNED QUESTIONNAIRE

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Date of birth: 1981/10/03 Sex: ☑ Male ☐ Female

Are any of your prescribed books in English? ☑ Yes ☐ No

Are you staying in a residence? ☑ No ☐ Yes, which one? _____

1st language: Afrikaans 2nd language: Engels

Which course are you doing: B.Ing(Rekenaars) Year no. 1

INSTRUCTIONS: This questionnaire is part of research into the cognitive associations made by South African young adults. Please answer all the questions below by writing down the first words that come up when reading each question, pertaining to the picture below.

1. What do you see? A criminal (1.1) convict (1.2) behind bars (1.3) prop.
2. What do you do with it? You keep him behind bars (2.1)
3. What group (category) does it belong to? (e.g. transport, furniture, etc.)
   correctional services (3.1)
4. Who uses it? The justice system (4.1)
5. How would you describe it? (e.g. size, shape, colour, substance, etc.) Large (3.1), square (3.2), building, grey (3.3), made of stone (3.4)
6. Where do you find it? In (prep) police stations (6.1), ayet, border (6.2) posts,
7. Which sounds and obvious utterances would you use with it? Bad, bad person (7.1)

8. Why would you use it? To make public aware of criminal status of person (8.1) (8.2)

9. What obvious parts does it have? A picture (9.1), description of person (9.2), large caption saying (was) (9.3) Hopefully a reward (9.5) for info (9.4).

10. Name other things that are similar Lost Dog posters (10.1)

11. In which forms do you find it? On Paper (11.1), Images on television screens (11.2).

12. What goes with it? A pin (12.1) to stick it to a pole (12.2).

13. How do you feel using it? Like a policeman (13.1)

Thank you for your time - it is highly appreciated!

APPENDIX G

SUMMARY OF CALCULATIONS MADE TO DETERMINE INTERRATER RELIABILITY

A) PRIMARY RECORDING OF RESPONSES

14 % of responses were submitted to the second rater to check for reliability

Total amount of responses = 480 x 16 = 7680 + 256 = 7 936
14 % of responses = (7 936 ÷ 14) x 100/1 = 1 112
Total amount of similarities = 1089
Total amount of differences = 23

Formula for determining interrater reliability:

$$\textit{Interrater reliability} = \frac{\textit{total amount of similarities}}{\textit{total of similarities and differences}} \times \frac{100}{1}$$

$$= \frac{1089}{1\,112} \times \frac{100}{1}$$

$$= 97{,}9\ \%$$

B) SECONDARY CATEGORIZATION PROCESS

14 % of common associations were submitted to the second rater to check for reliability

Total amount of common associations = 400
14 % of responses = (400 ÷ 14) x 100/1 = 56
Total amount of similarities = 54
Total amount of differences = 2

Formula for determining interrater reliability:

$$\textit{Interrater reliability} = \frac{\textit{total amount of similarities}}{\textit{total of similarities and differences}} \times \frac{100}{1}$$

$$= \frac{54}{56} \times \frac{100}{1}$$

$$= 97{,}3\ \%$$