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Literacy and the comprehension of public safety signs, with and without written aids.

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CHAPTER ONE
INTRODUCTION

The aim of this research is to investigate the varying comprehension levels individuals have of public safety symbols, with and without written text. In so doing, literacy is noted as a potential factor accounting for some of the variation in comprehension.

Industrial accidents, and sometimes on a larger scale, societal catastrophes have long been attributed to the notion of "human error" and as a result require continual appraisal regarding the ways in which individuals interpret and process information. It is no surprise then that the expansive range of warning and safety research remains a critical area of inquiry. Warning and safety research conducted over the past fifteen years has identified numerous factors that can influence the effectiveness of safety communications. Research has shown that when warnings lack certain design characteristics, factors that are internal to the design process, measures of effectiveness tend to dwindle (Wogalter, Kalsher & Racicot, 1993).

Similarly, warning effectiveness is also said to be influenced by factors external to the design of a specific warning sign such as environmental-related effects and the behaviour of other people. Given that warning signs are designed to promote safety awareness, it is imperative to reflect upon how the value of warnings might be preserved and improved (Frantz, 1992).

Bearing this in mind, the role of literacy is highlighted as a potential factor influencing this process. Prevailing conceptions of literacy incite that its acquisition gives rise to particular good effects. For example, literacy has been said to raise one's cognitive skills as well as develop a meta-cognitive understanding or rational outlook vital for progression (Prinsloo & Breier, 1996).

Furthermore, drawing on evidence from the South African context, a report by the Media Research and Training Unit of Rhodes University subtitled "Communicating Electoral Processes to a Low-Literacy Audience" (Pinnock & Polacsek, 1992) state:

> Firstly, people who cannot read have trouble understanding pictures…Our visual syntax is premised on literacy and we compose our pictures accordingly. Self evident as television pictures may seem to the literate, they are surprisingly confusing for people who do not read…Television is essentially an urban medium and is programmed by literate people for literate people. (p.2; and see Chapter 5).

In addition, the years between 1990 and 1994 were largely characterised by policy debate in anticipation of the work facing the new government, particularly in the domain of reconstruction and development (Cosatu, 1992; NEPI, 1992). During this time, the discourse of human resources development (HRD) emerged in policy work in education in general, and in adult literacy planning specifically (Kraak, 1992: Cosatu, 1992). Within this framework, literacy provision became part of Adult Basic Education and Training (ABET) and was projected as the provision of basic skills.

> "It is estimated that about 15 million black adults (over one-third of the population) are illiterate and have had little or no education…The lack of access to basic education, including literacy and numeracy, has consigned millions of our people to silence and marginalisation from effective and meaningful participation in social and economic development" (CEPD, 1994, p1; ANC, 1994, p87).

Through this system, labouring classes and the unemployed were promised a route for social advancement by way of state-guaranteed access to further education and training, and in turn higher level employment (Cosatu, 1992). However, the disparities between adult literacy policy intentions and the reality of adult literacy work on the ground were apparent.

The aforementioned thus highlights the motivation for assessing participants' literacy levels, as ascertaining one's level of literacy may give us an all-inclusive understanding as to why varying interpretations of safety signs exist. Literacy is therefore argued to be a crucial factor in safety sign comprehension and in essence, only once this has been accounted for, can designers of safety signs readily tackle how to communicate safety information to a wide-ranging South African audience efficiently. In alignment with this view, Ong (1982) advocates that literacy is a strong and socially determining technology, essentially the pivot around which key differences between oral and literate cultures are drawn (Ong, 1982).

The present study aims to align itself with this objective by investigating the role of literacy in the process of interpreting and comprehending safety information. In order to decipher whether individuals' level of literacy influences their understanding of the twelve safety signs used in the study; six signs representing pictorial features only, and six safety signs representing pictorial features with the addition of text (language), were compared. Using the details obtained from participants' educational backgrounds then provided the means to showcase some of the disparities in the comprehension of signs between those individuals that were literate versus those with lower literacy skills. Participants were accessed from the Johannesburg General Hospital to gain access to a broader public sample, and in that way produce a more varied demographic sample with across-the-board levels of literacy.

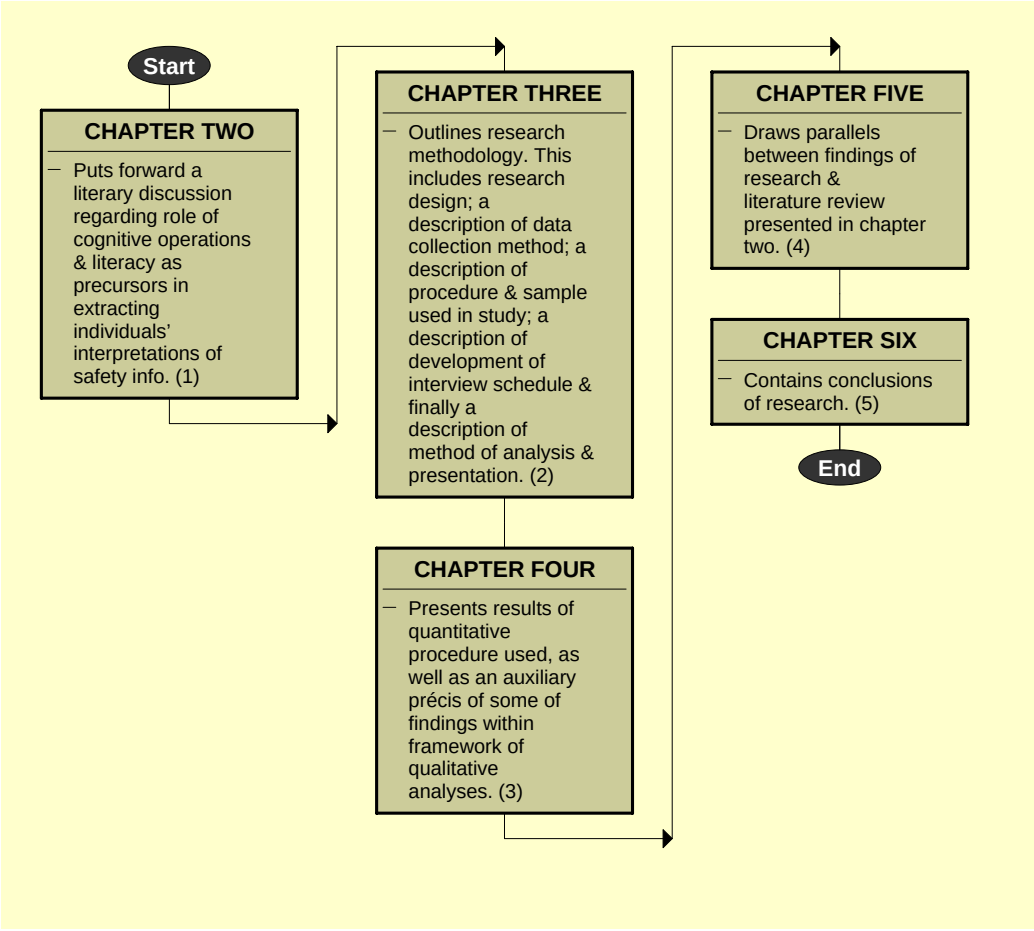
Chapter two provides the background and rationale about safety signs, comprehension and literacy as precursors for extracting individuals' interpretations of safety information.

Chapter three outlines the research methodology. This includes the research design; a description of the data collection method; a description of the procedure and sample used in the study; a description of the development of the interview schedule and finally a description of the method of analysis and presentation.

Chapter four presents the results of the quantitative procedure used, as well as an auxiliary précis of some of the findings within the framework of qualitative analyses.

Chapter five draws parallels between the findings of the research and the literature review presented in chapter two.

Chapter six contains the conclusions of the research.



CHAPTER TWO
LITERATURE REVIEW AND RATIONALE

2.1. Overview

In light of the wide-ranging approaches used to communicate safety information, certain characteristics such as the presence of a signal word or icon can be useful in increasing perceived hazard levels, facilitating comprehension and enhancing compliance (Laughery, Wogalter & Young, 1994). As such, international standards authorities, namely the International Organisation for Standardisation (ISO), have been instituted to evaluate pictorial symbols' comprehensibility. ISO International Standards are in no way binding on either governments or industry merely by virtue of being International Standards. The reasoning being that there are situations where certain types of standards may conflict with social, cultural or legislative expectations and requirements (ISO, 1984).

Consequently, this policy underlines the fact that national and international experts responsible for creating these standards do not always agree and not all proposals become standards by unanimous vote. Therefore, the individual nations and their standards bodies remain the final arbiters. However, more importantly for the purpose of this research, despite these standards, disagreement has come into sight as to whether or not these signs communicate the intended concepts to targeted populations effectively (ISO, 1984). Furthermore, Laughery, Wogalter and Young (1994), assert that there are disparities in warning standards and guidelines that have not been expansively clarified by research (Laughery, Wogalter & Young, 1994).

Accordingly, Wogalter and Dingus (1999), convey that the ultimate principle of safety signs is behavioural compliance. For this objective to be attained, signs need to influence people's behaviour in ways that do not lead to personal injury. Moreover, there are numerous criteria for the design of high-quality safety signs and, understandability is often considered the most important criterion of these. Therefore, testing people's comprehensibility provides a useful tool in effectively developing and revising safety signs.

ISO and ANSI criteria

Pictorial symbols have an important role to play in communicating information and as such both national and international standards have been established in order to illustrate how comprehensibility can be evaluated namely, the American National Standard Institute's ANSI Z535.3 (ANSI, 1991) and the Organisation for International Standardisation's ISO 3864 (ISO, 1984). These standards, (ANSI and ISO) advise that symbols must reach a certain criterion of at least 85% or 67% correct, respectively, in a comprehension test considered to be acceptable. This therefore implies that, the remaining 33% of individuals would not interpret symbols correctly and furthermore, that a significant proportion of people would be at risk of injury or serious harm.

While little research has evaluated various methods for testing comprehension there are two methods commonly employed to assess symbol comprehensibility namely, the multiple choice test and the open-ended test. The multiple choice method requires participants to choose the answer that best expresses the symbol's meaning from several alternative answers. However, in open-ended tests, participants are shown a symbol and then asked to give its meaning in their own words. According to the current version of the ANSI (1991) Z535.3 symbol standard, either test is permitted, although preference is given to the open-ended test method. As such, the open-ended technique was adopted in this study by showing participants 12 safety signs and then asking them to explain what they understood each sign to mean.

2.1.1. Signs and symbols

In short, pictograms are pictures or symbols used to represent an object or concept. They differ from realistic drawings in that they are considerably simplified, through only showing the key features of the information that is to be communicated (Reber, 1985). Furthermore, pictorial representations or *symbols* are said to be objects, characters or other concrete representations of concepts, ideas or other abstractions. From a more psychological perspective, every perception is said to be symbolic, where humans often react to symbolism on a subconscious level (Myers, 2004). Furthermore, the nature of symbols and the process of symbolisation are deeply rooted in the nervous system, where the relationship of that system to consciousness, thought and subjectivity is not amply understood (Myers, 2004).

However, one construal emphasises that language is ultimately made up of symbols. Therefore, the word "cat", whether spoken or written, is not a cat, but is rather a symbol for a cat (Jakobson, 1971). As such, pictographic or pictorial signs are increasingly used in an attempt to convey important safety information in a variety of organisational and community settings. The purpose of which is to reduce and ultimately eliminate workplace injury by ensuring that such signs communicate articulate, unambiguous information to all individuals (Wolff & Wogalter, 1998).

The significance of signs has been recognised throughout much of the history of philosophy and psychology (Danesi, 1994). In today's context, the use of semiotics provides insight into ways of improving ergonomic design in instances where it is important to ensure that individuals interact more effectively with their environments. As such, the use of public safety signs serves to enhance individuals' awareness of possible threats to their safety (Clarke, 1987).

Sturken and Cartwright (2001), advocate that the extent to which images affect us as viewers is dependent on the broader cultural meanings they invoke, as well as the social, political and cultural contexts in which they are viewed. In this vein, meanings lie not solely within their image components, but rather are acquired when they are viewed and interpreted (Sturken & Cartwright, 2001). Thus, meanings of images are said to be multiple and are created each time they are viewed (Sturken & Cartwright, 2001). We use many tools to interpret images and create meaning and we often do so automatically without giving it much thought. We decode images by interpreting clues to intended, unintended and even suggested meanings. Thus, every time individuals interpret an image and what it signifies, whether consciously or not, essentially the tools of semiotics are employed.

Furthermore, Cavallaro (2001) asserts that meaning resides not in the initial perception of a sign, but in the interpretation of the perception and subsequent action based on that perception. For example, we perceive an octagonal red sign with the letters STOP inscribed. The meaning then lies in the interpretation of the sign and subsequent action (we stop). We also decode images by interpreting clues and suggested meanings such as colour, contrast, composition and style of address to the viewer. The social context in which an image is presented also aids interpretation.

For instance, when confronted with the *skull and crossbones* image, the intended message is meant to convey danger or hazardous substances. However, in other socio-cultural contexts, varied perceptions exist. For example, the enigmatic image of the *skull and crossbones* is entrenched in the minds of many around the world as the symbol for piracy and death (Gardiner, 2006). Similarly, within African cultures, the same sign may be associated with ancestral nuances. Accordingly, Cavallaro (2001) suggests that signs become meaningful when they are decoded according to cultural conventions and systems which individuals employ both consciously and unconsciously.

From an applications point of view, symbols also offer an alternative means of expression, which gets around some of the limitations of written language (Easterby & Zwaga, 1984). For instance, symbols are able to transmit information with an element of visual impact, which is not implicit with words. The transmission of safety information therefore, remains an important undertaking for designers and ultimately all individuals regardless of their age, gender or native language should understand safety information. In light of this directive, designers of safety information face the challenge of generating "culture-free", unambiguous, and explicit pictorial representations (Reber, 1985). As such, in order for individuals to grasp the meaning of a given safety sign, the intricacies of the content and more specifically, the symbols portrayed in safety signs need to be unraveled.

2.1.2. Symbol Explicitness

Essentially, there are two deep-seated issues for the design and use of pictorial symbols. The first relates to matters associated with the specific visual characteristics of graphic representations in that they should be considered within some broader framework of human communication. The second concerns the extent to which graphic resources (e.g. representational style, size) can be interrelated systematically to fulfill communicative functions (Easterby & Zwaga, 1984).

Moreover, the degree to which individuals comprehend symbols or similarly, symbols with the addition of text, will largely depend on certain cognitive operations such as memory, past exposure and perceptual qualities that facilitate conceptualisations of the physical qualities of iconic material (e.g. size, shape, colour, legibility, abstractness and so forth). Therefore, one of the leading arguments supporting the use of pictograms or similarly, pictograms with text as a means of abstracting comprehension levels is that symbols are often perceived to be a relatively quick and easy means of conveying information and, furthermore on a cognitive level, symbolic representations of information are easily processed by most people (Easterby & Zwaga, 1984).

It has been reported that warning symbols enhance recall of warning information (Young & Wogalter, 1990). On the other hand, Ursic (1984) found that symbols did not enhance recall. These varied results reflect differences in the symbols used and therefore highlight potential factors that could affect participants' comprehension of safety signs. As such, the present study uses a comprehension test method, which is a procedure promoted by ISO 9186 – Graphical Symbols – Test methods for judged comprehensibility and for comprehension, (2001) and ANSI Z535.3: Criteria for Safety Symbols (1998). Again, ANSI and ISO standards advise that symbols must reach a certain criterion of at least 85% or 67% correct, respectively, in a comprehension test considered to be acceptable.

Importantly, Alves-Foss, Thomas, and Braun (1995), noted that warning guidelines such as ANSI (1998) provide multiple symbols for the same hazard without considering that different symbols might convey different levels of hazard. For instance, Alves-Foss et al. (1995) compared three versions of the electric shock and hand entrapment symbols that varied in explicitness (See Appendix 5). Their results indicated that high explicitness symbols received the highest perceived hazard ratings and low explicitness symbols received the lowest ratings of comprehension. This finding suggests that although symbols meet the required comprehension level, they can convey significantly different information. This in turn, makes clear that should individuals misinterpret safety information, they may also underestimate the severe consequences that non-compliance with such safety information could bring about.

Aligned with what has been discussed so far regarding the content of safety signs, the role of text or written language will also be deliberated.

2.1.3. Text Explicitness

This notion reflects the extent to which a warning identifies the type and severity of potential injuries that might result from noncompliance. Laughery, Rowe-Hallbert, Young, Vaubel and Laux (1991) demonstrated that increases in text explicitness increased levels of perceived hazard. More recently, Young and Wogalter (1998) showed that information concerning the severity of injuries accounted for the largest portion of the variance in a perceived hazard.

In addition, Robinett and Hughes (1971), point out that those symbolic representations comprising symbols and text, may produce uncertainty and ambiguities for the ways in which people process and understand signs, which raises the question, how much more so would this be the case for illiterate individuals? This has important implications for the present study since low literacy levels are endemic to the South African population and could therefore impede their ability to grasp the intended meaning of a sign. However, we cannot discredit the possibility that for some, safety signs aided by text (language) could enhance the comprehension level of those signs. Ultimately, both dimensions of this scale will be explored within the present study.

2.1.4. Safety signs and representation

Previous research has revealed that the use of familiar objects in pictures is often understood almost as quickly as words (Potter & Faulconer, 1975). Furthermore, familiar objects are recognised and stored in memory as both an analog spatial image as well as a symbolic (idea) encoding (Wickens, 1992). This concept will be unpacked further on in this discussion by delving into Baddeley's (1986) theory of working memory.

Wickens (1992) advises that pictorial symbols should be used with care due to the dynamics of individuals' comprehension or interpretation. Furthermore, this dynamic is not exclusive to the use of symbols but may also be apparent with words. Essentially, the interpretation of a symbol comprises two steps: the first being determining what object is being represented and the second being, what the object actually means. Subsequently, even if one recognises a symbol, the meaning thereof may not be interpreted correctly. Therefore, when individuals are exposed to safety information, the complexities lie in their ability to interpret the meaning of short or abstract signs and symbols correctly (Wickens, 1992).

In addition, public safety or warning signs generally comprise symbols (pictorial representations) and text that together aim to communicate particular information. As has been highlighted, the extent to which these safety or warning signs are clear and logical to intended audiences depends largely on one's comprehension of the features represented in a given sign. (Paivio, 1986). Paivio (1986) adds that thinking, comprehending and perceiving all presuppose representation of some kind.

Often, definitions of representation indicate that they can be physical or mental, symbolic (in that they can stand for something else) and that they vary in abstractness. However, one of the most notable distinctions of representations is that some are *picture-like*, while others are *language-like* (Paivio, 1986).

For instance, picture-like representations include such things as photographs, maps and diagrams, while language-like representations include natural languages as well as more formal systems such as mathematics and computer languages. As indicated earlier, picture-like and language-like representations can vary in abstractness in both a structural or functional sense (Paivio, 1986). For example, diagrams of objects are structurally more abstract than photographs since they depict fewer details. When it comes to the use of signs that encompass pictorial elements, often their symbolic function can be highly arbitrary and governed by convention. Examples of this include, structurally abstract silhouettes of a man or a woman that serve to indicate toilets. Similarly, curves on road signs are frequently used to represent curves on a road and so on. However, the shared factor in these examples is that they could also be used to represent any number of other situations (Paivio, 1986).

When it comes to unloading the characteristics of safety signs, an inherent role is to communicate a warning or danger of some kind. The term "warning" applies to a broad and complex concept. As such, multiple definitions of the term exist, however Ayers et. al (1991) point out that instead of reaching a consensus on a narrow definition of a warning, the aim rather should be to develop a clear understanding of the variety this concept encapsulates. This assertion then also allows researchers to explore potential impacts of different forms of warnings on different groups of people in diverse contexts. In light of this, Ayers et al (1991) draw on communication theory, which addresses the transmission and use of information. From this stance, communication incorporates a *sender*, a *message* and a *receiver* wherein each of these components can provide a definition of a warning.

The sender of a given message plays a decisive role in effectively communicating the intended meaning of a sign, as has been highlighted throughout this discussion. However, it is equally important to examine warning/ safety signs' comprehensibility from a recipient /receiver's point of view. As such, Ayers et al (1991) assert that a warning is any message that can be interpreted by the receiver as providing information about possible negative consequences of an action [or inaction] (Ayers, Gross, Fowler, McCarthy, Kalinowski & Lau, 1991).

Furthermore, a distinction is often made between safety warnings (messages about possible injury or death) and other warnings (messages that alert individuals to negative outcomes such as property damage, loss of time or money or general social disapproval. Ayers et al. (1991) emphasise that this sort of distinction may be inappropriate for the following reason. Formal research shows that the threat of physical injury or death is of little concern unless the "likelihood" of injury or death is perceived to be high. This claim then raises important questions for the present study in which individuals' level of safety sign comprehensibility is assumed to vary, thus making the implications of misinterpreting safety signs potentially more hazardous, since the perceived likelihood of personal injury or death may not be recognised at all.

Similarly, Laughery et al. (1994), explain that risk warnings are inadequate and ineffective because designers of warnings often do not take into account psychological and socio-psychological factors involved in constructing an effective

warning message. Some of which include, the number of warnings a person is exposed to, the experience of the individual, the individual's perception of the likelihood of the risk and the perceived effort involved in compliance. Given these factors, the implications of misinterpreting a safety message may be more hazardous especially since the comprehension of safety signs is assumed to vary.

2.1.5. Comprehension

Within workplace settings, industrial safety signs demand rapid and precise communication to a broad spectrum of individuals. Robinett and Hughes (1971) therefore caution that dependence on linguistics as the primary means of visual transmission of information is limiting given that differences in literacy and technical terminology may curb effective communication of thought even within a single language system. In other words, it may be the case that attempts to use only written warnings for a given hazard could in fact add to the possibility of an accident occurring rather than preventing it. Furthermore, it is also important to consider that there are inherent differences in language, which may affect the way a warning is interpreted. Thus, the formation of pictograms and the assignment of meanings to them have become of critical importance in the endeavour to strengthen the visual communication of hazards. However, this is easier said than done, since prior knowledge and cultural backgrounds can influence one's interpretation of a particular graphic shape (Cavallaro, 2001). It goes without saying then, that the challenge facing designers is to assign meanings to pictograms with the intended user in mind (Robinett & Hughes, 1971).

Past research has shown that the preferred means of communicating hazards is using pictograms only (Paivio, 1971). However, since safety signs often aim to communicate multifaceted information about the nature of the danger/ hazard and the process involved in alleviating harm or injury from that hazard, the message often needs to be conveyed to the user by means of both pictogram and printed text. Other supporting evidence indicates that generally nonverbal imagery alone, or both imagery and verbal processes add to the memorability of items (Paivio, 1971).

It is also suggested that efforts to maintain the same sign configuration for all hazard identifications as well as the same pictogram for each hazard could result in easier recognition of hazardous situations. Many argue that even with standards employed by government agencies and industrial organisations to provide safer products, the reality is that a profusion of warning signs has inadvertently produced a medley of unrelated and often perplex set of messages (Robinett & Hughes, 1971).

However, in an attempt to unravel the rationale for incorrect interpretations and understandings of safety information, a myriad of research has critically reviewed both constructive and developmental aspects of safety information. For instance, Desaulniers (1987) probed the layout and the effectiveness of consumer product warnings. Wogalter, Kalsher and Racicot (1992) investigated the influence of location or context on individuals' behavioural compliance to warnings. In essence, these and numerous other studies heighten awareness about the scope of complexity surrounding the design and correct interpretation of safety signs.

With that being said, the ways in which individuals interpret safety information through capturing, storing and essentially recalling information depends largely on our memory. Some studies have identified the crucial role memory plays in effectively interpreting safety signs and warnings (Young & Wogalter, 1988). As such, past research has identified that there are two different types of memory storage (Wickens, Gordon & Liu, 1998). The first is classified as working memory or short-term memory and the second is known as long-term memory. In essence, working memory holds information temporarily and is therefore active, whereas long-term memory is said to function as the reactivation of information (Wickens, Gordon & Liu, 1998).

In light of this, Baddeley (1986, 1990) proposed a model for understanding working memory. The model comprises three components in which a central executive component serves as an attentional control system that manages information from two 'storage systems' namely; an acoustically based, short term store and a more durable, semantically based, long term store of far greater capacity (Baddeley, 1986).

This approach to memory regards memory as an integral part of information processing tasks, such as perception, pattern recognition, comprehension and reasoning (Baddeley, 1986).

To reaffirm, what is known as the *visuospatial sketchpad* holds information in an analog spatial structure while it is being used (e.g. visual imagery). These images have been carried forward from the visual–sensory register or from long-term memory (Baddeley, 1986). Secondly, the *phonological loop* is responsible for representing verbal information in an auditory form (Baddeley, 1990).

However, whether information is spatial (visuospatial sketchpad) or verbal (phonological loop), the capacity to sustain information in working memory is dependent on two factors: firstly, the quantity of information that can be kept active and secondly, the duration that information can be kept active (Baddeley, 1990). Therefore, in order to evaluate why correct and incorrect interpretations of safety information exist, it is important to critically reflect on certain methods designed to draw out one's level of comprehension.

2.1.6. Comprehension testing and context

Traditionally, to test one's level of comprehension, participants are required to write the meaning of a pictorial symbol. However, the open-ended written test technique has been criticised for its inability to elicit complete answers from participants. Often, participants' responses are so brief that they may not demonstrate their full knowledge of the symbol's meaning. Therefore, these incomplete responses create challenges for judges during scoring and may lead to low comprehension scores that fall below certain acceptability criterion (Wolff & Wogalter, 1998). As such, a way of getting around the limitations of open-ended written tests is to use oral testing and probing. While oral tests can generally be more costly to perform than written tests, as participants need to be tested individually, the probing technique is effective in its capacity to draw out information beyond participants' initial answers. With that being said, when follow-up questioning or probing is used, interviewers are trained to avoid asking leading questions and instead ask broad questions such as, "What else can you tell me about this?"(Hernandez & Alonso, 1997; Mello & Fisher, 1996).

Research within basic cognitive literature suggests that context may be useful in determining symbol comprehension (Wolff & Wogalter, 1998). Context then, allows individuals to determine certain interpretations by providing them with a set of facts surrounding a situation or event (Cahill, 1975). With regard to pictorial symbol comprehension, a few studies have measured the effect of context. Cahill (1975) tested 10 graphic symbols in context (a drawing plus verbal instructions, where verbal instructions provided the context) or in isolation. In this study, symbols were identified easier when they appeared in context than when no context was provided at all (Cahill, 1975).

However, more recently, Wogalter, Sojourner and Brelsford (1997) were unable to show an effect of clear verbal consequence information on symbol comprehension. Similarly, Silver et al. (1995) found no comprehension improvement for symbols accompanied by a photograph and a verbal description of an environmental scene when compared with the same symbols without this information (Silver et al., 1995). In light of these findings, the effect of context in symbol comprehension tests is vague, making the reasons for why some studies show a benefit and others don't difficult to decipher.

However, one possibility could be the level of detail contained in the sign itself. For this reason, the visual detail contained in a sign may provide sufficient information about where the symbol would be placed and therefore, additional contextual information may then have negligible value (Dewar, 1994). Further, given that one of the purposes of pictorial symbols is to convey information to individuals who have less proficient language skills, using a pictorial context would seem fitting (Dewar, 1994).

However, it can also be argued that language in its own right is symbolic since people use spoken sounds and written words to represent actions, objects and ideas (Weiten, 2001). Similarly, the symbolic nature of language allows one to refer to objects that may be in another place and to events that may have happened in another point in time.

Similar to Baddeley's (1986) theory on working memory, Paivio's (1971) theory looks at the function of both nonverbal imagery and verbal mechanisms that are at play when interpreting information.

2.1.7. Dual Coding Theory

In an attempt to understand how nonverbal imagery and verbal mechanisms are processed, Paivio (1971) puts forward the dual-coding hypothesis. Here, imagery is said to increase with concreteness while verbal meaning does not. As concreteness increases, so too does one's capacity to store an item as an image.
Furthermore, recall of such an item is heightened because the *image* is somehow more memorable than a verbal code (Paivio, 1971).

The question emerging from this premise then is why is it that images should be superior to words as memory codes? While no explicit answer is available other than the fact that pictures are easier to call to mind than words, it is important to consider additional facets of the theory. According to the coding redundancy hypothesis, recall increases with concreteness since the items are more likely to be stored in both the verbal and nonverbal code. Therefore, concrete words can induce referent images and where availability of both codes is increased, the probability of item recall increases due to the fact that the response can be retrieved from either code (Paivio, 1971).

Later, Paivio (1986) asserted that the Dual Coding Theory is based on the premise that cognition consists of the activity of symbolic representational systems that are specific for dealing with environmental information in a way that meets functional or adaptive behavioural goals (Paivio, 1986). Moreover, this theory implies that such representational systems need to encompass perceptual, affective as well as behavioural knowledge.

One of the unique features of human cognition is that it has adapted to dealing simultaneously with language and nonverbal objects. In other words, the language system can manage to deal directly with linguistic input and output, which may be in the form of speech or writing, whilst at the same time serving a symbolic function concerning nonverbal objects and behaviours (Paivio, 1986).

Dual coding theory, postulates that there are two classes of phenomena dealt with cognitively by separate subsystems i.e. one adept for the representation and processing of information containing nonverbal (symbolic) objects, and the other adept for dealing with language (Paivio, 1979). This is similar to Baddeley's (1986) assertion on the two different types of 'storage systems'.

Furthermore, the theory suggests a hierarchical conceptual structure where cognitive systems serve a symbolic/representational function. This general level then divides into the verbal and nonverbal symbolic subsystems (Paivio, 1979).

Pictures or symbols then are said to be meaningful at both representational and referential levels in that they readily stimulate a concrete memory representation (image) and a verbal label. Whereas, the accessibility of the verbal code is believed to be relatively more complex since an extra process is involved i.e. the verbal code needs to be associatively provoked after the nonverbal representation has been activated by the picture (Paivio, 1979). Naturally, the verbal code would be even less accessible in the event that the pictures are unfamiliar or ambiguous.

Another facet of the theory delves into the mediational functioning of images and verbal processes where images essentially embody spatial characteristic, while verbal processes encompass sequential characteristics. Information in imagery mediators therefore may be more effectively unitised and subsequently better retained than sequentially organised information in verbal mediators since there would be less to remember in the case of images (Paivio, 1979).

Further, from a cognitive perspective images may have an added advantage during the memory retrieval process since parallel processing of multifaceted information is said to proceed more quickly than sequential processing of the equivalent amount of information (Neisser, 1967).

This therefore suggests that images may be retrieved quicker than verbal mediators for relevant associative information may. In light of this assertion, one area of inquiry in the present research is to determine whether this is the case. Specifically, does the presence of written text in a given sign allow participants to grasp the understanding of that sign better or is the understanding retrieved relatively the same if the sign were to contain symbols only? In order to determine this, the role of language and literacy needs to be explored.

2.2. Literacy

Thatcher, Mahlangu and Zimmerman (2005), point out that a safety sign's effectiveness in conveying information is proportional to the extent to which it is comprehensible in the population to which it is directed.

Furthermore, one of the main objectives of safety signs is to improve behavioural compliance and in order for this to occur, signs need to influence people to behave in ways that do not lead to personal injury.

Before this criterion can be met however, distinguishable levels of literacy need to be taken into consideration since one's literacy level will determine the degree to which individuals will be able to comprehend those safety symbols supplemented with written aids in an attempt to complement the intended meaning of a given sign (Wogalter & Dingus, 1999).

Literacy then, remains one of the most widespread anxieties facing almost all countries throughout the world since literacy is seen as essential for reaching political and economic goals. However, even in industrialised countries where compulsory schooling has been in affect for generations, there is still concern as to the persistence of a minority of illiterate adults and issues regarding the inadequacy of workforce literacy skills (Hannon, 1995). Literacy has been defined as the ability to derive and convey meaning from written words, which evidently has implications for the ways in which individuals interpret safety symbols with the addition of text in their immediate environment.

Moreover, literacy is not merely the process of decoding letter-sound correspondences in reading or forming letters and spelling correctly in writing, since no one reads simply to decode or writes to form letters. Instead, it is a matter of understanding others' meanings or communicating meaningfully with others through writing and reading text.

Many individuals even within industrialised countries will go to extraordinary lengths to disguise their inability to use written text for fear of being stigmatised as 'illiterate' (Hannon, 1995). This factor inherently incites caution when it comes to testing adults to determine their literacy levels since literacy ability is a relative concept and what matters is the individual's ability to cope with the demands they experience in society. For this reason, adult self-reports have been used instead although this method has also been greeted with criticism on the grounds that it relies on individuals' own judgments about their abilities and thus interview questions could guide overestimations or underestimations of true literacy levels (Hannon, 1995).

Literacy is also said to be embedded in culture and therefore different forms of literacy are prevalent. This means that apart from variations in the particular written language or variation in subject matter, variation can be expected in the actual *uses* of that written language (Hannon, 1995). Evidently, many definitions of literacy exist and this in itself presents problems since determining the level of literacy in a given population will ultimately depend on which definition of literacy one chooses to adopt. Prevailing conceptions of literacy propose that its acquisition will give rise to particular good effects.

Specifically, Street (1984) proposed that literacy produced particular universal characteristics giving rise to particular good effects. This autonomous model for viewing literacy therefore suggests that, regardless of context, literacy raises one's cognitive skills and in turn develops a meta-cognitive understanding and rational outlook that is crucial for growth (Prinsloo & Breier, 1996).

With that being said, certain consequences are noted by Gee's (1990) review:

> "The 'literacy myth' is seen to have produced claims that literacy leads to, or is correlated with, logical and analytical modes of thought; general and abstract use of language; critical and rational thought; a skeptical and questioning attitude; a distinction between myth and history; the recognition of the importance of time and space; complex and modern governments; political democracy and greater social equity; economic development; wealth and productivity; political stability; urbanisation; lower birth rates; people who are achievement orientated, productive, cosmopolitan, politically aware, more globally (nationally and internationally) and less locally orientated, who have more liberal and humane social attitudes, are less likely to commit a crime; and more likely to take the rights and duties of citizenship seriously. (1990:32)"

Such assumed outcomes of literacy emphasise the transformative effects of literacy. Specifically, Ong (1982), made the case for literacy as a strong and socially determining technology, essentially the pivot around which key differences between oral and literate cultures are drawn. Numerous literacy studies however, argue that literacy does not necessarily lead to any of the social outcomes previously assigned to it (Prinsloo & Breier, 1996).

For instance, Scribner and Cole (1976) found that illiterate adults, particularly in urban areas shared some of the skills and attitudes usually only associated with literate individuals. Hence, cognitive attributes were the outcome of particular social practices rather than the direct result of the acquisition of literacy (Scribner & Cole, 1976). Recent research points out that definitions and meanings constructed around literacy will be reliant on both the individual as well as the context, thus emphasising the nebulous nature of literacy.

In the present study, varying levels of literacy were determined by asking participants questions related to their educational backgrounds. Self-report data in this study, was captured by gaining participants' verbal accounts of their behaviours and understanding. It is thus important to note some of the drawbacks of this type of measure.

Krosnick, (1999) and Schuman and Kalton (1985) point out that often participants misunderstand questions in terms of the way in which they are worded and can therefore have a considerable impact on participants' responses (Shwarz, 1999). Furthermore, response sets can also be problematic, whereby participants respond to questions in a particular way that is unrelated to the content of the questions (Krosnick & Fabrigar, 1998). Another point is that by determining one's education level does not necessarily mean that we have determined their literacy level. However, even though some pitfalls of this method have been highlighted, using formal literacy tests was deemed inappropriate since they underestimate the breadth and depth of illiteracy within developing countries (Wagner, 1987).

What is more, given that South Africa has eleven official languages, solely assessing English literacy levels may not be the most extensive means of gathering comprehensive literacy information from a demographically diverse sample such as this one. Therefore, self report questioning which extracted specific details related to participants educational backgrounds was considered an appropriate means of determining literacy levels. Importantly, the history and movements aimed at enhancing literacy levels in the South African context will also be discussed.

2.2.1. Literacy in the South African context

For the present study, it is vital to unravel the role of literacy as a proponent of social transformation in South Africa today. Conceptions of adult literacy as a social problem have changed along with political circumstances (Prinsloo & Breier, 1996). During the apartheid years (approximately between 1950 and the 1990's), the problem of adult literacy was subsumed by the broader anti-apartheid political discourse. However, the political resolution initiated in 1990 changed the way the 'problem of illiteracy' was located in wider discourse. From then on, it became a development issue, which demanded certain strategies to address the social backlog brought on by apartheid (Prinsloo & Breier, 1996).

In these terms, work facing the new government was characterised by key requisites such as *reconstruction* and *development*, where reconstruction signaled a shift from concerns with injustices of the preceding era to the need for practical policy implementation, and where development signaled refocusing on plans for economic and social reform (Prinsloo et al., 1995; NEPI, 1993; South African Government, RDP White Paper, 1995).

Under these conditions, Human Resources Development (HRD) came into importance in policy work in education generally and in adult literacy planning in particular (Kraak, 1992; Cosatu, 1992). Thus, at the forefront of the HRD perspective was training of the industrialised workforce, as well as other groups, individuals, schoolchildren, the unemployed and individuals working in the informal sector. The HRD in this sense underlies proposals for the restructuring of education and training put forward by the Congress of South African Trade Unions (Cosatu, 1992).

As such, literacy provision became part of Adult Basic Education and Training (ABET) and is projected as the proviso of basic skills (Prinsloo & Breier, 1999). However, major disparities between policy intentions and the reality of adult literacy work 'on the ground' became apparent and subsequently turned researchers' attention towards the study of literacy in a social context. In so doing, this allowed researchers to determine what assumptions about literacy and its social uses were based on. According to a report by the Media Research and Training Unit of Rhodes University, subtitled "Communicating Electoral Processes to a Low-Literacy Audience" (Pinnock & Polacsek, 1992), hereafter referred to as the 'Rhodes Report':

> "Firstly, people who cannot read have trouble understanding pictures…Our visual syntax is premised on literacy and we compose our pictures accordingly. Self evident as television pictures may seem to the literate, they are surprisingly confusing for people who do not read…Television is essentially an urban medium and is programmed by literate people for literate people. (p.2; and see Chapter 5)".

Currently in South Africa, in fact the first time since 1994, the government has rolled out a comprehensive literacy campaign following Cabinet's R6,1-billion approval to tackle the skills deficit in South Africa (Mohlala & Pretorius, 2007).

This new campaign, *Kha ri gude – Masifunde* (Let us learn), aims to halve South Africa's number of illiterate adults by 2015 and recognises how illiteracy impedes skills development and economic growth. Following this strategy, the campaign seeks to overhaul and revise the content of the ABET curriculum and enhance the delivery of education to adults (Mohlala & Pretorius, 2007).

At this time, the following statistics reveal the overwhelming extent of illiterate adults within South Africa (Mohlala & Pretorius, 2007): there are 9,6-million functionally illiterate adults in South Africa and the provinces with the highest number of illiterates are Limpopo, Kwa-Zulu Natal and Eastern Cape. Given this data, the number of adults targeted by the campaign is 3,22-million.

Evidently, the intention to eradicate illiteracy in South Africa is underway; however, the materialisation thereof remains in a state of flux (Mohlala & Pretorius, 2007). Importantly, drawing attention to the context of illiteracy in South Africa sets the stage for unmasking participants' interpretations of safety signs when the sign is aided by text (language). More specifically, keeping this particular context in mind provides the means to assess whether or not text does in fact aid one's comprehension of a sign.

In addition, Pinnock and Polacsek (1992), point out that one's visual syntax is largely based on literacy and that literacy provides us with the tools to compose pictures (Pinnock & Polacsek, 1992). Similarly, individuals that are not able to read are said to face challenges when trying to interpret pictures. This point then raises questions around how individuals interpret images and furthermore, how individuals generate images that will communicate an intended message. To unpack this further, the concept of visual literacy will be explored.

2.3. Visual Literacy

Many diverse disciplines engaged with the research on visual literacy have attempted to define this concept, however little consensus has been achieved so far. This can be attributed to the fact that those representing the different disciplines and paradigms each want to interpret visual literacy in a way that reflects their contribution or way of thinking. As a result, a theoretical concept has emerged with no real apparent practical value.

With that in mind, there is a sense that visual literacy is associated with the ability to interpret images as well as to generate images for communicating ideas and concepts. Wileman (1993) defines visual literacy as "the ability to 'read,' interpret, and understand information presented in pictorial or graphic images" (p. 114). Wileman (1993) proposes that, visual literacy is associated with visual thinking, which is described as "the ability to turn information of all types into pictures, graphics, or forms that help communicate the information" (Wileman, p. 114). Similarly, visual literacy is "the learned ability to interpret visual messages accurately and to create such messages" (Heinich, Molenda, Russell, & Smaldino, 1999, p. 64).

It has been noted that the use and interpretation of images is a specific language, in that images are used to communicate messages that must be decoded in order to have meaning (Branton, 1999; Emery & Flood, 1998). Therefore, if visual literacy is looked upon like a language, then there is a need to know how to communicate using this language. This includes being attentive to visual messages and critically reading or viewing images as the language of the messages (Branton, 1999; Emery & Flood, 1998). Importantly though, while there are universal symbols or visual images that can be understood globally, essentially visual literacy, like language literacy, is culture specific. This tenet may have implications for the culturally varied sample accessed in this study.

Many forms of graphics for instruction and enhancing understanding exist. Visual organisers that incorporate illustrations and text to depict patterns of concepts and ideas serve as organisational frameworks to promote thinking and learning (Tarquin & Walker, 1997). Frameworks assist learners in visualizing how ideas may be related to prior knowledge, subordinate ideas, and information from other sources. Story maps that can be depicted as vertical or horizontal flow maps, Venn diagrams that prove useful in analyzing similarities and differences between two or more concepts, and certain frameworks that encourage thought regarding the whole and its parts, are examples of visual organisers.

It has been argued that visual literacy education, which is a more visually orientated system can lead to broader cognitive benefits, providing learners with a set of mental tools that will aid their understanding of both physical and social environments (Chideya, 1991; Greenfield, 1984). Furthermore, the assumption here is that images, like language are a means of making sense of reality.

Visual communication essentially comprises two parts. Firstly, on the part of the designer, the process involves creating a design out of many colours, shapes, textures and relative proportions for a sign or graphic representation. These elements are then intended to be related interactively by viewers of the sign and in so doing, the designer proposes meaning. The second part involves receiving or actually seeing this information, which highlights the process of absorbing and interpreting information. Expectedly, these cognitive operations can occur on a more or less common basis among individuals.

Another important facet of this study concerns gaining a sample that is representative of the broader South African population in terms of cultural and educational backgrounds. Therefore, the sample will be drawn from an environment that everyone has equal public access to, namely the Johannesburg General Hospital. A further reason for selecting a public hospital environment is that we can anticipate literacy levels among participants to fluctuate due to wide-ranging demographic and educational backgrounds.

A number of studies have investigated individuals' behaviour and responses to safety/ warnings signs (Wogalter, Desaulniers & Godfrey, 1985; Wogalter, Kalsher & Racicot, 1992), as well as the impact of certain design features on safety information (Kline, Braun, Peterson & Silver, 1993; Leonard, Creel & Karnes, 1991). However, little research has explored the dynamics of literacy as a potential factor in the comprehension of safety signs, specifically in the South African context where illiteracy is rife.

Therefore, in keeping with this discussion the following research questions emerge:

2.4. RESEARCH QUESTIONS

2.4.1. What is the comprehension level of pictorial safety symbols among South African people?
2.4.2. What is the comprehension level of pictorial safety symbols with text, among South African people?
2.4.3. How does this co vary according to level of literacy?

CHAPTER THREE
METHODS

3.1. Research Design

The purpose of this study is to examine the varying comprehension levels of public safety signs among South African people; those being signs that are accompanied with text (language) and those signs that are represented pictorially only. This chapter will therefore detail the methodology adopted.

Primarily, a quantitative analysis was conducted. However, some descriptive elements were incorporated in order to support the quantitative results found. The procedure therefore relied not solely on quantitative methods and instead adopted the use of 'multiple methods', as a means of minimising the biases and deficiencies that can arise from using either qualitative or quantitative methods exclusively (Babbie & Mouton, 2004). This ultimately allows more depth, detail and complexity to be added to unequivocal observations, resulting in a deeper understanding of the statistics and the relationships they describe (Babbie and Mouton, 2004).

3.1.1. Quantitative Methodology

Quantitative research is said to begin with a hypothesis, where the research concepts are in the form of distinct variables (Babbie & Mouton, 2004). This method allows for the collection of original data that in succession describes a population that is too large to be observed directly (Babbie & Mouton, 2004). Quantitative procedures aim to allow some anticipation of future events due to generalisability and therefore assume replication (Babbie & Mouton, 2004). Put in another way, quantitative procedures aim to generalise findings to some theoretical population wherein measurements are systematically produced before the data collection process and are standardised. The data is in the form of numbers generated from precise measurements, which are then analysed using statistics, charts or tables.

Through this procedure, the researcher is able to identify patterns in the numbers that indicate how the numbers are related to the research questions (Babbie & Mouton, 2004). Furthermore, quantitative research has the advantage of obtaining objectivity by controlling for extraneous variables i.e. credible inter-subjectivity. Thus, unlike qualitative research, which has been criticised for being less than "scientific" due its inductive nature, the quantitative approach is useful in generalising about the broader population (Babbie & Mouton, 2004). However, qualitative methods are able to draw out more rich and detailed responses that allow researchers to interpret findings more holistically.

3.1.2. Descriptive Analysis

The descriptive component of this study follows a qualitative paradigm. This type of research distinguishes itself from quantitative research by focusing on the process rather than on the outcomes by unraveling social action within a natural setting (Babbie & Mouton, 2004). Essentially, the aim of this methodology is to foster in-depth descriptions and understandings of actions and events. In addition, this approach is inclined to elicit the experiences, attitudes and expectations of individuals, as well as their personal responses to the environment in which they function, ultimately making it a rich and holistic method of analysing information.

One method of gathering data within the qualitative framework is through interviewing participants. In most cases, the interviewer has a broad set of questions that need not be asked in a particular order, nor using specific words. The result of which resembles that of a conversation, the only difference being that the interviewer establishes a direction for the conversation. In the present study, this will be achieved by asking all participants to identify and explain what they understand by each of the twelve safety signs. Lastly, transcripts of the interviews (or in this case manually written recordings) constitute the raw data that will be used to decipher meaning and ultimately supplement statistical findings.

Once information has been obtained from semi open-ended questioning during the interviews, thematic content analysis will be used to highlight certain commonalities. This process involves pinpointing central themes from each interview and then identifying dominant themes that emerge across the interviews. Unlike a typical numerical procedure, thematic content analysis entails investigating both the apparent and latent meanings behind individuals' words and actions (Babbie & Mouton, 2004).

In sum, the researcher sets out to describe what participants have understood and then reconstruct the data into a decipherable actuality.

While the quantitative procedures form the bulk of the method of analysis in this study, the qualitative component aims to supplement the findings on varying comprehension levels by using a number of case examples to explicate why comprehension levels of safety signs may differ according to one's level of literacy.

3.2. Sampling

Non-probability, purposive sampling was used to ensure that males and females were included in the sample and also that participants constituting varying demographic backgrounds were included, thereby gaining diversity with regards to literacy levels. One of the restrictions of such an approach to social research is its inability to derive a randomly selected group of individuals, since specific criteria for selecting individuals are predetermined. However, while non-probability sampling may be unrepresentative of the target population, given the large sample size, generalisability is palpable. Furthermore, since the aim of this research was to guarantee that all participants would have an equal right of entry to a public area containing safety signs, a total number of sixty participants between the ages of eighteen and seventy constituted the research sample at the Johannesburg General Hospital.

The biographical information was extracted using an open-ended questionnaire-type format (Appendix 1) from a sample comprising sixty participants. The sample comprised more women than men accounting for 65% of the sample. In terms of age, 46.6 % of participants were over the age of 35, while 40% were between the ages of 21 and 35 and 13.3% were younger than 20.

Importantly, the majority of the sample had only attained some level of high school education, accounting for 46.6% of the total sample, while 30% had passed Matric and only 23.3% had received some form of a post Matric qualification.

Linguistically, participants were categorised into the following groups where African languages constituted the main home language spoken among participants accounting for 73.3% of the sample, while 16.6% spoke English and 10% spoke Afrikaans. The African languages spoken were Zulu (34.09%), Xhosa (13.62%), Sotho (11.36), Tsonga (9.1%), Ndebele (15.91%), Venda (6.82%) and Tswana (9.1%).

In terms of occupation or trade, 23.3% of participants were unemployed, 28.3% were classified as unskilled, while another 28.3% were classified as semi-skilled and the remaining 20% of the sample were skilled workers. Of the total sample, 46 participants had been exposed to safety signs in their day-to-day lives and at work, while the other 14 participants had no contact with safety signs or did not actually know what a safety sign was at all. Furthermore, 76.6% of the sample did not receive any training on safety information in their work environment. Finally, none of the participants reported colour blindness.

To ensure participants' confidentiality, all personal details such as their names, ID numbers and so forth, were not included as part of the biographical questioning in the interviews (refer to Table 1).

Table 1. Sample Demographics

VARIABLES	GROUPS	FREQUENCY	PERCENT
Gender	Male	21	35.00
	Female	39	65.00
Age	<20	8	13.33
	21-35	24	40.00
	35>	28	46.67
Education	High school	28	46.67
	Matric	18	30.00
	Post Matric Qualification	14	23.33
Home Language	English	10	16.67
	Afrikaans	6	10.00
	African languages	44	73.33
Occupation	Unemployed (incl. students & housewives)	14	23.33
	Unskilled work	17	28.33
	Semi-skilled work	17	28.33
	Skilled work	12	20.00
Tenure	<1 year	12	20.00
	1-5 years	6	10.00
	6-10 years	23	38.33
	11-15 years	9	15.00
	16-20 years	6	10.00
	20> years	4	6.67
Signs at work	Yes	46	76.67
	No	14	23.33
Colour Blind	Yes	0	0
	No	60	100.00
Sign training	Yes	14	23.33
	No	46	76.67

Rationale for accessing the Johannesburg General Hospital

A brief synopsis of the research environment will be given. In this way, the specific context in which safety signs are viewed by participants can be examined, and the general characteristics of the health care environment can be assessed.

This organisation endeavours to provide quality public health care services to the public through safeguarding vulnerable individuals and ensuring that all citizens have equal access to health care. The Johannesburg General Hospital is a public hospital meaning that any individual can access it and since one of the core aims of this study was to extract varying literacy levels, a public health care provider such as the Johannesburg General Hospital which deals with a large influx of people, was deemed an appropriate environment in which to carry out the present study's research.

However, it is also important to note that accessing a public facility such as the Johannesburg General Hospital, may be likely to exclude wealthier and perhaps more literate or educated individuals. Furthermore, this facility was accessed since numerous safety signs can be found throughout the hospital.

Individuals for the purpose of this study were randomly approached and invited to participate in the research.

Of the forty-five outpatient individuals that initially volunteered to participate in the research, eight could not complete the interview process as they either felt too ill to continue or were called in by doctors for late appointments. For this reason, visitors and hospital staff were also approached and invited to participate in the study, thus constituting a total sample of sixty volunteer participants. Hence, forty-five participants were categorised as outpatients, thirteen were categorised as visitors and the remaining two participants were part of cleaning staff of the hospital.

3.3. Rationale for the safety signs chosen for this study

With reference to various site visits to the research setting, the researcher aimed to capture those signs that most people would view effortlessly (i.e. signs that were in public view at all times and that were not displayed in restricted areas). Secondly, signs were chosen on the basis that they were repeatedly displayed and were visible at various points throughout the hospital. Thirdly, a few signs were chosen for the purpose of ensuring that they were not too context specific or limited to the hospital environment, and that they could in fact be identified in other environments (e.g. no smoking and no entry). However, some signs were also chosen based on their incomprehensibility; due to the fact either that they were poorly positioned, or possessed poor visual quality. These issues were deemed pertinent considerations in appropriately evaluating participants' understanding of safety signs.

3.4. Procedure

To ensure that participants were drawn from an area within which everyone had equal public access, the Johannesburg General Hospital was approached and permission was obtained to interview random volunteers (See Appendix 6).

Following this, sixty semi-structured interviews were conducted. These were obtained by approaching random individuals at the hospital that fell into one of three groups: outpatients, visitors or hospital staff. The interview was structured into two parts. Part one entailed gaining demographic information from participants with particular emphasis on obtaining their highest educational level. This would then later serve as the primary means of determining varying literacy levels among participants. Part two then, formed the bulk of the interview, which entailed showing participants twelve randomly ordered safety signs (one by one) and then asking them to explain what they understood by each of the twelve signs (See Appendix 2).

The researcher familiarised participants with the task by reading aloud task instructions and ensuring that participants had no questions regarding performing the task. Six of the safety signs represented symbols only, while the other six signs represented symbols with text. These twelve safety signs were randomly ordered for each participant to control for possible learning effects and signs with symbols *only* were always presented first.

No manipulation was introduced in this study therefore making it a non-experimental design.

3.4.1. Measures and Instruments

Structured interviews, following a questionnaire-type format represented the method of data collection in this study. The interviews were structured into two parts namely: (a) a biographical blank and (b) semi open-ended response questions probing participants understanding of twelve safety signs. Six of which signified symbols only, while the other six comprised symbols with text.

The biographical blank contained questions that aimed to draw out participants' level of literacy. This was achieved by including questions such as, "what is your highest educational level?" The information obtained from this particular response can then be broken down into one of three categories: high school, Matric or Post Matric where literacy level is assumed to increase with educational level. This will become more apparent in chapter four.

In addition, related variables such as type of employment, languages spoken, whether or not participants had come into contact with safety signs in their working day and whether or not they had received any on-the-job-training in safety information, were also collected. These questions were included in order to draw out as much information as possible from participants regarding their daily contact with safety signs, as this may increase one's familiarity with safety signs, thereby aiding individuals' recognition and memory of certain safety signs.

Twelve randomly ordered safety signs were presented to each participant. The researcher then asked each participant to describe what he or she understood by each of the twelve signs. In this way, semi open-ended questions were utilised as it gave participants the opportunity to provide as much detail as they deemed necessary. However, unlike pure open-ended questions, the researcher was not in a position to guide their interpretation of the questions put forward in cases where they did not understand the meaning of a given sign. In many ways, the questionnaire-type format resembled open-ended responses in that the responses needed to be coded before they could be processed for computer analysis (Babbie & Mouton, 2004). This required the researcher to interpret the meaning of responses and categorise them into one of two answers namely; participants' interpretation of the safety sign was correct or it was incorrect. This in turn, allowed greater uniformity of the responses that could then be processed more efficiently.

3.4.2. Context Materials

The safety signs' size was approximately 6x6cm and they were presented individually, printed in colour. The safety signs presented below were included for the following reasons: (1) to foster generalisability to a broad range of safety signs and (2) these were the most frequently recurring signs throughout the hospital i.e. they were not isolated to one section of the hospital. The twelve signs used are presented below:

SYMBOLS ONLY



No smoking (SS1)



Electrical warning (SS2)



Emergency route (SS3)



Fire extinguisher (SS4)



No entry (SS5)



No thoroughfare (SS6)

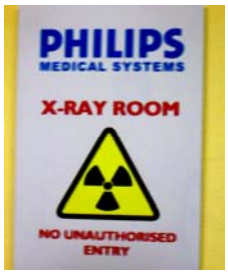
SYMBOLS WITH TEXT



No smoking (SS7)



Biohazard warning (SS8)



Radiation warning (SS9)



No trolleying (SS10)



Wheelchair access (SS11)



No thoroughfare (SS12)

3.4.3. Analyses

The Chi Square procedure is a test of significance. It is based on the assumption that there is no relationship between two variables in the total population (Babbie & Mouton, 2004). Tests of significance provide an objective index against which to approximate the significance of associations between variables. In this way, they assist in discarding those associations that may not portray true relationships in the population under study. In the present study, where there was more than one classification variable, the contingency table reflects the distribution of one variable at each level of the other, containing both observed and expected frequencies in each cell (Howell, 1999).

Furthermore, the Chi Square test is based in part on the assumption that if an experiment were to be repeated an infinite number of times with the same number of participants, the obtained frequencies in any given cell would be normally distributed around the expected frequency (Howell, 1999).

In the present study, the Chi Square procedure was carried out on the following variables: *symbols only* by education, *symbols with text* by education, *symbols only* by signs at work, *symbols with text* by signs at work, *symbols only* by training in safety sign information, *symbols with text* by training in safety sign information and signs identified correctly versus incorrectly across all signs.

In addition, a significance level of alpha = 0.05 was selected for the following reasons: firstly, it is rigorous enough to guard against accepting a non-significant result, secondly, it is essentially convenient since most statistical tables show 5% values and thirdly, it reduces the probability of making a type one error, meaning that the likelihood of accepting an hypothesis when the results were only due to chance, are lessened (Howell, 1999).

Where the assumptions of Chi Square were met, Hirotsu's (1983) technique was used. The Chi Squared technique is typically a test that requires a 'balanced sample' in order to provide some indication of significance. Sometimes however, due to sampling size or distribution a balanced sample is not possible. Hirotsu's (1982) method attempts to counter this by removing certain groups from the original sample and testing how this effects the remaining data - therefore in an unbalanced sample a Hirotsu transformation on the normal Cumulative Chi-squared test can be used.

Determining whether a participant had interpreted a sign correctly or incorrectly was based on whether or not the answer given reflected an adequate understanding of the consequences involved in the event that one did not adhere to the warning. Therefore, in terms of determining participants' comprehension levels, correct answers were assigned a score of "2" and incorrect answers were assigned a score of "1".

The aforementioned therefore outlines the statistical procedure used, the results of which will be discussed in chapter 4.

3.4.4. Motivation for excluding Literacy Tests

In order to capture competencies in literacy skills, some researchers have adopted the use of literacy assessments. However, the appropriateness of such a measurement instrument needs to be closely scrutinised to determine its applicability within the broad scope of literacy levels governing South Africa's multicultural populace. Upon critical inquiry into the use of such tests, the following concerns emerge: Firstly, many of the literacy assessments in third world countries, South Africa arguably being one of them, underestimate the breadth and 'depth' of the literacy quandary and as a result, many researchers continue to question the availability of sufficient evaluation resources (Wagner, 1990).

Secondly, with the eleven official languages spoken in South Africa, many safety signs are currently supplemented with written text in languages other than English (e.g. Zulu and Sotho), and therefore testing only English literacy levels may not be the most exhaustive means of gathering literacy information.

Thirdly, many literacy tests are time consuming, sometimes taking up to an hour to administer, which is not feasible in all research conditions. Largely, the aforementioned points are just some of the risks associated with such methods and therefore to avoid such irregularities, specific questions expected to guide comprehension responses regarding participants' literacy levels, were developed (See Appendix 1). However, it also important to point out that using one's highest educational level as a means of determining literacy levels is in itself limited, since individuals would have varied experiences of schooling and not all would necessarily have received the same quality of education.

3.5. Ethical Considerations

All participants were briefed on the purpose of the research and this was done by reading aloud a letter and explaining all aspects of the research. Since this was a volunteer sample, individuals were informed that participation in the study would neither advantage nor disadvantage them in any way. Participants that chose to participate in the study were also informed that should they wish to withdraw from the study at any given point, they had every right to do so, thereby ensuring informed consent. No one other than the researcher had access to the research material.

Two forms were given to prospective volunteers. The first form served to inform volunteers of the proposed research (See appendix 3). The second form required participants to confer their written consent to be interviewed (See appendix 4).

However, since literacy levels were assumed to vary, it became apparent that there might be instances where participants would not comfortably understand the written meaning of the form. In such cases, the contents of the form were then explained in more basic terms, thereby allowing participants to ask or clarify any part of the research that they did not understand.

The interviews were not tape-recorded. Instead, since the interviews were semi-structured, participants' responses were straightforward to record manually.

The data was kept in a secure place at all times by the researcher until the research had been completed. Following the completion of the study, all research material was stored in a secure place and will remain there in the event that someone would like to access the data for future research.

Participants were not required to give any personal details e.g. their names, and only group data was subsequently reported, thus ensuring confidentiality. Where participants requested feedback regarding the research outcomes, individual feedback sessions were arranged to provide them with the necessary information. This was made possible by the fact that participants recorded their contact details on a separate piece of paper during the interview stage of the study, allowing the researcher to contact them and at the same time ensuring anonymity.

CHAPTER FOUR

PRESENTATION AND ANALYSIS OF THE RESEARCH FINDINGS

4.1. Quantitative Results

The Chi Square procedure was performed on the data, where ($p < 0.05$) (see tables 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.1.5, 4.1.6, and 4.1.7). For certain significant findings, an additional analysis was conducted using Hirotsu's (1983) technique (see tables 4.1.8 and 4.1.9).

The Chi Square procedure was used on a sample size of 60 participants. This is the minimum sample size required to get meaningful statistical results. The tables displayed below highlight the various results obtained from the sample. It should be noted however, that the results have significant variances in them due to a number of factors, one of which is the relatively moderate size of the sample. The interpretation of these results is thus somewhat more complex due to these variances.

Furthermore, the Chi Square computation yielded frequencies both significantly above and below the norm of > 5.0. Removing the volatility from the results of the sample could be done in future research by extending the sample size and other statistical means. However, it was felt that the variances in the current sample are representative of the population and their understanding and as a result, the Chi Square computations have been interpreted as calculated.

Firstly, table 4.1.1, details the number of participants that comprehended a sign correctly and the number of participants who interpreted a sign incorrectly across all twelve safety signs. For this analysis, a frequency test was performed on the data and revealed an above average correctness level for the following safety signs (SS):

SS1 (no smoking) had a 95 % correctness level; SS2 (electricity) had a 65 % correctness level; SS3 (fire extinguisher) had a 73.33 % correctness level; SS7 (no smoking) had a 98.33 % correctness level; SS10 (no trolleying) had an 83.33 % correctness level; SS11 (wheelchair access) had a 60 % correctness level and finally SS12 (no thoroughfare) had a 61.76 % correctness level.

Interestingly, participants poorly interpreted the following signs:

65 % of participants interpreted SS2 (electricity) incorrectly; 73.33 % of participants interpreted SS3 (emergency route) incorrectly; 51.67 % of participants interpreted SS5 (no entry) incorrectly; 78.33 % of participants interpreted SS8 (biohazard warning) incorrectly and 61.67 % of participants interpreted SS9 (radiation warning) incorrectly (see table 4.1.1). It is important to highlight again, that the Chi Square results are relatively volatile since the population size is moderate.

Table 4.1.1. Correct Versus Incorrect across all safety signs

SAFETY SIGN	CORRECT VS INCORRECT	FREQUENCY	PERCENT
SS1 (No smoking)	Incorrect	3	5.00
	Correct	57	95.00
SS2 (Electricity)	Incorrect	39	65.00
	Correct	21	35.00* °
SS3 (Emergency route)	Incorrect	44	73.33
	Correct	16	26.67* °
SS4 (Fire extinguisher)	Incorrect	7	11.67
	Correct	53	88.33
SS5 (No entry)	Incorrect	31	51.67
	Correct	29	48.33* °
SS6 (No thoroughfare)	Incorrect	24	40.00
	Correct	36	60.00* °
SS7 (No smoking)	Incorrect	1	1.67
	Correct	59	98.33
SS8 (Biohazard warning)	Incorrect	47	78.33
	Correct	13	21.67* °
SS9 (Radiation warning)	Incorrect	37	61.67
	Correct	23	38.33* °
SS10 (No trolleying)	Incorrect	10	16.67
	Correct	50	83.33*
SS11 (Wheelchair access)	Incorrect	24	40.00
	Correct	36	60.00* °
SS12 (No thoroughfare)	Incorrect	23	38.33
	Correct	37	61.67* °

According to ANSI Z535.3 (ANSI, 1991) and ISO 3864 (ISO, 1984) criteria, only 3 out of the twelve signs were comprehensible, those being: the *no smoking* sign (symbol only); the *fire extinguisher* sign (symbol only) and the *no smoking* sign (symbol and text).

The other nine safety signs were not comprehensible and are shown by means of certain symbols following the percentages. As such, the following symbol (°) represents safety signs that did not meet ANSI (1991) criteria and (*) represents those safety signs that did not meet ISO (1984) criteria.

As the Table 4.1.1 indicates, many safety signs (in fact 75%) fell well below the minimum criteria for comprehension.

Table 4.1.2 details the results of the Chi Square procedure conducted on six safety signs that did not include text (symbols only) where *education* was a variable.

SS3 (emergency route) produced the only statistically significant result in this table where $\chi^2 = 8.0$ and ($p = 0.02$). Therefore, of the three education groups (high school, Matric and Post Matric) participants with a high school level of education were the group with the most number of incorrect interpretations of the sign, where: in the high school group, 41.67 % of participants interpreted the sign incorrectly, in the Matric group, 20 % of participants interpreted the sign incorrectly and in the Post Matric group, 11.67 % of participants interpreted the sign incorrectly.

The following results were statistically non-significant, where $p < 0.05$ meaning that there was no statistical difference between the 3 educational groups when it came to interpreting the signs: SS1 (no smoking) produced $\chi^2 = 1.02$; SS2 (electricity) produced $\chi^2 = 1.21$; SS4 (fire extinguisher) produced $\chi^2 = 3.51$; SS5 (no entry) produced $\chi^2 = 1.73$ and SS6 (no thoroughfare) produced a χ^2 result of 0.41.

Table 4.1.2. Chi Square Analysis [Symbols only by Education]

Safety Sign	Incorrect/ Correct	High school	Matric	Post Matric	Chi Square	P value
No Smoking (SS1)	Incorrect	2 3.33 %	1 1.67 %	0 0 %	1.02	0.60
	Correct	26 43.33%	17 28.33%			
Electrical warning (SS2)	Incorrect	20 33.33 %	10 16.67 %	9 15 %	1.21	0.54
	Correct	8 13.33%	8 13.33%	5 8.33%		
Emergency route (SS3)	Incorrect	25 41.67 %	12 20 %	7 11.67 %	8.0*	0.02
	Correct	3 5%	6 10%	7 11.67%		
Fire extinguisher (SS4)	Incorrect	5 8.33 %	0 0 %	2 3.33 %	3.51	0.17
	Correct	23 38.33%	18 30%	12 20%		
No Entry (SS5)	Incorrect	17 28.33 %	8 13.33 %	6 10 %	1.73	0.42
	Correct	11 18.33%	10 16.67%	8 13.33%		
No thoroughfare (SS6)	Incorrect	10 16.67 %	8 13.33 %	6 10 %	0.41	0.81
	Correct	18 30%	10 16.67%	8 13.33%		

Table 4.1.3 shows the results of the Chi Square procedure conducted on six safety signs with the addition of text (symbols and text) where again *education* was a variable.

In this section, only SS11 (no thoroughfare) produced a statistically significant result where $\chi^2 = 9.98$ and ($p = 0.01$). This means that of the three education groups, (high school, Matric and Post Matric), participants with a high school level of education were the group with the most number of incorrect interpretations of the sign accounting for 28.33 %, whereas in the Matric group 8.33 % interpreted the sign incorrectly and in the Post Matric group, only 3.33 % interpreted the sign incorrectly.

The following results were statistically non-significant, where $p < 0.05$, meaning that there was no statistical difference between the 3 educational groups when it came to interpreting the signs:SS7 (no smoking) produced $\chi^2 = 1.16$; SS8 (biohazard warning) produced $\chi^2 = 2.53$; SS9 (radiation warning) produced $\chi^2 = 2.74$; SS10 (no trolleying) produced $\chi^2 = 0.91$ and SS12 (no thoroughfare) produced $\chi^2 = 0.32$.

Table 4.1.3. Chi Square Analysis [Symbols + text by Education]

Safety Sign	Incorrect/ Correct	High school	Matric	Post Matric	Chi Square	P value
No Smoking (SS7)	Incorrect	1 1.67 %	0 0%	0 0%	1.16	0.56
	Correct	27 45%	18 30%	14 23%		
Biohazard warning (SS8)	Incorrect	24 40 %	14 23.33 %	9 15 %	2.53	0.28
	Correct	4 6.67%	4 6.67%	5 8.33%		
Radiation warning (SS9)	Incorrect	19 31.67 %	12 20 %	6 10 %	2.74	0.25
	Correct	9 15%	6 10%	8 13.33%		
No trolleying (SS10)	Incorrect	6 10 %	2 3.33 %	2 3.33 %	0.91	0.63
	Correct	22 36.67%	16 26.67%	12 20%		
Wheelchair access (SS11)	Incorrect	17 28.33 %	5 8.33 %	2 3.33 %	9.98*	0.01
	Correct	11 18.33%	13 21.67%	12 20%		
No thoroughfare/exit (SS12)	Incorrect	11 18.33 %	6 10 %	6 10 %	0.32	0.85
	Correct	17 28.33%	12 20%	8 13.33%		

Table 4.1.4 provides the results of the Chi Square procedure conducted on six safety signs that did not include text (symbols only), with *signs at work* being the variable of interest.

There were no statistically significant results found in this analysis, indicating that when it came to interpreting a sign (with symbols only), whether participants had come into contact with safety signs in their working day or not, made no major difference to their interpretation of a sign.

SS1 (no smoking) had a $\chi^2 = 0.96$; SS2 (electricity) had a $\chi^2 = 0.0$; SS3 (emergency route) had a $\chi^2 = 0.76$; SS4 (fire extinguisher) had a $\chi^2 = 0.36$; SS5 (no entry) had a $\chi^2 = 1.16$ and SS6 (no thoroughfare) had a $\chi^2 = 1.00$.

Table 4.1.4. Chi Square Analysis [Symbols only by Signs at work]

Safety Sign	Incorrect/ Correct	Contact with signs at work	No contact with signs at work	Chi Square	P value
No Smoking (SS1)	Incorrect	3 5 %	0 0 %	0.96	0.33
	Correct	43 71.67%	14 23.33%		
Electrical warning (SS2)	Incorrect	30 50 %	9 15 %	0.00	0.94
	Correct	16 26.67%	5 8.33%		
Emergency Route (SS3)	Incorrect	35 58.33 %	9 15 %	0.76	0.38
	Correct	11 18.33%	5 8.33%		
Fire extinguisher (SS4)	Incorrect	6 10 %	1 1.67 %	0.36	0.55
	Correct	40 66.67%	13 21.67%		
No Entry (SS5)	Incorrect	22 36.67 %	9 15 %	1.16	0.28
	Correct	24 40%	5 8.33%		
No thoroughfare (SS6)	Incorrect	20 33.33 %	4 6.67 %	1.00	0.32
	Correct	26 43.33%	10 16.67%		

Table 4.1.5 provides the results of the Chi Square procedure conducted on six safety signs with the addition of text, with *signs at work* being the mediating variable.

Here too, there were no statistically significant results found, meaning that when it came to interpreting a sign (with symbols and text), whether participants had come into come into contact with safety signs in their working day or not, made no major difference to their interpretation of a sign.
SS7 (no smoking) produced a $\chi^2 = 0.31$; SS8 (biohazard warning) produced a $\chi^2 = 2.12$; SS9 (radiation warning) produced a $\chi^2 = 0.16$; SS10 (no trolleying) produced a $\chi^2 = 0.07$; SS11 (wheelchair access) produced a $\chi^2 = 0.14$ and SS12 (no thoroughfare) produced a $\chi^2 = 0.74$.

Table 4.1.5. Chi Square Analysis [Symbols + text by Signs at work]

Safety Sign	Incorrect/ Correct	Contact with signs at work	No contact with signs at work	Chi Square	P value
No smoking (SS7)	Incorrect	1 1.67 %	0 0 %	0.31	0.58
	Correct	45 75%	14 23%		
Biohazard warning (SS8)	Incorrect	38 63.33 %	9 15 %	2.12	0.15
	Correct	8 13.33%	5 8.33%		
Radiation warning (SS9)	Incorrect	29 48.33 %	8 13.33 %	0.16	0.70
	Correct	17 28.33%	6 10%		
No trolleying (SS10)	Incorrect	8 13.33 %	2 3.33 %	0.07	0.78
	Correct	38 63.33%	12 20%		
Wheelchair access (SS11)	Incorrect	19 31.67 %	5 8.33 %	0.14	0.71
	Correct	27 45%	9 15%		
No thoroughfare/exit (SS12)	Incorrect	19 31.67 %	4 6.67 %	0.74	0.40
	Correct	27 45%	10 16.67%		

Table 4.1.6 provides the results of the Chi Square procedure conducted on six safety signs (with symbols only), and *safety information training* being the variable under investigation.

SS3 (emergency route) produced a statistically significant result where $\chi^2 = 5.08$ and ($p = 0.02$). Therefore, for SS3 (emergency route) there was a statistically significant difference between participants that had had safety information training and those that did not. Essentially, 61.67 % of participants that did not have safety information training interpreted this sign incorrectly, whereas only 11.67 % of participants that had received safety information training interpreted this sign incorrectly.

No statistically significant results were found for the other five safety signs, meaning that there was no statistical difference between participants that had received safety information training and those that did not for signs with symbols only: SS1 (no smoking) had a $\chi^2 = 0.96$; SS2 (electricity) had a $\chi^2 = 1.80$; SS4 (fire extinguisher) had a $\chi^2 = 0.12$; SS5 (no entry) had a $\chi^2 = 0.02$ and SS6 (no thoroughfare) had a $\chi^2 = 0.06$.

Table 4.1.6. Chi Square Analysis [Symbols only by training in safety sign/ info]

Safety Sign	Incorrect/ Correct	Training in safety sign/ information	No training in safety sign/info	Chi Square	P value
No Smoking (SS1)	Incorrect	0 0 %	3 5 %	0.96	0.32
	Correct	14 23.33%	43 71.67%		
Electrical warning (SS2)	Incorrect	7 11.67 %	32 53.33 %	1.80	0.18
	Correct	7 11.67%	14 23.33%		
Emergency route (SS3)	Incorrect	7 11.67 %	37 61.67 %	5.08*	0.02
	Correct	7 11.67%	9 15%		
Fire extinguisher (SS4)	Incorrect	2 3.33 %	5 8.33 %	0.12	0.73
	Correct	12 20%	41 68.33%		
No Entry (SS5)	Incorrect	7 11.67 %	24 40 %	0.02	0.89
	Correct	7 11.67%	22 36.67%		
No thoroughfare (SS6)	Incorrect	6 10 %	18 30 %	0.06	0.80
	Correct	8 13.33%	28 46.67%		

Table 4.1.7 provides the results of the Chi Square procedure conducted on six safety signs with the addition of text (symbols and text), and *safety information training* being the variable under investigation.

No statistically significant results were found in this analysis which means that there was no statistical difference between participants that had received safety information training and those that did not, for signs with symbols and text: SS7 (no smoking) had a $\chi^2 = 3.34$; SS8 (biohazard warning) had a $\chi^2 = 0.58$; SS9 (radiation warning) had a $\chi^2 = 0.16$; SS10 (no trolleying) had a $\chi^2 = 0.07$; SS11 (wheelchair access) had a $\chi^2 = 0.14$ and SS12 (no thoroughfare) had a $\chi^2 = 2.73$.

Table 4.1.7. Chi Square Analysis [Symbols + text by training in safety sign/info]

Safety Sign	Incorrect/ Correct	Training in safety sign/ information	No training in safety sign/info	Chi Square	P value
No smoking (SS7)	Incorrect	1 1.67 %	0 0 %	3.34	0.07
	Correct	13 21.67%	46 76.67%		
Biohazard warning (SS8)	Incorrect	12 20 %	35 58.33 %	0.58	0.44
	Correct	2 3.33%	11 18.33%		
Radiation warning (SS9)	Incorrect	8 13.33 %	29 48.33 %	0.16	0.70
	Correct	6 10%	17 28.33%		
No trolleying (SS10)	Incorrect	2 3.33 %	8 13.33 %	0.07	0.78
	Correct	12 20%	38 63.33%		
Wheelchair access (SS11)	Incorrect	5 8.33 %	19 31.67 %	0.14	0.71
	Correct	9 15%	27 45%		
No thoroughfare/exit (SS12)	Incorrect	8 13.33 %	15 25 %	2.73	0.10
	Correct	6 10%	31 51.67%		

Hirotsu's Comparisons

Where significant Chi Square results were found, Hirotsu's (1983) technique was used. Statistical significance was found for the following two sets of variables: Education and Safety Symbol 3 (SS3) and Education and Safety Symbol 11 (SS11), where group 1 represents some level of high school education, group 2 represents a Matric pass and group 3 represents a post Matric qualification.

Table 4.1.8.

SS3 (Emergency Route)	Education 1-3	Education 2-3	Education 1-2
Chi Square	7.94*	0.91	3.56
P value	0.04	0.34	0.05
Fisher's Exact	0.01	0.18	0.05

The result in table 4.1.8 indicates that there is a statistically significant difference between Education group 1 (high school) and Education group 3 (post Matric) for safety symbol 3, where $\chi^2 = 7.94$ and $p = 0.04$. The interpretation of this result is based on an understanding of the populations' educational background and implies that there is a noticeable difference in understanding between those with a post Matric qualification and those who have only completed some level of high school. Ultimately, this suggests that there is a relationship between level of education and the understanding of this specific safety sign. This is reiterated by the Chi Square results for the Matric and post Matric groups, where little difference between the two groups was found.

Table 4.1.9.

SS11 (Wheelchair access)	Education 1-3	Education 2-3	Education 1-2
Chi Square	8.12*	0.83	4.76
P value	0.004	0.36	0.02
Fisher's Exact	0.004	0.23	0.02

Here again, the result in table 4.1.9 is statistically significant between Education group 1 (high school) and Education group 3 (post Matric) for safety symbol 11, with $\chi^2 = 8.12$ and $p = 0.004$. This result, based on the sample's educational backgrounds indicates that there is a noticeable difference in understanding between those with a post Matric qualification and those who have only completed some level of high school. Therefore, a relationship between level of education and participants' correct interpretation of the wheelchair access safety sign was found and is supported by the fact that in the Matric and post Matric groups, this was not the case.

4.2. Descriptive Analysis

The qualitative portion of this study uses thematic content analysis to draw out certain trends gathered from one-on-one interviewing. These findings support the quantitative results presented and in addition, the information gained from the interviews added more depth and detail to the statistical results.

Before unpacking emergent themes from the interviews, some responses to a general question posed to participants to familiarise them with the types of questions that would be asked throughout the interview follows: "Is there any safety sign that stands out in your mind?" Approximately, 66% of the sample could not recall a single sign that came to mind, while the remaining 33% of participants reported varied signs, some of which were related to traffic/road signs. The two most common signs recalled by participants were the *stop sign* and *fire extinguisher* sign. This was followed by an equal proportion of participants recalling *no smoking* signs, *exit* signs, *no entry* signs and the *safety goggles* sign. Some reported *electricity* signs, *AIDS* signs as well as *smash and grab hot spot* signs.

4.2.1. Descriptive analysis of each safety sign

- **Electrical warning**



A large proportion of participants correctly identified that this sign implies the presence of electricity. While there were also a great number of individuals that proposed no understanding of the sign (approximately 28 percent), there were also many incorrect responses unrelated to electricity at all. Some of these responses include the following: “road goes zigzag”; “work in progress”; “T-junction”; “road is bending”; “hump/corner”; “robot”; “road narrows” ; “jagged road”; “sharp bend in road” and “arrow giving direction”. These interpretations suggest one common denominator, being that they all relate to the road or transport environment more so than they do the hospital environment. This feature will be explored further on in the discussion.

- **Emergency route**



While many of the interpretations for this sign were incorrect, they were somewhat aligned to the actual meaning of the sign. Such responses included the following: “no running”; “exit staircase”; “fire escape”; “follow arrow”; “if fire, run this way”; “arrow to show steps”; “walking area”; “shows the right way” and “run for it, trouble!”. Other responses that were significantly unrelated to the actual meaning of the sign included: “toilets this way”; “where fire pipes are”; “admission in that direction”; “right of way”; “after crossing robot, it shows which way to go”; “go when green”; “walking on pavement”; “take this street”. Here too, the common thread that can be identified is that many individuals interpreted the meaning of this sign in the context of the road/transport environment.

- **Fire extinguisher**



As confirmed by the statistical results, this sign was for the most part interpreted correctly, with most participants identifying the sign as a fire extinguisher. However, there were some participants that did not recognise the sign at all and other interpretations that were incorrect. These included “Fire break”; “petrol”; “for hire” and “gas”. While these responses were incorrect, it is imperative to consider the variations of interpretations given as they provide insight into cultural and cognitive factors at play. These factors will be extrapolated further on this section.

- **No entry**



While many individuals identified this sign correctly, there were a number of individuals that could not identify the sign at all. Varied interpretations of the sign included the following: “restricted area”; no throughway”; street way”; “robot”; “stop sign”; “yield”; “danger” and “cul-de-sac”. Again, many individuals conveyed interpretations of the sign within the road/transport environment.

While some interpretations of this sign are loosely related to the correct meaning of the sign such as, “restricted area” and “no throughway”, other interpretations such as “robot” and “cul-de-sac” expose the risk of incorrectly interpreting a sign that is in reality aimed at protecting individuals from situations or substances that pose a threat to their safety.

- **No thoroughfare**



This sign roused many variations of the actual meaning of the sign. Most participants identified that the sign imposed a restriction of some kind, but interpretations as to what exactly this was, varied. Some of the more correctly related responses included: “no pedestrian crossing”; “no people walking by foot”; “no walking”; “no entry”; “no trespassing” and “can’t pass”. There were also more unrelated and incorrect responses such as: “not allowed to walk over street”; “children prohibited”; “stop”; “just walk”; “no parking”; “no passengers”; “not allowed to walk alone” and “no men allowed”.

- **Biohazard warning**



A large proportion of participants did not recognise this sign at all. However, the participants that offered their interpretation of the sign gave answers that were related to the sign in some way. Most frequently, participants identified it as “dangerous chemicals”. Other responses included “dangerous gas”; “hazard”; “protective garments”; “danger”; “can only go in with access card”; “authorised people only”; “private”; “car hazard” and “sharp objects”. Importantly though, many participants simply read the ‘biohazard’ text to convey their answer. The actual biohazard symbol remained puzzling to most participants and in this instance, the written text seemed to aid participants’ interpretation of the sign. The implications of which will be discussed further on.

- **Radiation warning**



Here too, many participants merely read the text "X-ray room" as their answer, which exposes the possibility that in fact they did not understand the symbol specifically used to convey radiation. Other varied responses included: "can't go for X-rays"; "not open to public"; "where they make X-rays"; "danger, poison"; "coding system up ahead" and "air conditioning in area".

- **No trolleying**



Akin to the preceding two signs, this sign also perpetuated responses that were read rather than fully understood, with one of the most frequently reported responses' being "hand trolleys prohibited". While other interpretations of the sign were not entirely correct, they were however more aligned to the actual meaning of the sign and these included: "no entry for people with trolleys"; "can't push trolleys"; "no walking with trolleys"; "no trolleys with lots of people"; "used on lifts"; "danger, don't use trolley"; "can't enter with a trolley" and "used to help with pushing".

- **Wheelchair access**



Approximately 60 percent of participants identified this sign correctly, while other responses were related to the wheelchair symbol or disability in some way. These included: “wheelchair storage”; “no steps, only wheelchair”; “disabled people entrance”; “people needing wheelchair when arriving at hospital”; “wheelchair parking”; “gear lever for wheelchair to come in”; “turning wheel” and “bell ringing here”.

- **No thoroughfare/exit**



Many participants identified this as a no exit sign while other participants provided similar answers that could not be deemed incorrect. These were “no exit on foot”; “not allowed to go out” and “can’t go through”. There were also responses that were incorrect and in one instance contradictory to the actual meaning of the sign. These included: “not allowed to cross road”; “no crossing”; “no entry for people who are alone”; “somebody walking in a safe place” and “robot”.

- **No smoking (with and without text)**





Of the twelve safety signs presented to participants, both 'no smoking' signs had the two highest correct response rates, where *no smoking with text* had a 98% correct response rate and *no smoking without text* had a 95% correct response rate. Since these results are significantly different from the other ten signs, it is important to deliberate why this could be so. One rationalisation is that the 'no smoking sign' is comparatively more prominent and more frequently displayed in public areas than the other safety signs and is not exclusive to the hospital environment. No smoking signs can be seen in public transport areas, restaurants and many other public buildings that can be frequently accessed by all members of the public.

4.3. Emergent themes

Two prominent themes emerge from the foregoing discussion. The first theme relates to context and the second theme relates to literacy. In relation to the first theme, participants often interpreted safety signs within the context of the road or transport environment. While some safety signs can arguably be found in areas where people commute daily, there are some interpretations that are context specific to the hospital environment and where they would not necessarily be seen in the transport/ road environment. For example, the *radiation* sign. This sign is of particular importance in the hospital environment where we would expect pregnant women to frequent the hospital for check-ups and procedures and therefore failure to recognise the risks of radiation depicted in the sign could result in dire consequences.

However, in the case of non-context specific signs such as a *no entry* sign, individuals may have had more contact with the sign purely by virtue of daily commuting where no entry signs are regularly displayed to inform the public of certain private buildings and roads. Another example would be a *fire extinguisher* sign, which is accessible to people not only in hospitals but in restaurants and other public buildings too.

The second theme relates to literacy, in cases where participants read the text supplementing the signs. There were some instances where it was not entirely clear to the researcher whether participants actually understood the meaning or implications of a safety sign. This stems from the fact that participants looked at the radiation symbol obscurely and verbalised that they had not seen that symbol before. However, once participants read the radiation or biohazard text, they recognised that the sign might denote some form of harm or injury. The extent to which they truly understood the implications of the sign were less apparent. Perhaps in future research, one way of testing this assumption would be to provide participants with the radiation and biohazard symbols only, thereby eliminating the aid of written text and seeing what kinds of interpretations emerge.

The themes identified in this chapter highlight some commonalities found within a demographically varied sample. However, many interpretations of the safety signs were incorrect, bringing attention to the fact that from a safety perspective, repercussions could be severe. Some possibilities as to why such vast gaps in understanding exist will be grappled with in the next chapter.

CHAPTER FIVE

DISCUSSION

5.1. Introduction

This chapter will unpack the results presented in chapter four. Based on the statistically significant findings, certain inferences are made using a descriptive means of analysis and in so doing, inherent repercussions associated with these findings are also discussed.

5.1.1. General discussion

The demographics of the sample demonstrate varied educational and literacy levels and therefore allow more generalisable assertions to be made. In light of literacy levels, the majority of the sample had only received some level of high school education accounting for 47%, while 30% of the sample had matriculated and only 23% had gone on to complete some form of a post Matric qualification. As such, most participants were employed as unskilled or semi-skilled labour. Mostly, these participants had access to safety signs in their daily working environments however; only 23% of the total sample had received some form of training about safety information. This fact exposes the possibility that although individuals are exposed to safety signs, their interpretations thereof may not be accurate unless identified and corrected by formal safety training.

As a means of familiarising and putting into context the purpose of the research, participants were asked the following question, “Is there any safety sign that sticks out in your mind?” This question was designed to encourage participants to draw on their knowledge and contact with safety signs in order to provide an example thereof.

According to Baddeley (1986), whether information is spatial or verbal, the capacity to sustain information in working memory is dependent on both the quantity of information being relayed as well as how long the information can be kept active. Concerning the present study, interestingly 66% of the sample could not recall a single sign that came to mind. This finding could be attributed to the fact that a clear distinction between road signs, safety signs and other signs in general, was not made. As a result, participants could easily have misinterpreted the question since no specific context was provided.

However, the two most common signs that were recalled by the remaining participants were the *stop sign* and the *fire extinguisher* sign. This was followed by an equal proportion of participants recalling *no smoking* signs, *exit* signs, *no entry* signs and the *safety goggles* sign. Some reported *electricity* signs, *AIDS* signs as well as *smash and grab hot spot* signs. With regards to the two most common signs identified by participants, both the *stop sign* and *fire extinguisher* sign can be found in areas outside the hospital domain, and may suggest that the reason why individuals recall these signs easier than others is due to the fact that they are displayed in many other contexts and environments, making them more familiar to individuals and thus easier to remember.

This is further supported by Baddeley's (1986) assertion that memory is an integral part of information processing tasks such as perception, reasoning and comprehension and that duration plays a critical role in keeping information active. Therefore, if individuals are exposed to certain signs longer than others, like for instance in one's daily work environment, it would explain why those signs are easier to process and recall from memory (Baddeley, 1990). With reference to the '*smash and grab hot spot'* sign, this may have been easier to recall since many people spend a portion of their day commuting via public transport and they would therefore be exposed to this sign on the road. Perhaps more importantly though, this sign highlights the current reality of the society we live in.

Importantly, signs that did not meet ANSI's (1991) criterion of at least 85% correctness were SS2 (electrical warning), SS3 (emergency route), SS5 (no entry), SS6 (no thoroughfare), SS8 (biohazard warning), SS9 (radiation warning), SS10 (no trolleying), SS11 (wheelchair access) and SS12 (no thoroughfare). Similarly, signs that did not meet ISO's (1984) criterion of at least 67% correctness were SS2 (electrical warning), SS3 (emergency route), SS5 (no entry), SS6 (no thoroughfare), SS8 (biohazard warning), SS9 (radiation warning), SS11 (wheelchair access) and SS12 (no thoroughfare).

5.1.2. The comprehension of safety signs with symbols only

Safety sign 3 (emergency route), produced a statistically significant result demonstrating that participants with only a high school level of education had the most number of incorrect interpretations of the sign. This is supported by the fact that in the high school group, 41.67% of participants interpreted the sign incorrectly, whereas in the Matric group, 20% of participants interpreted the sign incorrectly and in the post Matric group, 11.67% of participants interpreted the sign incorrectly. Hirotsu's (1983) analysis, enhanced this finding where $\chi^2 = 7.94$, between groups 1 (high school) and 3 (post Matric) suggesting that there is a noticeable difference in understanding between those with a post Matric qualification and those who had only completed some level of high school. As such, there is a statistically significant relationship between one's level of education and the understanding of this specific safety sign.

Furthermore, for the same sign (SS3), there was a statistically significant difference between participants that had received safety information training and those that did not (refer to Table 4.1.6.). This finding substantiates the argument that past exposure or experience of safety signs plays an influential role in enhancing one's level of understanding (Laughery et al, 1994).

The qualitative or descriptive portion of this study corroborates these findings. Easterby and Zwaga (1984), note the benefits of using symbols as a means of getting around some of the limitations of written language. However, in the present study both the *biohazard* and *radiation* warning signs seemed to suggest otherwise. The majority of participants could not make out the *radiation* or *biohazard* symbol. Although, once they read the text supplementing the sign, they were able to interpret what the sign might mean. Important to note here is not only the abstract nature of the *biohazard* symbol but also the word 'biohazard' itself. In this vein, it was not clear whether participants actually understood what a 'biohazard' was or what it meant.

This finding reiterates the argument that it is imperative to reduce serious confusions of a given sign to prevent the possibility of unsafe behaviour. This is supported by findings that suggest reducing such confusions is more important than raising one's comprehension level of a sign (Duarte & Rebelo, 2005; in Thatcher, James & Todd, 2005). With that being said, once participants read the text supplementing the sign, they were somewhat able to offer ideas as to what the sign might mean. Furthermore, even though in most cases this interpretation was wrong, participants still used the text in the process of unraveling what the sign could mean. This finding therefore calls into question the role symbol abstractness plays in guiding correct interpretations of safety signs and suggests that the addition of text sometimes does not enhance the comprehension of safety signs sufficiently.

In this vein, Easterby and Zwaga (1984) also put across the importance of visual characteristics such as representational style that aid the process of communicating safety threats i.e. the ability to transmit information with an element of visual impact. This is supported by Alves-Foss et al's (1995), study that investigated the impact symbol explicitness had on perceptions of warnings. Their results showed that high explicitness symbols received the highest perceived hazard ratings and contrastingly, low explicitness symbols received the lowest ratings of comprehension (Alves-Foss, Thomas & Braun, 1995).

The symbolic function of pictorial elements in signs is argued to be highly arbitrary and often governed by convention (Paivio, 1986). For example, curves on road signs are used to convey curves on a road. However, important to note is that the same symbol could also be used to represent any number of other situations (Paivio, 1986). As was seen in the present study, signs meant to minimise conveying ambiguous information, often did just the opposite. For example, numerous participants associated the electricity sign with features on a road. Similarly, for the *emergency route* sign (SS3), many unrelated interpretations came up such as; "toilets this way", "go when green" and "take this street". Ultimately, these responses point out the poor communicative value some signs have, that use symbols *only* to convey safety information, particularly with people that have lower levels of literacy. Moreover, Ayers et al. (1991), caution that the threat of physical injury or death is of little concern unless the likelihood of injury or death is perceived to be high. As such, participants in the present study incorrectly interpreted the *electricity* sign to mean "curves on a road", thus exposing the fact that the likelihood of injury to themselves may not have been recognised at all (Ayers et al, 1991).

5.1.3. The comprehension of safety signs with symbols and text

In general, this study found that participants with lower levels of education had the highest error rates. However, these were only statistically significant in one case. SS11 (wheelchair access) produced the only statistically significant result for signs with symbols and text. This result indicates that of the three education groups (high school, Matric and post Matric), participants with only a high school level of education were the group with the most number of incorrect interpretations. This is further supported by the results obtained from Hirotsu's (1983) analysis, where a relationship between level of education and participants' correct interpretations of the *wheelchair access* safety sign was found, i.e. there was a significant difference in understanding between those with a post Matric qualification and those who had only completed some level of high school education (refer to Table 4.1.9).

In light of this, Robinett and Hughes (1971), argue that in cases where individuals are illiterate, the use of symbolic representations with the addition of text, could lead to ambiguities in the way they then process and interpret signs. The aforementioned finding confirms this assertion since participants with a lower level of education (high school) had the most number of incorrect interpretations of SS11 (wheelchair access), whereas those participants with a post Matric qualification (arguably literate individuals) had the lowest number of incorrect interpretations. Further evidence of this occurrence has been mentioned where, although participants read the text accompanying the *radiation* and *biohazard* signs, a clear understanding as to the dangers or implications associated with these signs, could not be determined. Past studies confirm this finding advocating that the preferred means of communicating hazards be through the use of pictograms only (Paivio, 1971).

Furthermore, Paivio's (1971), dual coding hypothesis argues that imagery increases with concreteness and as such, so too does one's capacity to store an item as an image. The same cannot however be said for verbal meaning. Symbols are also meaningful at the representational and referential level since they stimulate a concrete memory representation and a verbal label. Whereas the accessibility of the verbal code is believed to be, somewhat more complex since an extra process is involved (Paivio, 1979).

Moreover, recall of a symbolic item is heightened since an image is generally more memorable than a verbal code (Paivio, 1971). In the present study, participants were at times baffled by certain symbols. Specifically, the *radiation* warning, the *biohazard* warning and the *emergency route* sign. Results obtained from the analysis indicated that these three signs received the highest number of incorrect responses out of all twelve safety signs. While, the *radiation* and *biohazard* warning signs were accompanied with text, it was not clear to the researcher whether individuals understood what the implications or dangers associated with these signs were. The emphasis here again is that the symbols depicted in these signs were highly arbitrary and vague and were in no way meaningful as is usually the case, according to Paivio (1971).

Paivio (1971), also points out that generally nonverbal imagery alone, or both imagery and verbal processes add to the memorability of items (Paivio, 1971). Contrastingly, Robinett and Hughes (1971) assert that although safety standards are employed, the plethora of safety signs that have been produced have inadvertently produced a mixture of unrelated and perplexing messages (Robinett & Hughes, 1971). Participants' lowest comprehension scores on the *biohazard* warning and the *emergency route* sign corroborate this fact. In particular, 73.33% of participants interpreted the *emergency route* sign incorrectly, which is a sign containing symbols only or as Paivio puts it, 'nonverbal imagery'. Additionally, 78.33% of participants interpreted the *biohazard sign* incorrectly, which comprises symbols with the addition of text or as Paivio (1971) suggests, both imagery and verbal processes. Essentially, both examples provide explicit evidence of the poor communicative value some signs still have and question whether any change has transpired with regards to enhancing individuals' understanding of safety signs. As Robinett and Hughes (1971) pointed out over thirty years ago, this ultimately remains the central challenge to developing clear and recognisable safety signs.

5.1.4. How literacy influenced interpretations of safety signs

Hannon (1995) advocates that literacy is imbedded in culture. In the present study, a large proportion of unrelated interpretations of safety signs were evident and could therefore suggest that one's culture played a significant role when it came to interpreting safety signs. For instance, the *radiation sign* was interpreted as "coding system up ahead" as well as "air conditioning in area". Similarly, the *no entry* had unrelated responses such as "robot"; "stop sign" and "yield".

Furthermore, Dewar (1994) argues that pictorial symbols can effectively be used to convey information to individuals with less proficient language skills (Dewar, 1994). However, Pinnock and Polacsek (1992) argue that people who cannot read have trouble understanding pictures. In light of Dewar (1994) and Pinnock and Polacsek (1992), evidence of both postulations was evident in this study. As can be seen in Table 1, 47% of the sample had only received some level of high school education.

Thus, according to Dewar, (1994) the use of symbols would be an effective means of conveying information to such an audience. However, vast unrelated interpretations of various signs were apparent, suggesting that the symbols were not in and of themselves clear and explicit. This was particularly evident for the following safety signs, which had above average error rates among participants: 65% of participants incorrectly interpreted SS2 (electricity), 73.33% of participants incorrectly interpreted SS3 (emergency route), 78.33% of participants incorrectly interpreted SS8 (biohazard) and 61.67% of participants incorrectly interpreted SS9 (radiation).

Importantly, participants with only a high school level of education were the group that generally interpreted safety signs the poorest, (both those signs with text and those without). This is supported by the statistical results presented in Table 4.1.2 (symbols only by education) and table 4.1.3 (symbols and text by education) which show that the high school group (individuals with the lowest level of education of the three groups) consistently had the highest percentage of incorrect interpretations of the twelve safety signs.

Notably, this percentage seemed to decrease as one's level of education increased. For example, safety signs with *symbols and text* such as SS11 (wheelchair access), where 28.33% of participants in the high school group, interpreted this sign incorrectly, while 8.33% of participants in the Matric group interpreted the sign incorrectly and only 3.33% of participants in the post Matric interpreted the sign incorrectly. The same occurrence was noted for safety signs with *symbols only*. For instance, SS3 (emergency route), 41.67% of participants in the high school group interpreted the sign incorrectly, while 20% of participants in the Matric group interpreted the sign incorrectly and 11.67% of participants in the post Matric group interpreted the sign incorrectly. Both examples clearly demonstrate that participants with a lower level of education were the group that had the biggest gap in understanding and interpreting safety signs correctly. This trend was consistent across all twelve safety signs (refer to Tables 4.1.2 and 4.1.3).

While Pinnock and Polacsek (1992) argue that illiterate individuals battle to understand images, in the present study, even though the majority of the sample had inadequate education, many signs containing symbols only were correctly interpreted (such as the *no smoking* sign and the *fire extinguisher* sign). A plausible reason for this could be that both of these signs are displayed in many different public domains, for example places of eating and places of public transportation, making these signs more accessible and more familiar.

5.1.5. The impact of culture

Sturken and Cartwright (2001), convey the importance of considering broader cultural meanings as a proponent of interpreting images. As such, the present study highlights several examples of where this factor could have played a significant role in participants' interpretation of a sign, owing to the fact that their responses were markedly unrelated to the sign itself. Various examples of where this was evident follow: some responses of the *emergency route* sign were "toilets" and "fire pipes"; the *electrical warning* sign was interpreted by some as a "robot"; some responses to the *fire extinguisher* sign were "petrol" and "for hire"; the *no entry* sign was interpreted by some as a "cul-de-sac"; some responses to the *no thoroughfare* sign were "children prohibited" and "no men allowed"; the biohazard sign had responses such as "sharp objects" and "car hazard" and finally, the wheelchair access sign was viewed as a "turning wheel" and a handful of participants thought the sign meant "bell ringing".

These examples also draw attention to the fact that meaning resides not only in the initial perception of a sign, but also in the interpretation and subsequent action taken based on that interpretation (Cavallaro, 2001). This is also supported by Gardiner's (2006) assertion of the influence of entrenched socio-cultural contexts on perceptions.

5.2. Theoretical and practical implications

As highlighted, 66% of the sample could not recall a single sign that came to mind. This alludes to the fact that, regardless of exposure, individuals do not typically understand most of the safety signs that they come into contact with. The inherent danger associated with this finding is that incorrect interpretations of safety signs may lead to serious injury and in severe cases even death. This ultimately is contradictory to the main purpose of safety signs, which is to promote effective and clear communication of hazards and hazardous situations (Wogalter, Kalsher & Racicot, 1993).

While Easterby and Zwaga (1984) argue that the use of symbols in safety signs is one way of getting around the limitations of written language, in this study, the findings suggest otherwise. Instead, many participants responded with interpretations that suggested the signs had a high level of abstractness. Here again, it is evident that the symbols depicted in the signs were not explicit and that the addition of text, in no way facilitated a clear understanding of what the sign meant. Supporting evidence shows that of the twelve safety signs under investigation in this study, only three safety signs (SS1, SS4 and SS7) were acceptable according to ANSI Z535.3 (1991) and ISO's 3864 (1984) criteria.

In addition, Dewar (1994) contends that the use of symbols can be an effective means of conveying information to individuals with less proficient language skills. In light of the present research findings, this did not appear to be the case. As such, future research in this area should take the arbitrary nature of symbols into account, especially since most safety signs have been developed internationally and therefore do not cater for environments where individuals' interpretations could be effected by cultural, social and poor educational backgrounds. As such, this point calls into question the applicability internationally designed safety signs have within the South African context.

5.3. Limitations

Some limitations of this study need to be pointed out. This research was conducted in one of Johannesburg's public hospitals, and is therefore not generalisable to private hospitals within the country or to other public safety signs in other environments. Another issue relates to the genre of individuals interviewed. While the majority of the sample constituted outpatients, the study could possibly have produced different results if more professional participants, such as doctors and nurses were interviewed, whom we would assume to have higher literacy levels and who would be exposed to safety signs more frequently in their working day.

In addition, since this was a public hospital, the sample group may not necessarily be representative of the broader population, since a public hospital is likely to exclude wealthier and perhaps more literate or educated individuals. Also, the sample size of this study was fairly moderate (sixty participants) and this would therefore have an effect on statistical power. This became more apparent in the results section where data needed to be interpreted with caution due to distorted frequencies. This could be avoided in future, by extending the sample size.

The interviewing procedure also exposes certain biases. Babbie and Mouton (2004), assert that, "the interview is a social interaction and involves norms, expectations and social roles" (p.249), and therefore when individuals are interviewed, they may in some instances feel beholden to respond in 'socially desirable' ways. This was evident when participants asked the researcher to affirm whether their responses were correct or incorrect. In such cases, the researcher explained that essentially there were no correct or incorrect answers, that all opinions and understandings would be taken into account and that they should try to put into words what they thought the sign meant.

Participants in this study were volunteers, thus constituting a non-probability sample. On that note, using a non-probability sample means that there is no way to ensure that each component or individual will have an equal opportunity to be included in the sample. This in turn, affects the generalisability of the research findings (Rosenthal & Rosnow, 1991).

With regards to the descriptive section of the study, thematic content analysis was used to supplement the quantitative results. As such, the researcher coded the data and did not use a second or third coder to validate the themes identified, thus exposing an element of bias. Furthermore, the researcher did not stipulate that the twelve safety signs presented to participants were actual pictures taken from the Johannesburg General Hospital. Therefore, a specific context was not provided and is supported by the fact that many participants thought that the safety signs presented, belonged to the road or transport environment.

Ascertaining in-depth information around participants' literacy level was limited. The present study used the information gained from participants' educational backgrounds as the sole means of gaining an understanding of one's literacy level. As such, it is important to look at some of the reasons why this method may possibly have been an inappropriate measure of literacy. Given South Africa's history of apartheid and continuing drive to enhance the accessibility of education for all learners, evidence suggests that major variances in educational standards still exist which ultimately affects one's literacy development (Prinsloo & Breier, 1996). Furthermore, differences in one's locale and resources (e.g. urban versus rural areas) may also contribute to the dilemma of disproportionate literacy levels. Finally, it is important to consider the stigma that is often attached to a person's literacy level and the effect this could have on them when declaring their own literacy level. Collectively, these factors point to some of the pitfalls associated with using *educational background* as the only means of ascertaining literacy levels.

However, if formal literacy tests were to be used, the following factors also need to be considered. Firstly, many literacy tests are time consuming, sometimes taking up to an hour to administer, which is not practical in all research settings. Furthermore, given the eleven official languages spoken in South Africa, many safety signs are currently aided with written text in languages other than English (e.g. Zulu and Sotho) and therefore testing only English literacy levels may not be an all-encompassing method of collecting literacy information. Finally, twelve safety signs were used in this study, which represents only a small subset of all available signs that could be used in this context.

5.4. Directions for future research

One of the themes that emerged in the study was that many symbols conveyed a high level of ambiguity. This is supported by the findings presented in chapter 4. As such, for particularly arbitrary symbols like the *radiation* and *biohazard* symbols, one might consider removing the aid of text to see whether different responses emerge. Furthermore, it may be useful to probe participants' responses by asking them why they think a particular symbol means what it does or perhaps taking a more behavioural approach by asking them what they would do in the event of seeing such a symbol. This may then assist the researcher in adequately determining whether participants actually comprehend the implications or dangers associated with the sign.

In order to increase the generalisability of research findings, it may be useful to compare interpretations of safety signs among individuals in private hospitals with those in public hospitals. Not only will this increase the size of the sample, but it will also allow researchers to draw a sample with more wide-ranging educational backgrounds and skills. Future research in this area may benefit from providing participants with a specific context in which the safety signs under study could be found, thereby narrowing the scope of unrelated interpretations that could be made. Finally, in order to fully grapple with individuals' varied levels of comprehension, a deeper understanding of one's cultural background needs to be ascertained. This can be achieved by collecting more in depth and detailed knowledge around individuals' cultural heritage and social background.

CHAPTER SIX

CONCLUSION

This study aimed to determine individuals' understanding of twelve safety signs (six comprising symbols only and six comprising symbols with text). In addition, literacy was noted as a potential factor in comprehending a given safety sign correctly. Essentially, both of these objectives were met as varying comprehension levels for each safety sign were determined through one-on-one interviewing and in certain cases, specifically the interpretation of SS3 (emergency route) and SS11 (wheelchair access), the level of education one had played a significant part in the correct interpretation of a sign.

This point is supported by the findings indicated in Table 4.1.7. and 4.1.8. which revealed a significant difference in understanding of certain safety signs between those participants with a post Matric qualification and those who had only completed some level of high school. These findings suggest that there is a significant relationship between one's level of education and one's interpretation of a safety sign. Essentially, this exposes the macro level challenge of designing public safety signs that reach an audience with across-the-board literacy skills. Furthermore, the disparities in the comprehension of safety signs in this study suggest that there are factors beyond illiteracy that influence one's interpretation of a sign such as, one's cultural background, the context in which safety signs are viewed and the degree of explicitness safety sign symbols are able to convey.

This study has facilitated a deeper understanding of the dynamics involved in interpreting safety information, specifically safety signs. By accessing a diverse sample of individuals indicative of the broader South African population, this study was able to draw out some of the pitfalls associated with existing methods of communicating public safety information. According to ANSI Z535.3 (1991) and ISO 3864 (1984) criteria, only three of the twelve safety signs used in the study were comprehensible.

This finding alone demonstrates a pivotal need to re-examine the varied perceptions that these “visual metaphors” invoke and calls for the redress of developing unambiguous safety signs, whether they include symbols-only or symbols with the addition of text. In sum, the effective communication of intended concepts to targeted populations remains the core goal (ISO, 1984). Drawing on the results obtained from the present study, this can be partly achieved by scrutinising methods of collecting varied literacy levels and taking into account wide-ranging educational and cultural backgrounds that are emblematic of the South African population.

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APPENDIX 1: Biographical Information Schedule

1. Gender: Male/ Female
2. Age _____
3. Highest Educational Level _____
4. What are your primary and secondary languages?

   _____
5. Did you attain any post-Matric/ post-school qualifications or training?

   _____
6. Occupation _____
7. How long have you been employed in your current position? _____
8. Do you come into contact with safety/information signs during your working day? _____
9. Are you colour-blind? If so, has this in any way affected your understanding of safety signs? _____
10. Have you received any training on safety/information features during your time at your current organisation or elsewhere?_____
11. What safety/information sign(s) stands out the most for you i.e. can you describe it and what it means? _____

Your answers to this study will be treated at all times as strictly confidential

APPENDIX 2: Questionnaire/Interview Schedule

Each participant is shown the twelve different safety/information signs below.
[Six being pictorial symbols only and the other six being pictorial symbols with text].

Participants provide their own verbal understanding as to what each sign means or represents.

- Participants that give an incorrect answer are allocated a **1** and
- Participants that give a correct answer are allocated a **2**

SYMBOLS ONLY



No Smoking



Evacuation Route



Electricity



Fire Extinguisher



No Entry



No thoroughfare

SYMBOLS WITH TEXT



No Smoking



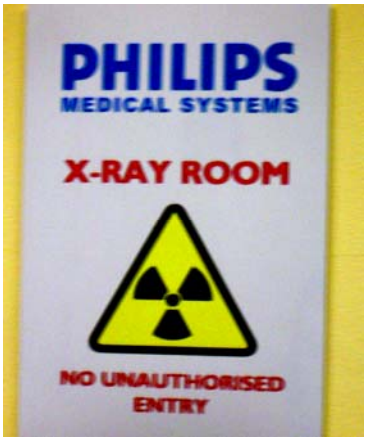
No thoroughfare



Danger: Biohazard



No thoroughfare with trolleys



Radioactivity



Wheelchair Access

APPENDIX 3: Participant Information Sheet (Qualitative Interview Based Research)

School of Human and Community Development
Private Bag 3, Wits 2050, Johannesburg, South Africa
Tel: (011) 717-4500
Fax: (011) 717-4559
Email: 018lucy@muse.wits.ac.za

My name is Lindsay Howell and I am a Masters student at the University of the Witwatersrand. This study is for my Masters degree and will look at what people understand by different safety signs found in the hospital environment.

If you would like to participate in this study, it will mean me interviewing you. The interview will last for about half an hour. You may choose to participate or not to participate. There are no risks or benefits to you for participating in this study. You may choose to withdraw at any stage of the interview and you may choose not to answer any questions that you do not want to.

The information from the interview will be kept private and confidential. No names will be used during the report process and only group information will be reported. None of the interview information will be seen by any other person at any time and will be processed by me. The information will be stored in a locked cabinet by my supervisor until the research is complete. Once the research is complete, all information will be destroyed.

You will need to sign a consent form to be interviewed. If you require feedback about the research outcomes, you may give me your contact details on a separate piece of paper (before or after the interview process) and I will then contact you to give you feedback. If you have any further questions you may email me at this address: Lindsay.Howell@hotmail.com or alternatively you may phone me on 073 251 8443. Your participation in this study would be greatly appreciated.

Yours sincerely
Lindsay Howell

APPENDIX 4: Consent Form: (Interview)

I,_____ consent to being interviewed by Lindsay Howell for her study on Literacy and the comprehension of public safety signs with and without written aids. I understand that:

- Participation in this interview is voluntary.
- That I may refuse to answer any questions I would prefer not to.
- I may withdraw from the study at any time.
- No information that may identify me will be included in the research report, and my responses will remain confidential.

Signed _____

APPENDIX 5: Symbol and Text Explicitness Case Study

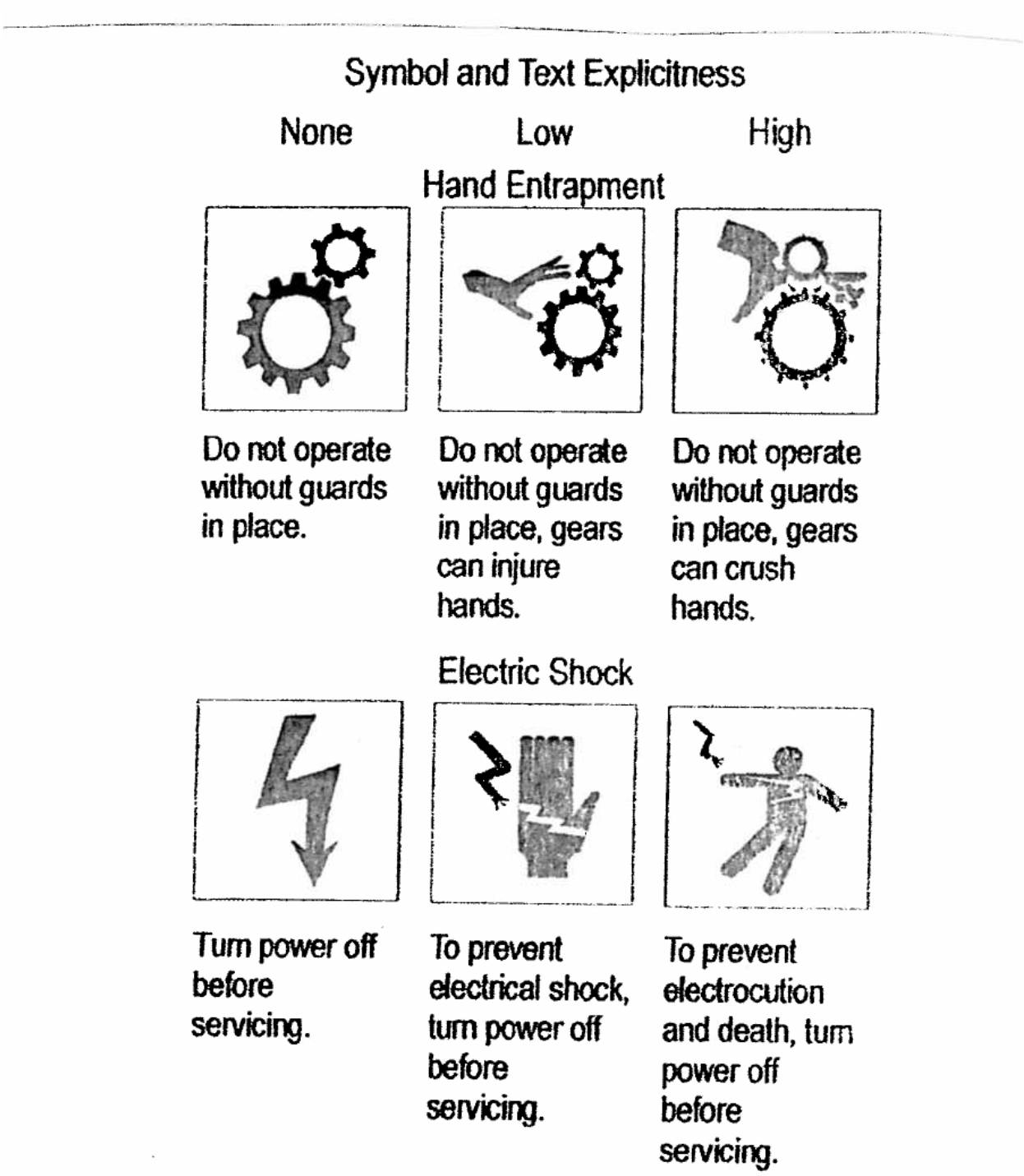


Figure 1. Levels of symbol and text explicitness. Symbols used by Alves-Foss, Thomas, and Braun (1995).

APPENDIX 6: JHB General Hospital Permission Form

Private bag X39, Johannesburg 2000, South Africa
Tel: +27 (0) 11 488 4911, Fax: +27 (0) 11 643 1612
www.johannesburghospital.org

Gauteng Department of Health

Enquiries: M. Motjelele
(011): 488-3785
(011) 488-3753

16October 2006

Dear Ms. Howell

RE: PERMISSION TO UNDERTAKE RESEARCH ON THE COMPREHENSION OF PUBLIC SAFETY SYMBOLS WITH AND WITHOUT WRITTEN AIDS

Permission is granted to conduct the above research as described in your request dated 7 July 2006, provided: -

1. The Gauteng Department of health will not in anyway incur or inherit costs as a result of the said study.
2. Your study shall not disrupt services at the study sites.
3. Strict confidentiality shall be observed at all times.
4. Informed consent shall be solicited from patients participating in your study.

Please liaise with the Head of Department and Unit Manager or Sister in Charge to agree on the dates and time that would suit all parties.

Kindly forward this office with the results of your study on completion of the research.

I wish you success in your studies.

Yours sincerely

Sagie Pillay
Chief Executive Officer

APPENDIX 7: Ethics Clearance Certificate

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Division of the Deputy Registrar (Research)

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
R14/49 Howell

CLEARANCE CERTIFICATE	**PROTOCOL NUMBER M060710**
PROJECT	Literacy and the Comprehension of Public Safety Symbols with and without written Aids
INVESTIGATORS	Miss L Howell
DEPARTMENT	SHCD/Psychology
DATE CONSIDERED	06.07.28
DECISION OF THE COMMITTEE*	APPROVED UNCONDITIONALLY

Unless otherwise specified this ethical clearance is valid for 5 years and may be renewed upon application.

DATE 06.08.23 **CHAIRPERSON** .....
pp (Professor A Dhai)

*Guidelines for written 'informed consent' attached where applicable

cc: Supervisor : Prof A Thatcher

DECLARATION OF INVESTIGATOR(S)

To be completed in duplicate and **ONE COPY** returned to the Secretary at Room 10005, 10th Floor, Senate House, University.
I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee. **I agree to a completion of a yearly progress report.**

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES