The role of semiotics in health, safety, and environment communication in South African mining and its influence on organizational culture

L. Scott[1] and M.A. Goncalves[1]

Synopsis

Effective communication is a sought-after non-technical skill in the health, safety, and environmental (HSE) function and is fundamental in achieving an organization's safety objectives. While different channels are used to communicate HSE matters, many organizations employ posters, videos, and/or signs containing images to convey information. Communication through signage and graphical hazard symbols has been regulated in standards, but vast sections of HSE communication are bespoke communications and exist outside the sphere of standards.

Effective HSE communication through images requires an understanding of the organizational culture in which the images will be used, as well as an understanding of the semiotics of the images themselves. Creative interpretation within HSE communication can create situations where the message that was received is not the message that was intended, leading to confusion and misinterpretation. This paper is aimed at elucidating the semiotics of South African HSE visual content. It was found that the indexical mode of images was most preferred in visual communication, and text-only designs the least preferred. Senders and receivers of messages differ in their opinions on the complexity of HSE communication.

Keywords

health, safety, and environment, communication, signs, symbols, semiotics.

Introduction

Mining is a high-risk operation. Although there have been great strides in addressing this in recent years, 2019 saw 51 fatalities and a total of 2 406 injuries reported in the South African mining sector (Department of Mineral Resources, 2020). The promotion of a culture of health and safety is one of the objectives in the mining industry (South Africa, Mine Health and Safety Act, 1996) and to achieve this goal, effective communication is required. Misalignment between the nature of the communication and the culture of an organization can lead to misinterpretation of messages.

Health, safety, and environment (HSE) communication addresses a broad variety of topics and uses many different channels, such as visuals, dialogue, and text, and is pivotal to the effective operation of the organization. It is therefore crucial that these communications are congruent with the culture of the organization to avoid potentially life-threatening problems. This study focuses on the use of visuals in HSE communications. To do so it is necessary to establish an understanding of the constituents of culture and the field of semiotics.

The three levels of culture

A formal definition of safety culture can be difficult. Guldenmund (2000) shows this by providing nine definitions of safety culture and seven about safety climate. The definitions have been the subject of much debate and discussion. Schein (2010) defines the culture of a group as 'a pattern of shared basic assumptions learned by a group as it solved its problems of external adaptation and internal integration, which has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way to perceive, think, and feel in relation to those problems.' Here the focus is on how

beliefs and values are introduced, reinforced, and integrated into the fundamental structures of organizational culture. Schein (2010) states that culture can be analysed at three different levels, separated by the degree to which the cultural phenomenon is visible to an observer. The levels range from the tangible manifestations to the deep, underlying basic assumptions of a culture.

Tacit assumptions

At the deepest level of culture are the tacit or basic underlying assumptions which drive the other two levels of culture. These assumptions may have been values at one time, but through consensus have become ingrained deeper into the culture, moved out of conscious debate, and are so embedded that very little deviation will be found within a social unit. Because tacit assumptions tend to be non-debatable, they are very resistant to change.

Espoused beliefs and values

The espoused beliefs and values of an organization can be elicited by asking members of the organization what their artefacts mean. At this level of culture, values such as freedom, teamwork, fairness, and individual competitiveness can be found. Espoused values and beliefs can be debated and confronted. It is possible for some espoused values and beliefs of an organization to contradict other espoused values and beliefs of the same organization. When values and beliefs that provide comfort and meaning are not congruent with values and beliefs that correlate to effective performance, an organization's espoused values tend to reflect desired behaviour rather than observed behaviour (Schein, 2010).

Artefacts

The manifestations of a culture that one can see, hear, and feel are the artefacts of the culture. Artefacts of an organization include the architecture of its physical environment, its language, its posters and presentations, and observable behaviour. Artefacts are easily observed but can be difficult to decipher without a thorough understanding of the other levels of an organization's culture.

The three levels of culture are interdependent and can either reinforce the substance of other levels or create dissonance between the levels. Artefacts such as posters can easily be incongruent with the culture of the organization or with the message that the sender is trying to communicate. For posters to be an effective means of communication, two concepts need to be understood. Firstly, there needs to be an understanding of the culture of the organization in which the poster will be placed, i.e. the context in which the poster will be used. Secondly, a thorough understanding of the semiotics of the posters (how the posters convey meaning) is needed. Both are required to ensure that the posters are effectively communicating the correct message within the confines of the organization's culture.

Semiotics

Semiotics is the study or 'science of signs' and their general role as vehicles for meaning and communication (Hall, 1997). Signs can include words, icons, images, gestures, symbols, musical notes, and objects, to name a few. A sign is something that represents concepts, ideas, and feelings in such a way that it enables others to understand or interpret the meaning in approximately the same way that we do. Understanding semiotics, then, is vital for effective communication.

The Saussurean model

Ferdinand de Saussure (1857-1913), considered one of the founders of semiotics, identified two interlinked components of the sign, which he called the 'signifier' and the 'signified'. The signifier is the material or physical form of the sign (it can be seen, heard, touched etc.), while the signified is the concept that the sign represents. A sign always has both parts, as one cannot exist without the other.

Saussure argued that the relationship between the signifier and signified is generally arbitrary or unmotivated; that there is no necessary, intrinsic, direct, or inevitable relationship between the signifier and the signified (Chandler, 2007). Subsequent semioticians stress that signs are not completely arbitrary and that the relationship between signifier and signified is dependent on social and cultural conventions. These conventions can differ greatly across borders (whether physical, perceptual, or hierarchical) and time. Because of the arbitrary nature of the Saussurean model, those who adopt it must avoid 'the familiar mistake of assuming that signs which appear natural to those who use them have an intrinsic meaning and require no explanation' (Culler, 1975 cited in Chandler, 2007).

The Peircean model

Charles Sanders Peirce (1839-1914) formulated a model of the sign which was composed of three parts. The parts are the representamen (the form that the sign takes, also called the sign vehicle), the interpretant (the sense made from the sign), and the object (something beyond the sign to which it refers, a reference). While Saussure did not offer a typology of signs, Peirce offered several, as well as modes of relationships between sign vehicles and what is signified. The three modes that were identified are:

1. **Icon/iconic**. In this mode the signifier is perceived to resemble or imitate the signified, in that it is similar in possessing some of its qualities, e.g. a portrait, a cartoon, a scale model.
2. **Index/indexical**. This mode connects the signifier and signified in some direct way (physically or causally). This link can be observed or inferred, e.g. smoke/fire, thunder/rain, reading on a thermometer/temperature.
3. **Symbol/symbolic**. Here the signifier does not resemble the signified but has an arbitrary or purely conventional relationship such that the relationship must be agreed upon and learned e.g. Morse code, traffic lights, national flags.

Visual communications, such as posters, can contain all three modes within an image. Each of the three modes has its limitations. Icons, for instance, can only represent real objects, which excludes abstract concepts such as freedom, danger, and warning. Both symbolic and indexical signs can represent abstract concepts and can serve as an effective means of communication. In this case, the relationship between the signifier and signified is to some degree arbitrary/conventional, which can limit the efficacy of the communication as it requires the meaning to be known beforehand.

The trajectory of communication can be thought of as how a message moves from one entity to another. The basic trajectory is that an addresser encodes a message which is decoded by an addressee. The code that is used in the transfer of the message could be the language, a set of conventions, traditions, or norms, to name a few. The code must also be understood by both the

addresser and the addressee for successful communication of the message. Hall, (2012) lists the trajectory of communication as having eight key semiotic concepts as messages travel from sender to receiver, and possibly back again.

1. The first concept is the **sender or addresser**. The former is a real person that transmits the messages while the latter is the persona that the message says it is from.

2. Next is the **intention** of the communication, what the sender aims to achieve with the message.

3. The **message** is concerned with what the sender is trying to say.

4. The **transmission** of the message concerns itself with the medium or channel through which the message is carried from sender to receiver.

5. The **noise** involved in a communication is the potential interference that occurs to a message while it is being transmitted, which can change the nature of the message.

6. The **receiver** (the actual person who gets the message) or **addressee** (the person who is said to be the target of the message) then obtains the message.

7. When a message has been interpreted, it has reached its **destination** or the endpoint of its journey. The message that reaches the destination, however, is not necessarily the same message that has been sent.

8. **Feedback** mechanisms exist so that receivers can be corrected if it appears that they have received the message in the incorrect form, allowing the receiver to adjust their response to the message.

Semiotics and health, safety, and environment

Effective communication is a sought-after non-technical skill in the HSE function and as communication between all levels of an organization is fundamental in achieving safety objectives (Hughes and Ferrett, 2016). While different communication channels are used to communicate HSE matters, many organizations utilize posters, videos, and/or signage containing images to convey information.

As seen in the previous section, communication through images can be difficult. To counteract these difficulties there has been a push globally to standardize the visuals used in hazard communication with the development and deployment of standards such as ISO 7000:2019 and ISO 7010:2019 as well as the Globally Harmonized System of Classification and Labelling of Chemicals (GHS). One objective of the GHS is to harmonize hazard communication elements, including requirements for labelling and safety data sheets (United Nations, 2019). ISO 7000:2019 provides a collection of graphical symbols which are used to instruct the operator of equipment as to its operation, while ISO 7010:2019 prescribes safety signs for the purposes of accident prevention, fire protection, health hazard information, and emergency evacuation. These visuals are still conventional and an understanding of them beforehand is needed for them to be effective, which is usually addressed during training and/or induction of workers. It can be said that the purpose of these visuals is to impart HSE information.

While the aforementioned standards cover a wide variety of topics, a large number of HSE communications use bespoke visuals. These bespoke visuals are plagued by the same issues affecting the visuals from the standards, but have the additional problem that the conventions are not communicated through training and/or induction.

Posters can be used to impart either HSE information or HSE propaganda (Hughes and Ferrett, 2016) and can use combinations of standardized and bespoke images. Dekker (2019) questions the use of posters in an HSE setting, stating, 'the safety-scientific literature still offered no empirical study or data to prove the efficacy of such posters or of the moral-behavioural appeals on them' (Dekker, 2019, p. 101). Saari (1998) reiterates this sentiment, observing that a poster campaign had very little behavioural effect. However, the authors also found that peoples' opinions about the campaigns were very positive. While the authors did not believe the value of a poster campaign lay in its direct effect on injuries, they stated that its most valuable effect may be in preparing for other HSE interventions (Saari, 1998).

Advantages and disadvantages of using images

There are many benefits to using images in communications, but the most compelling is the multimedia principle – people learn more deeply from words and graphics than from words or graphics alone (Clark and Mayer, 2016). When visuals are used to impart information, the evidence tends to suggest that simple visuals are better than complex visuals (*e.g.* a 2D line drawing vs a 3D drawing), but there is the exception where learning can be improved by using a modest level of emotional design focused on relevant visuals (Clark and Mayer, 2016). Sell (1977) outlined the requirements for HSE posters to be effective. These include that posters should deal with topics over which the audience has control, and should be specific to a task or situation. Additionally, HSE posters should not involve horror or be negative in nature. Brookes and Harvey (2015) also question the use of 'scare tactics' in public health campaigns. Posters can become out-of-date fairly quickly and become largely ignored if not changed frequently (Hughes and Ferrett, 2016).

There are also many dangers involved in using images in communications. Extraneous images can be distracting and disruptive to learning (Clark and Mayer, 2016). Cultural and lingual contexts are also factors in the understanding of signage, and given the multicultural and multilingual South African context, the design of signage/posters should preferably be as culturally unbiased as possible (Nicol and Tuomi, 2007). The use of metaphor in HSE propaganda can be a risky gambit. A well-understood metaphor can be immensely powerful, but a misused metaphor has the potential to cause great harm. Military metaphors contribute to the stigmatizing of illnesses, and consequently of those who suffer from the illnesses (Sontag, 1989). This is of particular relevance during this time of the COVID-19 global pandemic.

The semiotics of mining in South Africa

Inequality and mining have been inextricably linked in South African history. Support and implementation of discriminatory policies brought about inequalities in all avenues of South Africa society, but in the mining industry in particular. This linkage between South Africa's apartheid and colonial past and the statues, monuments, cartoons, and artworks related to mining is a prominent one. This linkage means that the mining sector is frequently represented as exploitive, unjust, unsafe, and unethical. Examples of such representations are seen in the works of Sam Nhlengethwa, Gerard Sekoto, William Kentridge, Jonathan Shapiro, and others. This perception of the mining industry is problematic for internal communication promoting safety and justice.

The role of semiotics in health, safety, and environment communication in South African mining

Mining-related advertising in the mainstream media focuses on machinery, landscapes, and staged photographs depicting a representation of work. Key visual references in mining currently are high-visibility vests, hard hats, work boots, and other personal protective equipment and are mostly represented by males.

Methodology

Fifteen topics in total were chosen for study (five health, five safety, and five environmental topics). For each of these topics, the intention of the designs was decided. Each topic also required a design containing an icon and text, a symbol and text, an index and text, and a design containing text only. The illustration style was standardized across all designs. Reference images for the illustrations were sourced from popular internet search engines. The text used was consistent for each of the topics addressed. No colour, branding, or slogans were used in the designs. The Helvetica font was chosen as it is considered a neutral font (Braun, Silver, and Stock, 1992). All these restrictions were put in place to minimize the influence of factors other than that of the designs themselves. The design concepts included a blend of safety propaganda, instructional, and educational tactics.

The posters were collated into a survey which was administered digitally only. The restrictions of movement due to the COVID-19 global pandemic made face-to-face interviews and paper-based surveys impossible. The respondents were grouped into academics, HSE professionals, workers in the mining sector, workers who supply the mining sector, other high-risk working environments, design/creative fields, and 'other'. Respondents were asked to select the design that best communicated the intention, as well as answer additional qualitative questions (using the five-point Likert scale). Surveys that were partially completed were disregarded.

Results and discussion

The group most represented in the survey was the design/creative fields (24.75%), followed by 'other' (23.76%), workers in the mining sector (16.83%), and workers who support the mining sector (12.87%). Academics (8.91%), HSE professionals (7.92%), and other high-risk working environments (4.95%) were the least represented. The total number of respondents was 101, and 63.38% of those had received some form of HSE training before.

Overall, the index option was the most selected (53.53%) followed by the icon option (26.86%), the symbol option (17.43%), and the text-only option (2.18%) (see Figure 1). The text-only option represented no more than 10% of the choices in any individual question, and was not chosen in 6 of the 15 questions. This evidence shows overwhelmingly that text-only communication is the least preferred form of communication with the respondents.

While selections in most topics (10 out of 15) followed the index-icon-symbol-text order, there were a few exceptions. In the 'HIV/AIDS' topic (Figure 2), the icon option had slightly more selections than the index option. This is thought to be because of the sexual nature of the index option which could have pushed respondents to select the icon option, which is a mainstream image relating to the topic.

The icon option for the 'wellness' topic was overwhelmingly chosen (Figure 3). This is possibly due to the instructional nature of the image, which linked action and intention. The niche topic

fall of ground', seen in Figure 4, had a relatively high selection of the symbol option. This variance from the norm could be attributable to the topic not being relatable to many respondents, being only relevant to underground mining, coupled with the prevalence of this type of image in popular culture.

Regarding 'biodiversity' and 'protecting endangered animals', the symbol option was substantially more preferred, with the index then icon options following and the text option again the least preferred (Figures 5 and 6). This is an instance of a
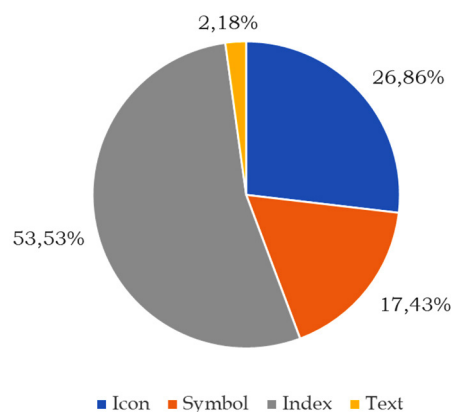

Figure 1—Percentage selection by image mode - all respondents
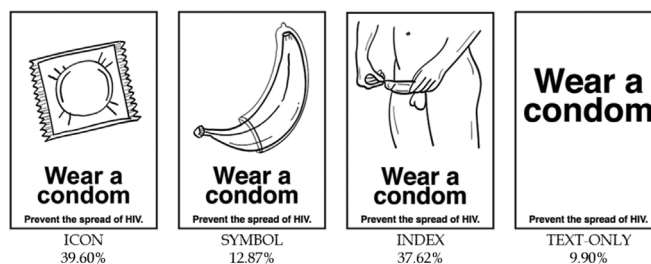

Figure 2—Images, image mode, and percentage selection for all respondents. Images are trying to communicate that wearing a condom prevents the spread of HIV
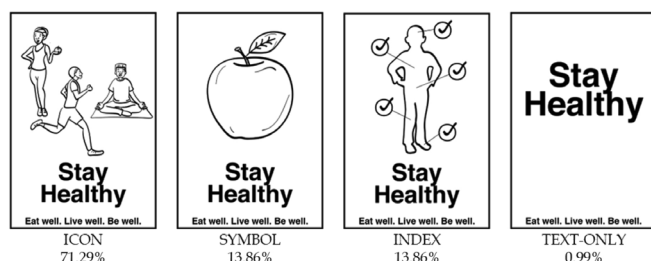

Figure 3—Images, image mode, and percentage selection for all respondents. Images are trying to communicate promoting wellness
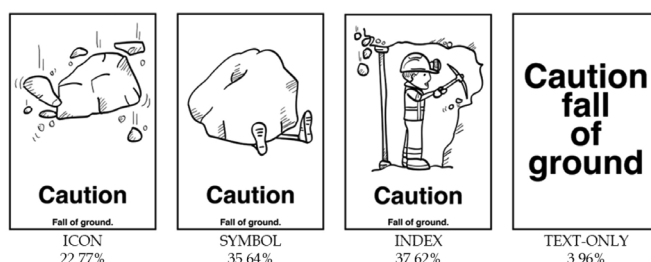

Figure 4—Images, image mode, and percentage selection for all respondents. Images are trying to communicate warning about fall of ground

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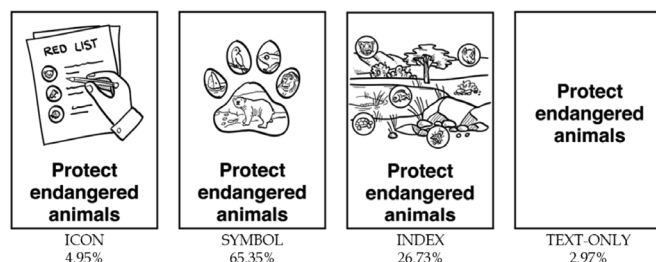

Figure 5—Images, image mode, and percentage selection for all respondents. Images are trying to communicate the concept of protecting endangered animals
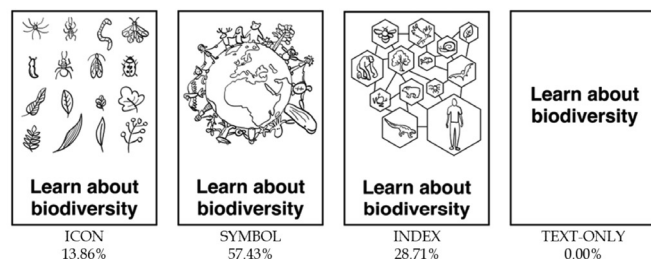

Figure 6—Images, image mode, and percentage selection for all respondents. Images are trying to communicate biodiversity

symbolic image transmitting the intended message well. It is presumed that this is due to respondents having prior exposure to similar images or an understanding of the metaphors embedded in the images.

The design/creative-HSE professional-worker in the mining sector triad is of particular interest as the views of these three groups embody the conceptualization, creation, and reception cycle of visual communications. The design/creative group consistently chose the symbolic images more than the HSE professionals or workers in the mining sector (in 11 out of 15 topics). Symbolic images were selected in slightly more topics by workers in the mining sector (5 out of 15) than HSE professionals (4 out of 15). HSE professionals never chose the text option, while the other two groups chose the text-only option infrequently. No discernible trend was apparent in the selection of the iconic and indexical images when comparing within the triad.

Other questions regarding the respondent's opinions on HSE communications and mining were also posed. Again, the focus is on the design/creative-HSE professional-worker in the mining sector triad. While both HSE professionals and workers in the mining sector generally disagreed with the statement that HSE communication is a boring topic, the design/creative group was more sceptical, with just over a third either strongly agreeing or agreeing with the statement. This view of HSE communications is important as disinterest could lead to the creation of visuals which lack the intended impact. This sentiment is mirrored in the responses to the question asking if HSE communication was a creative topic. HSE professionals and workers in the mining sector generally agreed with the statement, while slightly under a third of the design/creative respondents disagreed. All respondents within the triad agreed that HSE communications ranged from 'somewhat important' to 'extremely important'.

Most of the triad (88%) believed that mining was a dangerous work environment. A majority of HSE professionals and workers in the mining sector had positive or very positive feelings towards the mining sector (see Figure 7). The design/

creative groups had negative, neutral, and positive feelings (20%, 52%, and 24% respectively).

Just under half (46%) of the triad agreed or strongly agreed with the statement that HSE communications is a complex topic, and 46% disagreed or strongly disagreed, with the remainder neither agreeing nor disagreeing (see Figure 8). In the design/creative group, 64% perceived HSE communications as a complex topic. This could be due to the lack of familiarity with the subject matter of HSE communications. The HSE professional group was split 37.5% (agree) to 62.5% (disagree) as to whether it is a complex topic, and worker in the mining sector groups were split 23.53% to 70.59% in the same manner.

This split raises some interesting points. Firstly, the groups that conceptualize and create HSE communications, that is the design/creative and the HSE professionals, disagree on the complexity of HSE communications. These two groups frequently work together, and the discordant perceptions could lead to difficulties in creating visual communications that are consistent with the intention. Secondly, given that a high proportion of HSE professionals believe that HSE communication is not a complex topic, it is possible that these HSE professionals are not adequately considering or testing the semiotics of their visual communications, which could lead to a divergence between the intention of the message and its reception. Lastly, workers in the mining sector also perceive the topic of HSE communications as not complex. This could have troublesome implications. The first of these implications is that these workers could move into an HSE role and carry with them this perception, leading to similar problems as discussed previously. The second implication is that it could lead to a lack of critical thinking about HSE communications, limiting the amount and/or quality of feedback
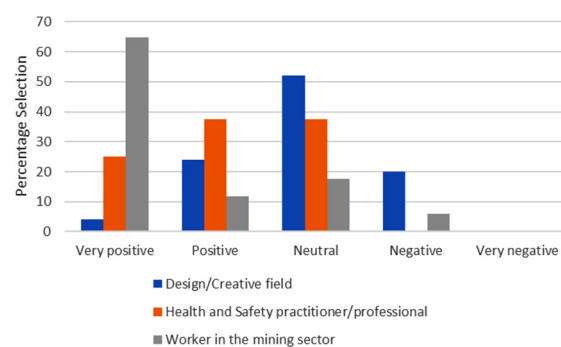

Figure 7—Response of design/creative-HSE professional-worker in the mining sector triad when asked what their feelings are toward the mining sector
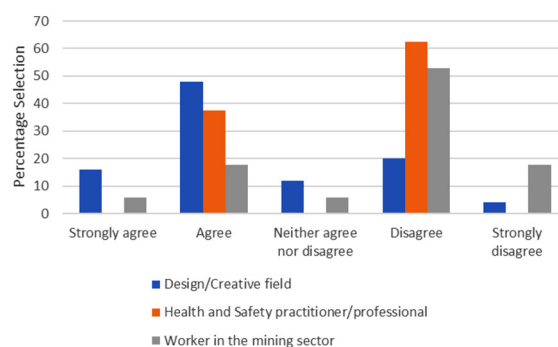

Figure 8—Response of design/creative-HSE professional-worker in the mining sector triad to the question 'Do you agree or disagree with the following statement, 'Health and safety communication is a complex topic?'

to those that conceptualize and create. This makes it difficult to verify that the received message matches the intended message.

Conclusion and recommendation

This study seeks to address the role of semiotics in HSE communications in the South African mining community. While the study aimed to gather the opinions of a diverse collection of respondents, we believe that HSE professionals were underrepresented. Future research should, therefore, seek to represent the HSE professional more thoroughly. It is accepted that there are other factors which influence the efficacy of HSE communications, such as level of literacy, cultural background, and language. These should be included in future studies on the role of semiotics.

The results emphatically show that text-only images are the least preferred mode and should be avoided where possible. Overall, indexical images outperformed other image modes, but there were a few instances where the symbolic image was preferred. This is attributed to the effective use of metaphor within the image; however, care should be taken when using this image mode. The design/creative-HSE professional-worker in the mining sector triad was the focus of this study as it represents the conceptualization, creation, and reception cycle of visual communications. Perceptions as to whether HSE communications are complex or not were of particular interest. The groups within the triad differed in this opinion, which could lead to practical difficulties in creating visual HSE communications.

References

BRAUN, C.C., SILVER, N.C., and STOCK, B.R. 1992. Likelihood of reading warnings: The effect of fonts and font sizes. *Proceedings of the Human Factors Society Annual Meeting*, vol. 36, no. 13. pp. 926–930. https://journals.sagepub.com/doi/abs/10.1177/154193129203601301

BROOKES, G. and HARVEY, K. 2015. Peddling a semiotics of fear: A critical examination of scare tactics and commercial strategies in public health promotion. *Social Semiotics*, vol. 25, no. 1. pp. 57–80.

CHANDLER, D. 2007. Semiotics: The Basics. Taylor & Francis, New York.

CLARK, R.C. and MAYER, R.E. 2016. E-learning and the Science of Instruction: Proven Guidelines for Consumers and Designers of Multimedia Learning. Wiley, Hoboken, NJ.

DEKKER, S. 2019. Foundations of Safety Science: A Century of Understanding Accidents and Disasters. CRC Press, Boca Raton, FL.

DEPARTMENT OF MINERAL RESOURCES. 2020. Minister Gwede Mantashe: 2019 Mine Health and Safety Statistics [Press release, 24 January 2020]. https://www.gov.za/speeches/2019-mine-heatlh-and-safety-statistics-24-jan-2020-0000

GULDENMUND, F. 2000. The nature of safety culture: A review of theory and research. *Safety Science*, vol. 34, no. 1–3. pp.215–257.

HALL, S. 1997. The work of representation. *Representation: Cultural Representations and Signifying Practices*, vol. 2. pp. 13–74.

HALL, S. 2012. This Means This, This Means That: a User's Guide to Semiotics. Laurence King, London.

HUGHES, P. and FERRETT, E. 2016. Introduction to Health and Safety at Work: For the NEBOSH National General Certificate in Occupational Health and Safety. Routledge, New York.

NICOL, A. and TUOMI, S. 2007. Hazard sign comprehension among illiterate adults. *Stellenbosch Papers in Linguistics*, vol. 37. pp.67–88.

SAARI, J. 1998. Safety interventions: International perspectives. *Occupational Injury: Risk, Prevention and Intervention*. Feyer, M. and Williamson, A. (eds). Taylor & Francis, London. pp. 179–195.

SCHEIN, E.H. 2010. Organizational Culture and Leadership. Wiley, Hoboken, NJ.

SELL, R.G. 1977. What does safety propaganda do for safety? A review. *Applied Ergonomics*, vol. 8, no. 4. pp. 203–214.

SONTAG, S. 1989. AIDS and its Metaphors. Macmillan, New York.

SOUTH AFRICA. 1996. Mine Health and Safety Act of 1996. *Government Gazette*, vol. 527, no. 32226, 12 May 2009, as amended.

UNITED NATIONS. 2019. Globally Harmonized System of Classification and Labelling of Chemicals. New York. https://unece.org/ghs-rev8-2019 ◆