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HAZARD PERCEPTION AND REPORTING

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Reporting of hazards is a key aspect of safety management in industry, but relatively little empirical investigation of reporting has been undertaken. This research reports on an investigation that was carried out in the Science gallery at Trinity College Dublin to explore the detection and reporting of hazards by members of the public. Three simulated hazards were developed and placed around the risk lab. The experiment was designed to assess the capacity to recall recognise and report hazards of the participants by means of an exit survey. Participants performed better at recognition than recollection with no actual reporting of hazards recorded. The results validated some of the findings suggested by the literature and can assist in the development of a new experimental methodology as training within organizations to improve awareness of hazards and reporting practices.

Introduction

Across many industries there is now a requirement for the implementation of a Safety Management System (SMS) including proactive risk assessment (Leveson 2011). For example, within the aerospace industry there is the European policy for aeronautical repair stations (EASA 145) which specifies a requirement for collecting proactive information on risks and hazards as they are encountered within the life cycle of the organisation (Pérezgonzález, McDonald, & Smith, 2005). A reporting system is an effective way of addressing these requirements and collecting information on hazards from the workforce. Many reporting approaches use reports submitted from the "shop floor" as one of the inputs on risk and hazards that will be managed by the SMS. There has been significant literature on the factors that can influence the level of reporting within the organisation from the design of the data collection forms, to the procedure, to cultural considerations of the SMS system (Johnson, 2003; Leveson, 2011). However, before reporting a hazard, the reporter has to successfully notice and identify the hazard. The literature in the area to date has not investigated this aspect of reporting. The study reported here took advantage of an exhibition called the "Risk Lab" in the Science Gallery in Trinity College Dublin to explore the rate at which the general public will notice, identify and report hazards. Although outside an industrial setting, the hazards used in the study represented a clear and recognisable danger to the public.

Existing efforts to stimulate hazard reporting within Industry

Several studies have looked at developing a proactive approach to risk management; a recent example can be found in Leva, et al. (2010) where a proactive "daily journal" was developed and implemented in a small Italian regional airport. The new methodology rolled out was a web-based tool consisting of an anomaly log that should be completed by ground staff after each aircraft "turnaround". The anomaly log, while providing immediate benefits to the ground staff by assisting in the shift handover procedures, also collects proactive data on anomalies that are encountered during each turnaround allowing these anomalies to be captured immediately after they occur (Leva, Mcdonald, et al., 2010). Literature such as Wiegmann & von Thaden, (2003) highlight the importance of collecting data on anomalies and incidents immediately after the actual occurrence of an incident. Leveson, (2011) highlights the importance of designing a suitable reporting form to allow the reporters to provide the information they want to provide without being an extra burden into their day-to-day workload. Reporting approaches that are cumbersome or add more paperwork to already overburdened staff can act as a barrier to reporting. Furthermore, the reporting system should be designed with the objective of delivering benefits to the day-to-day operations of the staff expected to use them (Kongsvik, Fenstad, & Wendelborg, 2012; Leva, Cahill, Kay, Losa, & McDonald, 2010)Therefore, communication and training about the benefits of the reporting system should also be provided to the staff. Industrial initiatives in this area all rely on staff seeing hazards, and then reporting them into some form of a system. The majority of the research so far has been on the procedure behind compiling a reporting form and its follow up and considerable effort is made to raise the awareness of hazards through, for example, posters or training, with the assumption that these will increase the detection and reporting of hazards. However there is a crucial question before this process can begin: Are the reporters able to notice and identify all relevant hazards?

From Hazard detection to reporting

This paper assumes that there are four steps in a reporting process: 1) witnessing a hazardous scenario, 2) identification of the scenario as hazardous, 3) risk assessment of the scenario, and 4) reporting. First, the individual needs to pay attention to the visual/auditory/olfactory/tactile stimuli that represent the hazard. There are several factors that could influence this process ranging from the salience of the hazard to the "unexpectedness". Wogalter et al. (1999) suggest that hazard perception is affected by the likelihood of the hazard introducing a risk of injury to the reporter. There are also environmental considerations to be taken into account: a busy loud environment can make some hazards harder to distinguish from the background noise. Personal experience has been found to have a significant role in hazard detection. There have been studies on the hazard perception habits of new drivers (Deery, 1999) that show how inexperienced drivers will treat all hazards with a similar priority, while more experienced drivers will tend to assess hazards more proactively and prioritize

them accordingly (Wiegmann & von Thaden, 2003). (Deery, 1999), in a study of hazard perception with regards to driving age, found that age groups are non-homogenous with regards to the level of risk perception and factors such as personality and task attitude can have a significant influence on how an individual perceives a hazard.

Second, scenarios have to be sufficiently processed by the individual to be identified as hazardous. This study explores the level to which hazards are processed by asking participants to recall hazards. This was explored in two ways using a computer-based survey at the end of the exhibition. Participants were first asked to recall and note any hazards they had seen during the exhibition. They were then presented with a set of "hazards" on the computer screen, some of which had been present during the exhibition and some which were not, to investigate if participants can recognize hazards that they may not have identified and recalled in the first place. The study draws on the levels of processing theory, which posits that the more cognitive processing are applied to stimuli the more readily accessible they will be (Craik & Lockhart, 1972). The hazard recall (i.e. being able to remember the hazard unprompted) is taken as an index of a deeper level of processing than recognition.

Third, the hazard needs to be assessed as being of significant risk to be worthy of reporting, and then, fourth, reported. Steps three and four were measured together in terms of whether or not the hazards were reported.

The objectives of the study were to:

1. Examine the levels of reporting of reporting hazards from the general population
2. Examine the difference between levels of recall and recollection of hazards from the general populations

Method

Design
The investigation consisted of three hazards that varied in salience, size and "unexpectedness" located within the science gallery. Participants explored the Science Gallery exhibit where the hazards were located; however the hazards were not the focus of the exhibition. They were part of the environment as would be expected within an industrial setting.

Reporting, recall and recognition were assessed by exit survey as participants were leaving the gallery. Recall was measured by means of a free text box that asked participants to report hazards that they had encountered in the risk lab. Then they were asked if they had reported any of these hazards to the Gallery staff (Reporting). Subsequently they were presented with pictures of the hazards and asked if they had seen that specific hazard during their visit (Recognition).

False hazards, which were not present in the gallery, were included in this section to ensure genuine recognition was being measured.

Participants

The investigation was hosted within the "Risk Lab" exhibition at the "Science Gallery" at Trinity College Dublin, which was a free exhibition open to the public. 153 participants completed the exit survey, with a mean age of 26.6 years and a range of 37 years.

Equipment and Materials

A professional prop company produced three realistic (but not hazardous) hazards for the experiment. The three hazards were: a leaking chemical cupboard, a faulty switchbox and a leaking pipe. The "hazards" were placed around the risk lab exhibition before it was open to the public. The fuse box was placed near the entrance lobby, the pipe was placed in a busy corridor and the chemical cupboard was placed at the top of the main staircase in the exhibition.

Figure 1 Switchbox

Figure 1 is the switchbox hazard used. As shown there is an inadequately secured panel on the side of the unit, several "tripped" circuit breakers and there was a device installed that simulated a blue light and sounds indicating electrical arcing occurring. The unit was designed to look as if it belonged in the science gallery owing to electrical piping joining the real piping in the environment.

Figure 2 Chemical Cupboard

The second hazard was the chemical cupboard shown in Figure 2. This consisted of a cupboard with a "staff only" sign, an open lock with the key left in, several containers with evident hazardous substance symbols being visible and a simulated leak onto the floor.

Figure 3 Leaking Pipe

The final hazard was a leaking pipe (shown in Figure 3). The pipe was placed beside identical real pipes, and held a pressure gauge showing a pressure reading in the red area and making occasional hissing noises.

Data Collection

The participants were asked to complete a short (approx. 1 min) survey before leaving the exhibition; the survey was hosted on an apple iPad running Survey Gizmo software.

Results

Figure 4 shows the results for the study in terms of hazard recall, recognition, and reporting rates to exhibition staff. The chemical cupboard had the highest rates of recognition, recall and was the only hazard that was reported to staff. 51% of participants could recall having seen this hazard, as compared to 37% for

the fusebox and 0% for the pipe. Recall rates for both the chemical cupboard and fusebox were lower than recognition rates, as would be expected. In total, only three people (approx. 2%) reported any hazard to the exhibition staff.
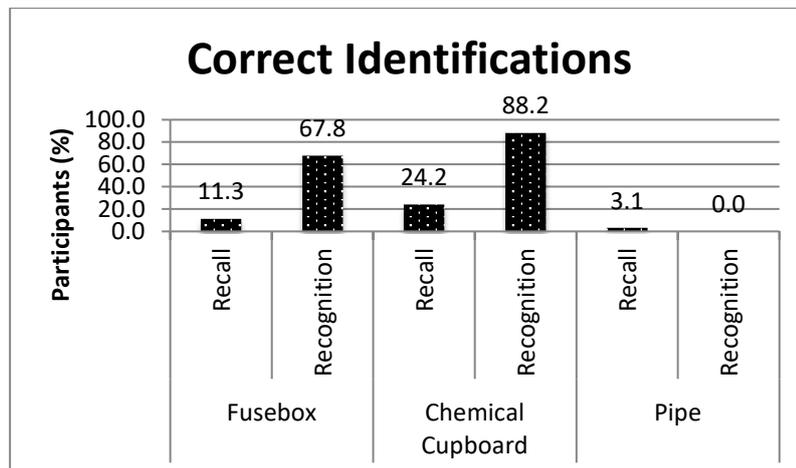
Correct Identifications

A bar chart titled "Correct Identifications" with y-axis "Participants (%)" ranging from 0.0 to 100.0. The bars show: Fusebox Recall 11.3, Fusebox Recognition 67.8, Chemical Cupboard Recall 24.2, Chemical Cupboard Recognition 88.2, Pipe Recall 3.1, Pipe Recognition 0.0.

Figure 4 Frequency of Recall and Recognition

Discussion

The objective of this study was to investigate the levels of reporting, recall and recognition of hazards by participants in the general population. Each of these will be discussed in this section.

In the exit survey, participants were first asked to recall any hazards they had encountered during their visit. 33% of participants were able to recall a hazard from their time in the exhibition, suggesting that they had both witnessed the scenario and identified it as hazardous (steps 1 and 2 of a reporting process). Further, 51% of participants recognized the chemical cupboard hazard when presented with it, showing that they had witnessed the hazard (step 1) but had not necessarily identified it as hazardous (step 2). However, only three participants went on to report the hazard, suggesting that steps 3 and 4 of the reporting process were a blocker to reporting in this study.

The main result from this study is the extremely low reporting of hazards to the exhibition staff. Of 153 participants who completed the exit survey, and the several hundred overall visitors to the exhibition, only three proactively reported a hazard. The participants may not have noticed the hazard to begin with (i.e. they did not witness a hazard). However, the recognition data shows that this was not the case for a large section of the participants. Secondly, the participants may not have identified that hazard, but again the recall data shows that this was not the case for a substantial section of the group. The data appears to show

unwillingness among the participants to proactively report hazards and a "filtering" of hazards through perceptual, cognitive and social processes. The hazards could be seen/heard by participants but were not identified as hazards until presented as such. Hazards were recalled that were not reported. As discussed earlier in the paper, a number of reasons are outlined in the literature to explain poor reporting. Wogalter et al (1999) suggested that the likelihood of injury may drive reporting and in this experiment the exhibition environment may have been perceived as a 'safe' area, meaning that participants did not expect to be injured during their visit. The literature also suggests that unexpected hazards are more likely to be reported than expected hazards which explains why the chemical cupboard was reported the highest as the fuse box and the pipe are features one would expect to find in this environment. The environment may also influence reporting; in this case, the busy and noisy environment of the Science Gallery may have reducing the ability of participants to notice the hazards, particularly the pipe which make a hissing noise but may not have been sufficiently loud to overcome background noise. The other exhibitions around the hazards were specifically designed to engage visitors and may have reduced their attention to their environment.

The study was limited by the lack of control over the sample that was drawn from the general public meaning there may have been a mix of people from backgrounds with different levels of risk and hazard awareness. However, the size of the sample should provide some balance for this. The study also lacked control over the experimental conditions with varying levels of noise and busyness as well as a lack of ability to monitor participants during their visit. Future studies may replicate the experiment in a more controlled, industrial environment to collect results in a setting with higher face validity.

The outcomes of this investigation provide lessons for the process of risk reporting within industry. In particular, the suggestion that a 'safe' environment generates less reports is also applicable in an industrial context and reinforces the messages from Safety Culture research around engaging staff and taking personal responsibility for safety, not expecting safety to be provided for them. Secondly, busy or noisy environments containing highly engaging activities may also reduce reporting as individuals focus on the specific aspect of the environment of interest. Staff within an organization will have to be more engaged and trained on hazard perception if good quality data is to be derived from a reporting system as the results are suggesting staff needs to be made aware of hazards and be involved in actively assessing them themselves if they are expected to remember and recall the hazards accurately. There is scope to use this experimental methodology as training within organizations to improve awareness of hazards and reporting practices. Furthermore there may be benefits to study possible alternatives in the actual physical methods of reporting to see which method may produce the best reports.

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