Use of spot the difference puzzles as a measure of occupational safety orientation

---

A dissertation submitted in partial fulfilment of the requirements

for the

Degree of

Master of Science in Applied Psychology

at the

University of Canterbury

by

Elizabeth Shaw

2013

Research Supervisors: Associate Professor Christopher Burt, University of Canterbury

Dr Katharina Näswall, University of Canterbury

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Acknowledgments

I would like to thank my research supervisor Chris Burt for his ongoing support, time and guidance throughout this project. Without his patience and encouragement, this project would not have been achievable. I would also like to thank my secondary supervisor Dr. Katharina Näswall for her support, feedback and guidance.

Thanks also must go to my father, Gary Shaw, who organized the participants for the project. His organisation and assistance throughout the project has been invaluable.

I would like to thank Fletcher Construction for allowing their employees and contractors to participate in the project.

Finally, I would like to thank my APSY classmates for all the late nights, support and laughter over the past two years.

Abstract

Assessment of employee's or job applicant's occupational safety is typically limited to the use of self-report safety scales, and/or examining their accident history. The present study investigated whether a series of spot the difference puzzles could be used as a valid measure of an employee's safety orientation. The validation of the spot the difference puzzle tool was conducted on a working sample from a construction company. The first task-required employees to complete a series of ten spot the difference puzzles containing five neutral and five safety differences. Measures of a number of safety constructs, and accident history ratings were then taken from both employees and their supervisors. Supervisors were to rate each of their employee's on a series of the safety constructs and past accident frequencies, while employees completed these same measures using a self-report scale. Results from employee and supervisor safety measures were then correlated with scores from the spot the difference puzzles. The primary aim of the research was to validate the use of the spot the difference puzzles in measuring a job applicant's safety orientation during recruitment. Forty employees, and four supervisors holding a range of construction based jobs participated in the study. Results confirmed that a subset of five of the puzzles produced significant relationships with measures of an employee's safety knowledge, motivation and co-worker caring. In addition, results found that safety knowledge and motivation produced significant relationships with measures of employee accident history. With many current measures of safety being effected by biases, such as social desirability, memory recall and impression management, this subset of puzzles may provide organisations with an objective and unbiased tool to measure safety orientation during recruitment.

Introduction

Overview

This study investigated the relationship between existing measures of occupational safety and a newly developed measure of safety orientation. Assessment of employee's or job applicant's occupational safety is typically limited to the use of self-report safety scales. Self-report scales often take a measure of an applicant's safety compliance, participation, rule obedience, motivation and attitudes. However, several response biases, such as impression management or social desirability, often limit the validity of these measures. An alternative measure organisations may employ in predicting an applicant's future safety performance involves an assessment of previous accident history. Specifically, this requires the applicant to recall the number of accidents/incidents in which they have been involved within their time working in a specific industry. Yet data on applicant's previous accident history are inherently inclusive of limitations, information may be limited by memory issues such as recall biases. In addition, accident history has no practical value in assessing applicants who are beginning their very first job. The new safety measure developed for the purposes of this study uses a series of 'spot the difference' puzzles. Each of the puzzles consists of five safety based differences and five neutral based differences. The measure provides an objectively scorable tool, which can be used as a measure of safety orientation. It is hoped that this measure may be less susceptible to biases such as social desirability and impression management.

New Zealand and International Labour Accident Statistics

According to the New Zealand Department of Labour (2012), occupational accidents were responsible for 85 deaths and 445 serious, non-fatal injuries in New Zealand within the 12-month period ending June 2011. Despite this, the cost of human lives due to workplace safety is not limited to New Zealand workplaces.

Occupational fatalities, accidents are a global issue. The International Labour Office (ILO) reports that 1.7 million workers die worldwide each year as a result of workplace accidents. The ILO breaks this figure down, reporting that 5000 men and women lose their lives each day at their place of work (International Labour Office, n.d). What is more concerning, is that the ILO suggests this figure is vastly underreported, with an alarming number of workplaces ignoring practices surrounding accident reporting. Probst and Estrada (2009) found that for every accident reported to management, an average of 2.48 accidents go unreported. Statistics as such have prompted fundamental efforts to be made in the development of legislation and regulations surrounding workplace health and safety (Macky & Johnson, 2003).

The cost of human lives is evident through statistics reported both nationally and globally. However, occupational accidents also result in significant economic costs (Quilan, Bohle, & Lamm, 2010). Figures from New Zealand's Accident Compensation Corporation (ACC) showed that half a billion dollars was paid out for 209,700 work related injury claims, for the year ending June 2011. On average, these figures equate to two million workers being absent for at least one day of work per year (New Zealand Department of Labour, 2012). Hofmann, Morgeson and Gerras, (2003) outline this compensation cost is a small part of the expense in losing an employee to a workplace accident. The authors suggests that the expense for organisations involved in finding replacement staff and training those replacement staff on how to perform the job, is even more significant. Moreover, suggestions have been made that employees absent due to workplace accidents or injuries will not only affect the productivity of the organisation, but the profitability also (Hofmann, et al., 2003).

Health and Safety Legislation

Various pieces of legislation have been introduced in response to the growing interest and literature surrounding workplace health and safety. For example the New Zealand Health and Safety Employment Act (HSEA) (1992) was amended substantially in 2002. The introduction of this Act saw a drive in the prevention of both workplace accidents and proactive safety measures within organisations. The Act was designed with the primary objective to 'promote the prevention of harm to people in, or within the vicinity of the workplace', with a focus on the efficient management of health and safety maintaining safe work environments while implementing sound practice. The regulations within the New Zealand HSEA (1992) apply to all workplaces, employees, employers, principals and any others in positions to regulate or manage hazards (Ministry of Business Innovation and Employment, n.d). However, the legal perspective surrounding occupational health and safety has altered within New Zealand over the past decade. Figure 1 represents a time line of the major occupational health and safety movements within New Zealand.

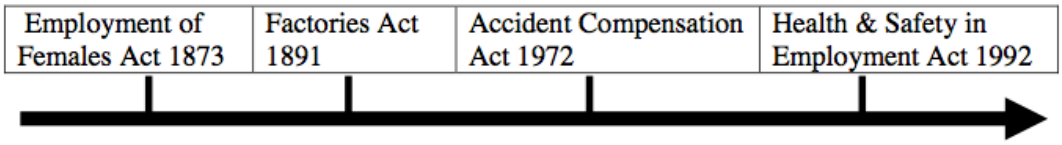

Figure 1. Time-line of Major Occupational Health and Safety Legislation within New Zealand, (Lamm, 2009)

Within New Zealand safety regulations have altered from a self-regulatory approach to a highly prescriptive approach. Currently the New Zealand HSEA (1992) is a co-regulatory approach that sits between the two extremes. This approach requires managers to take more responsibility for the control of hazards within their work environment.

The New Zealand Government lists Construction, Agriculture, Forestry, Fishing and Manufacturing as the five primary sectors responsible for the majority of

workplace accidents (New Zealand Department of Labour, 2012). To match the growing emphasis on occupational health and safety as seen in the New Zealand HSEA alteration, the government has recently implemented an action plan. The New Zealand 'Action Agenda' has been put in place, primarily to target safety procedures in these five priority sectors. Efforts are currently focused towards enhancing safety leadership, develop capability of workers, building safety knowledge, and supporting a robust health and safety system. These specific actions are being put in place to reduce the toll of workplace injuries, disease and fatalities within New Zealand (New Zealand Department of Labour, 2012). Additionally, the New Zealand Government has taken steps in implementing interventions with regards to the HSEA (1992). Inventions have focused on the distribution of infringement notices, and compliance orders, as well as the enforcement of prosecution for non-compliance. Enforcement of these interventions depends on the seriousness, repetition, remedial action and potential harm to others as an effect of the non-compliance (New Zealand Department of Labour, 2012).

The development of workplace health and safety legislation is not unique to New Zealand. The United States created the Occupational Safety and Health Act (1970) to ensure that organisations and their employees conduct work safely. This Act sought to provide workers with an environment free from excessive noise, mechanical dangers, heat or cold stress, and exposure to toxins or unsanitary conditions (United States Environmental Protection Agency, 2012). In addition to this Act, the United States Congress created a National Institute for Occupational Safety and Health as a research establishment for the Department of Labor. This research institute ensures that safety and health regulations are enforced across all 50 states within the US. Globally, legislation has succeeded in reducing the number of injuries and accidents that occur within the workplace. In the United States, fatal work injuries within the

construction saw a 7% decrease from 774 in 2010 to 721 in 2011 (United States department of Labor, 2012). Similarly, New Zealand workplace injury claims in the construction industry declined from 23,900 in 2010, to 21,300 in 2011 (New Zealand Department of Labour, 2012).

In recent years, Health and Safety regulation Acts, including the New Zealand HSEA (1991) have shifted their focus. Previously, legislation had focused on safety equipment, policies and programs within organisations (Didla, Flin & Mearns, 2010). However the direction of health and safety has now swung to a more individual and behavioural approach. Here focus is on the employee's attitudes, behaviours and actions, identifying risks and governing behaviours (Specht, Chevreau & Denis-Remis. 2006). Understanding these actions, behaviours and attitudes is essential in ensuring organisations can work proactively towards workplace safety. This proactive approach to is said to be driven by human, managerial factors, and understanding the cause of workplace accidents as opposed to technical failures (Flin, Mearns, O'Connor & Bryden, 2000).

Health and Safety in the Workplace

Workplace health and safety is of critical importance to organisations and their employees. Neal and Griffin (2002) discuss the consequences of unsafe behaviours as 'a major concern for organisations, being the source of substantial direct and indirect costs'. Occupational health and safety encompasses all aspects of work in environments ranging from building and construction sites to office settings (Lamm, 2009). Lamm (2009) also outlines two factors that effect the level and success of workplace health and safety. These factors include; an organisations preoccupation with productivity, and the unprecedented advancements in technology.

Organisations preoccupation with occupational health and safety, versus productivity, is a two-fold argument (Maudgalya, Genaidy & Shell, 2008). Many

organisations are choosing to ignore the demands of safety in the workplace in favour of productivity. This idea involves treating workplace health and safety as an, ‘extra cost’ or ‘dirt money’. Expenses outlaid for health and safety are perceived to be wasted resources by the company and are often spared (Lamm, 2009). This opinion is thankfully diminishing within organisations, with a number of organisations dedicating an entire division or team to occupational health and safety.

Safety Management

It could be argued that a significant shift has been made in the way organisations measure their safety success. That is, focus has shifted away from retrospective and lagging measures of safety, which previously focused on accident rates. These measures of accident/incident rates, fatalities and lost time injuries, have been replaced by ‘leading indicators’ (Flin, et al., 2000). These ‘leading indicators’ or measures, assess safety conditions within the organisation through safety audits and assessments of the safety climate. In order to achieve and maintain a positive safety climate, an emphasis should be placed on safety within recruitment. Identifying potentially risky employees at the outset could significantly reduce the number of accidents, while improving compliance rates within the organisation. New recruits, particularly unsafe new recruits, can have a significant impact on the organisation, their co-workers and themselves. Burt, Chmiel and Hayes (2009) suggest that a ‘degree of caution’ should be exercised when working with a new recruit. Further, it is suggested that co-workers should, “not trust their organisation’s ability to select or train...to ensure new recruits will work safety” (Burt et al., 2009 p.1003). With effects that stretch organisation wide, it is essential that safety related behaviours and attitudes are assessed prior to employment. Hansen (1989), outline that certain variables measured during recruitment may be used to predict safety related behaviours, including personality traits such as distractibility.

Progressively, researchers and governments have begun to focus on the measurement individual risk-taking and unsafe behaviours **(**Conchie & Burns, 2009). Incident reports from disasters such as Piper Alpha (1988) and Chernobyl (1986), have outlined that it is human error that is to blame for these accidents (Didla et al., 2010). Donald and Canter (1993) confirm that the majority of workplace accidents are under the control of the employee/s involved. It is believed that these individual behaviours are carried out whether the individual intended the accident to occur or not (Donald & Canter, 1993). Organisations have therefore shifted their attention towards sound safety management and understanding the safety climate in order to avoid unsafe employee behaviours (Didla et al., 2010).

Safety Climate

A meta analysis conducted by Clarke (2003), suggested that workplace accidents, safety practices, unsafe behaviours, and safety performance are all influenced by the safety climate of an organisation to some degree. Measuring dimensions, such as behaviours and attitudes, will give insight into the unique safety climate of each workplace. Griffin and Neal (2000) argue that "the perceived safety climate is an antecedent of safety behaviour" (p.947), specifically, within an organisation, it is the safety climate that describes individual perceptions of the value of safety. This perception will be influenced by management, organisational practices, communication, and employee involvement in health and safety practices (Neal et al., 2000). An employee's safety orientation must mirror that of the organisation in order for the safety climate to be successful. This can be achieved in recruitment by hiring applicants with the right safety orientation. Individual perceptions of procedures, practices, and policies relating to workplace safety will also affect an organisations safety climate (Neal & Griffin, 2006). It is therefore the buy in of employees that will determine the behaviours and attitudes central to a positive safety climate. Selecting

and hiring those employees who possess the right safety attitude may help achieve "buy in" to the organisations safety climate, provided the climate is a good one.

To ensure that the safety climate is a positive one, individual employees must display positive safety behaviours from the early stages in recruitment. Such behaviours include safety compliance, which concerns the observation of rules and regulations within a workplace. The concept of safety compliance is of particular importance within high-risk work environments or industries (Neal, Griffin & Hart, 2000). Specifically, safety compliance concerns rule obedience, avoiding any dangerous practices, wearing compulsory protective clothing, and using regulation equipment to perform work (Didla et al., 2010). The concept of safety compliance is closely linked to safety participation. Neal et al., (2000) give a more contextual definition of safety participation defining it as the attendance to safety meetings, participation of voluntary safety activities, and actions that improve the safety environment within the workplace. Both safety compliance and participation are measures of safety behaviours within an organisation (Flin et al., 2000). Safety compliance and participation will be influenced by individuals' positive or negative perceptions of the safety climate (Neal & Griffin, 2006). Further, safety participation and compliance behaviours are likely to be influenced by the attitudes of the individual. For organisations, particularly during recruitment, measures of these constructs are essential in ensuring that the organisation hires applicants who are oriented towards safety.

Perhaps what has the greatest effect on organisational safety climate, is the employee's motivation and attitudes. It is individual attitudes and perceptions of policies, procedures and practices that drive group safety climate within an organisation (Neal & Griffin, 2006). Safety participation and knowledge may be taught by organisations, safety motivation and attitudes however, are not changed as

easily. Neal and Griffin (2006) suggest that employee motivation mediates the relationship between several safety behaviours and the organisations safety climate. Safety motivation describes the commitment that the employee has to achieving the safety objectives of the organisation. Safety motivation is a measure of how important the individual perceives workplace health and safety to be. Further, safety based motivation assesses the effort the individual is willing to outlay in order to improve or maintain their own, and others, personal safety (Neal & Griffin, 2006). Safety motivation has a stronger relationship with workplace safety participation than compliance (Neal et al., 2000). It is essential that employees are motivated to perform safety activities as workplace participation is generally less mandated than compliance (Neal et al., 2006). An organisations safety climate will also have an influence on the safety knowledge of employees (Sui, Phillips & Leung, 2003) which acts as a mediator variable between safety participation, motivation and skills (Sui et al., 2003). Here, a general knowledge or understanding of the safety regulations within an organisation, along with strong motivation to achieving safety, will give the best result for organisations. More specifically, safety knowledge describes the ability to use equipment correctly, perform the job correctly, and reduce the risk of accidents, while improving and maintaining health and safety within the workplace (Neal et al., 2000). Generally, those employees with greater safety knowledge will have a strong positive attitude towards safety in the workplace (Donald & Canter, 1993).

An organisations safety climate may also have an impact on the frequency of accidents that an employee is involved in. In recent years a shift in the safety literature has been made away from individual level factors that may be responsible for accidents (Reason, 1990). Specifically, the emphasis has moved from a focus on non-compliance with safety procedures, to organisational-based factors such as safety climate. The safety climate of an organisation may therefore have a direct impact on

an employee's accident and incident rate. An organisation with a positive safety climate, who hires an applicant with a good accident history does not have a problem. However issues may occur where there is a "miss match" in the safety climate and accident history of an applicant or employee. For example, an applicant or employee with a poor safety accident history who enters an organisation with a positive safety climate may increase the accident rates within the organisation, or cause harm to their colleagues. Conversely, an employee or applicant with a good safety accident history who enters an organisation with a poor safety climate may become frustrated or let their safety practices slip. It is therefore essential that an organisations safety climate matches that of its employees.

Safety Attitudes

Safety attitudes are perceived to be the driver of participation and motivation of safe behaviours within organisations (Donald & Canter, 1993). Literature suggests that whether or not individuals intend accidents to occur, the behaviours leading to these accidents are intentional. It is the employee's safety attitude that drives these behaviours and actions (Donald & Canter, 1993). Adverse employee attitudes towards health and safety have caused considerable effort to be made towards changes in workplace health and safety (International Labour Office, 2012). Efforts have focused on reducing the numbers of accidents within the workplace, whilst trying to change employee attitudes.

Eliminating any risk to health and safety within the workplace is of fundamental importance for any organisation (Cadieux, 2006), and there are several flow on effects from employee safety attitudes. Research suggests that employee safety attitudes have an effect on the group safety climate within organisations (Neal & Griffin, 2006), which can directly impact on an employee's colleagues. This can be defined as 'co-worker caring', or the "notion that employees care about their work

colleagues to the extent that they actively promote safe behaviour, monitor the environment for hazards, and intervene whenever necessary to ensure safety" (Burt, Gladstone, Grieve, 1998. p.363). Co-worker caring, assesses how employees react to hazards, unsafe behaviours, accidents and communication with their co-workers as they provide a channel for new rules of safety and safety information to be communicated (Tucker, Chmiel, Turner, Herscovis, & Stride, 2008). In addition, Westaby and Lowe (2005) found that co-workers have an impact on the risk taking behaviour of other employees. Identifying employees who have a positive safety orientation before they are hired, may reduce the outcome of risk taking behaviours and subsequent accidents, particularly where new team members are involved. New recruits pose a risk to themselves and co-workers within high-risk environments. When a new team member is bought into a high-risk environment team, it is essential that the group is accommodating to the ability of the new member, ensuring that this new recruit familiarises their selves with safety equipment, procedures and risks. Accidents are likely to increase where there is a clear lack of familiarity and no compensatory changes are made (Goodman & Garber, 1988). Understanding new recruits safety orientation before they enter a job should help reduce safety risks and ensure easy accommodation into the team.

There are also several adverse behaviours that affect the safety climate within an organisation. Rule breaking and breaching of procedures, has a considerable impact on both individuals and teams within a workplace. Rule breaking and breaching of organisational policies is linked strongly to employee safety attitudes (Cox & Cox, 1991). Although measures of rule breaking behaviours is perhaps the most crucial aspect of safety that an organisation should measure, it is subject to a number of response biases. Measures of rule breaking or breaching of procedures assess whether individuals have abided by the organisations rules, how much

attention they pay to workplace health and safety, and whether they report safety hazards (Cox & Cox, 1991). If employers and organisations are able to measure job applicants on the propensity to break safety rules or breach before they are hired, the risks and frequency of rule breaking will decrease.

Currently, there is little research on safety based recruitment nor are there many tools which enable employers to measure individual safety orientation in an objective manner during recruitment. The ability to eliminate those candidates who are likely to perform risky behaviours prior to employment will have unmeasurable savings for organisations. This provides a clear rationale for the development of a new measure of safety that can be utilised at the recruitment stage, allowing organisations and employers to eliminate workplace risks before they occur.

Personality as a measure of safety

A study conducted by Iverson and Erwin (1997) examined the effects of the 'Big 5' personality dimensions, quality of work and occupational accidents. Their findings suggested that both personality dimensions, in particular 'Agreeableness', and the quality of work, were significant predictors of involvement in occupational accidents. Several traits outside the 'Big 5' have also been identified as being predictive of accident involvement, such as, impulsiveness, and sensation seeking (Hansen, 1988).

Sutherland and Cooper (1991) measured the effects of stress on occupational accidents. Their findings showed that individuals under stress are more likely to be involved in a workplace accident. Specifically, the authors make a link between extraversion and behaviours which may intensify response to stress, suggesting that personality characteristics such as extraversion, seem to mediate the response to stress, in turn increasing the vulnerability to accident involvement (Sutherland & Cooper, 1991). Evidence within this research also suggests that there is an association

between the dimension of neuroticism, and the driving behaviours of accidents (Sutherland & Cooper, 1991). Although Sutherland and Cooper (1991) showed that certain personality traits may be drivers in the occurrence workplace accidents, research by Greenwood and Yule (1920), provided an alternative explanation. This, along with the research from Visser et al. (2007) suggests that 'accident proneness' theories do exist. If these theories are proven to exist then measures of personality during recruitment may be void.

Finally, Jones and Wuebker (1993) suggest that 'safety locus of control' can influence individual's safety perceptions and actions within the workplace. An individuals 'safety locus of control' can be explained as the extent to which someone believes they have control over external events within a safety domain. Those with an internal 'safety locus of control' are likely to take the necessary safety precautions to prevent injury, however those with an external 'safety locus of control' are less likely to take adequate precautions. During recruitment, personality profiling may provide organisations with an alternative to assessing previous accident history, and safety behaviours or attitudes. Research from Clarke (2006), Sutherland and Cooper (1991), and Iverson and Erwin (1997), all provide evidence suggesting that personality traits may be used as a valid predictor of safety behaviour within the workplace.

Current safety measures used in selection

Many organisations are aiming to improve their safety climate or culture while reducing the number of accidents within the workplace. As a result, test providers are producing tools and measures oriented towards safety orientation. These tools can be used to measure existing employees or more importantly, job applicants. As an example, Australasia's OPRA consulting group provides the Health and Safety Indicator (HSI) in order to assess a range of abilities and personality characteristics, shown to relate to safe behaviours in the workplace. The HSI measures the applicants

ability to; understand instructions, check attention to detail, safety motivation, safety diligence, safety confidence, safety composure, adherence to rules, openness to guidance, and understanding of the safety environment. OPRA outlines that the HSI can be used to ensure that those employees selected into the organisation can behave safety, whilst facilitating the development of safety behaviours in existing employees (http://www.opragroup.com). Although the HSI provides a good measure of applicant's safety orientation, biases such as impression management and social desirability can affect the applicants' responses. Distortion in responses of safety are often greatest during recruitment, where applicants are eager to gain employment. A measure which is less subject to biases and less 'obvious' in what it is measuring (safety orientation), is required to overcome drawbacks of such measures as the HSI.

Safety Measurement Issues

The current approach towards measurement of occupational health and safety within organisations is problematic. Safety measurement and analysis of results can lead to the correction of risky situations and conditions, however safety measurement results cannot fully represent the 'real' health and safety performance within workplaces (Booth, 1993; Conley, 2000; Mitchell, 2000; O'Brien, 2000; Shaw & Blewett, 1995; Simpson & Gardner, 2001). "Recent academic interest in the measurement of safety climates, has resulted in a production of assessment instruments, typically in the form of self report questionnaires administered as large scale surveys..." (Flin et al.,2000 p.179). There are however, a number of issues surrounding these measures of safety. Accident/incident reports, self/supervisor questionnaires are all subject to biases. Common biases, which threaten the validity of self-report measures include social desirability and impression management (Johnson & Fendrich, 2002). These biases occur as a result of current measures of safety being too 'obvious' in what they are measuring. When employees recognize that they are

being questioned on sensitive issues such as health and safety practices, responses will often be influenced (Fastame & Penna, 2012). Both employees and supervisor understand that their responses will have a direct impact on how they are perceived by their organisation. For this reason, it is in their best interest to respond favourably, although perhaps not truthfully, to these measures. These problems are even more likely in job applicants who are motivated to appear safety oriented in order to gain the position they have applied for.

Fastame and Penna (2012) describe social desirability as a multi-component personality trait defined by two factors; impression management, a goal directed deception process, and self-deception, creating an overly positive self image of oneself. Specifically, social desirability refers to the tendency for individuals to regulate or adjust their answers within measures of traits or behaviours (Fastame & Penna, 2012). These adjustments are made for a number of reasons; to avoid criticism, satisfy the need for social approval or to establish a positive impression (Johnson & Fendrich, 2002; Paulhus, 1984). Individuals will often under, or overestimate the likelihood that they will perform a workplace activity. The purpose of this behaviour is to make the individual appear more society oriented or altruistic than what they truly are. This social desirable tendency causes individuals to "deny socially undesirable behaviours and admit socially desirable ones" (Chung & Monroe, 2003. p.291). Additionally, when individuals are required to respond to self-report measures concerning desirable and undesirable traits or behaviours, responses will take longer.

The individuals concern with their social image, can cause this delay in responses (Holtgraves, 2004). This effect is exaggerated where risk and blame is involved in the consequences of the behaviour, thus occurring often in measures of occupational health and safety. Impression management can be likened to the concept of social

desirability. Social desirability often causes errors within self-reports or questionnaires results. Impression management refers to a goal directed deception process (Schlenker, 1980). Individuals consciously conduct this process in order to control the impression that others form of them (DuBrin, 2010). Here individuals change, shape, manage or regulate their answers in order to influence others perceptions of them. This is done in the hope that the impression they form will be a positive one (Fastame &Penna, 2012). Response biases such as social desirability and impression management are a result of the "obviousness" of safety scales in what they are measuring. For example the HSI used by OPRA, takes a measure of the applicants awareness in understanding the safety environment by asking, "Have you ever faced any crisis or emergencies in your workplace? How did you respond?". Generally, applicants will be favourable in their answers as they are aware that a poor, but maybe honest answer, could result in them not being hired. Responses affected by social desirability, or impression management biases, can change the mean level of the overall responses for the scale, presenting a view of the respondent, which may not be valid or reliable (Podsakoff, Mackenzie, Lee 2003). Social desirability effects can introduce systematic bias or variance into the assessment of a given trait (Spector, 2006).

Selection and Impression Management

Impression management is often an issue within the selection and hiring processes. Studies of impression management and selection processes are one of the most emerging issues within current research (Posthuma, Morgeson, & Campion, 2002). Impression management is used within applicant letters, and assessment centres but is most prevalent in selection interviews where the high stakes and social interaction inherent in the interview, creates an ideal opportunity for applicants to engage in it (Schlenker, 1980). Impression management can be divided into two

types; assertive and defensive. Assertive impression management behaviour is used to promote and acquire favourable impressions and self-promotion (Tedeschi & Norman, 1985), often conducted to evoke attributions of competence. In contrast, and what occurs more often where previous accident reports are concerned, is defensive impression management. This form of impression management is used to repair or protect one's image (Schlenker, 1980). Here applicants will uses excuses, justifications, or elude the truth to protect or repair their image. With impression management being so prevalent throughout the selection process it is important that organisations and employers have solid measures to overcome these biases. Selection biases are of particular importance when it is a high-risk industry that is being recruited for. If impression management affects applicants answers and information regarding their past safety behaviours and accidents, the recruiter has no way of knowing the true safety orientation of the applicant.

Limitations of Accident and Incident Frequency Reports

Some organisations may also use measures of an applicant's previous accident history as a predictive measure of their future safety performance. Although this may provide some validity in predicting future safety behaviours, not all applicants for a job will have work experience. Where a job applicant has a low or no previous accident history, it is difficult for the organisation to predict their safety behaviour. This is often the situation that recruiters are faced with, especially where new recruits are coming straight from a tertiary, or secondary school environment with no previous work experience. What is needed is a measurement tool, which has the ability to predict safety behaviours from candidates who have no previous experience in high-risk work environments.

Further, predictions based on information from the past cannot be guaranteed to replicate real life situations. As, Lalande and Bonanno (2011) explain, accident

history can often be effected by memory recall biases, giving the organisation unreliable data to base predictions on. Further, social desirability and impression management biases are also likely to effect the responses that applicants give to questions regarding past accident history. It is therefore, in the applicant's best interest to make themselves appear to be a safe individual, whether that information is reliable or not.

Although accident reports are informative in detailing the series of events that cause accidents to occur, these measures often contain biased information. Accidents rates and near hits are vastly underreported within organisations. Often this is due to the consequences that individuals face from their organisation (Sato & Kawahara, 2011). This effect is exaggerated within the recruitment stages of high-risk industries. Employee's applying for high-risk industry jobs may underreport their previous accident history for two reasons; memory or recall issues, or intentional masking, motivated by a desire to achieve the desired position. Either reason is problematic for employers and organisation in measuring safety orientation of new recruits. Cognitive psychology has demonstrated that retrospective reports and recall of accident events are often distorted with Lalande and Bonanno (2011) suggesting that recall of accidents will cause memory recall to be inaccurate. Further, research suggests that data from negative events such as workplace accidents, is generally exaggerated or under-reported (Sato & Kawahara, 2011). These researchers found that negativity biases contaminate self-report scores in retrospective reports over a long time frame (Sato & Kawahara, 2011). Results from this study suggested that in general, people under report negative events. The effects of retrospective biases, should cause concern for organisations that wish to use previous accident history, particularly when this information is used as a predictive measure of safety performance. When biases such

as memory recall effect this data, it provides little predictive validity for the organisation.

Spot the Difference Puzzles

In order to reduce measurement error and ensure that organisations can gain valid and reliable safety information about job applicants, a more unassuming and less bias measure of safety is required. Spot the difference puzzles present two otherwise similar images to participants. Participants who are presented with two almost identical images are required to identify the area of difference on one of the puzzles. Image depictions can be photographic, cartoons, animations or drawings. Manipulations are often made to alter; colour, objects, removing/adding objects, changes in shape, and change of positions.

Testing through the use of spot the difference puzzles is not something that has been utilised within organisational research. It provides an ethical and potentially very effective approach to measure areas of employee behaviours, without being subjects to biases such as impression management and social desirability. As a measure of workplace safety orientation, spot the difference puzzles do not put the applicants at risk. This could be the case if work sample tests were used to measure safety. Use of a dynamic tool such as spot the difference puzzles provides a number of advantages in measuring job applicant's safety orientation. If applicants are not told that the spot the difference puzzles are a measure of 'safety', a clearer unbiased representation of their safety orientation may be obtained by the organisation. More specifically, the use of this objective tool could reduce measurement error such as social desirability and impression management.

Present study

The present study investigated the relationship between self-report measures of safety including; safety participation, motivation, knowledge, compliance, rule

breaking, co-worker caring, perceived risk, attitudes, voicing behaviours, and reactions to new team members, and a series of 'spot the difference' puzzles. The 'spot the difference' puzzles were designed for the purposes of this study.

Four hypotheses were examined:

Hypothesis 1 concerned ratings of the safety scales completed by both employees and supervisors. This hypothesis suggested that, if employee self-report scale ratings on (Participation, Compliance, Knowledge, Motivation, Voicing Behaviours, and Rule Breaking/Breaching Procedures) are valid, results from these scales should be similar to those of the supervisor's ratings. Distortion between these two results may suggest that social desirability and impression management not only influence self-report ratings, but also supervisor perceptions of their employees.

Hypothesis 2 suggested a relationship should exist between employee self-reports of accident history, and the accident history in their current job, as reported by their supervisors. A measure of accident history may be taken as part of the job applicants recruitment process based on the logic that past accident history may be used as a predictive measure of future accident behaviour.

Hypotheses 3 tested the validity of the puzzle scores as a measure of safety. Specifically, this hypothesis predicted that puzzle scores such as (*total differences found, safety differences found,* and *safety order scores*) should correlate positively with measures of (Participation, Compliance, Motivation, Knowledge, Voicing Co-worker caring, and Voicing Behaviours), if the puzzles were a valid measure of safety.

Hypothesis 4 was also used to test the validity of the puzzle scores as a measure of safety. This hypothesis predicted that negative safety measures should correlate negatively with puzzle scores if the puzzles were a valid measure of safety.

Method

Design

A within subjects design was used for the purpose of this study. Two sets of participant's were involved, employees and their supervisors. The study required the completion of two tasks by the employees, and one task by the supervisors. All participants were workers from Fletcher Construction and held a range of different jobs including painters, labourers, bricklayers and site managers.

The first task required employees to complete a series of ten spot the differences puzzles on a computer. Following this, employees were required to complete a total of ten safety scales measuring different constructs, and one additional measure of their accident history. Supervisors were then asked to rate each of their employees on six of these same safety scales (knowledge, participation, compliance, rule breaking, motivation and safety voicing), with the additional of an accident history measure.

In order to try and control for common method variance, safety scales within the questionnaire were randomly ordered for both employees and supervisors. With the exception of the accident and incident frequency ratings, all scales were rated on a 5-point Likert scale. Two variations of scale anchors were used; Never – Always, with 1= Never and 5= Always, and Strongly Disagree to Strongly Agree, with 1=Strongly Disagree and 5=Strongly Agree. Accident and Incident frequencies were rated in numerical values from 0 upwards.

Participants

Recruitment/ Sampling

Prior to the study commencing, Fletcher Construction was approached and given a brief summary of the research design. The organisation was offered the opportunity to participate in the research, and were provided with the accepted ethics

application, in conjunction with the study's Information Sheet (Appendix A) and Consent Form (Appendix B). It was made clear to the organisation that their, along with their employees' participation, was voluntary and that there was no obligation for them to be a part of the study. Fletcher Construction designated a set of supervisors who had the time and resources (enough employees) to do the study. After reading the requirements of the study (Information Sheet), each supervisor either accepted or declined to participate. Each of the participating supervisors then selected a group of their employees who were willing to participate in the study. Selection of these employees was made based on the amount of other work the employees had to complete. It was then at each individual employees' discretion whether or not they chose to participate. Finally, the organisation, supervisors and employees, were informed that if, at any time, they wished to withdraw from the study they may do so without penalty.

Employee demographic data

There were a total of 39 employees in the study with considerably more male participants N=34 (87.18%), than female N=5 (12.82%). There was reasonable variance within the ages of the employee's with the youngest aged 22 years old, and the oldest, 61 years old. The mean age of the workers was 42 years old, with a standard deviation of 11.79.

The employee questionnaire took a measure of tenure for the participant's *current job* and time within the *industry*. Tenure for the participant's *current job* ranged from 2 months to 9 years with a mean tenure of 13 months, and a standard deviation of 18.50. Tenure within the *industry* showed more variance, with the shortest term being 2 months and the longest 35 years. The mean industry tenure for this sample was 12.55 years, with a standard deviation of 11.21.

Supervisor demographic data

There were a total of four supervisors who were responsible for the 39 employees (Supervisor 1 was responsible for 11 employees, Supervisor 2 was responsible for 16 employees, Supervisor 3 was responsible for 3, and Supervisor 4 was responsible for 10 employees). The supervisor questionnaire took a measure of tenure based on the *length of time* they had supervised/worked with each of their employees. These score ranged from a minimum of 1 month to 7 years as the maximum. The mean time from this measure was 12.92 months, with a standard deviation of 17.36. Supervisors were required to complete one questionnaire for each of their employees.

Materials

Materials for this study were also split between employees and supervisors. Employees completed a series of ten spot the difference puzzles, and a self-report questionnaire, while the four Supervisors completed only the safety questionnaires about their respective employees.

Safety scales used in the employee and supervisor measure were adapted from previous research. These questionnaires can be viewed in Appendix C (supervisor questionnaire) and Appendix D (employee questionnaire). Within the safety scale measure, both employees and their supervisors completed six of the same scales. The additional four safety scales were only used in the employee questionnaire, as wording and content made them unsuitable for use in the supervisor measure. For example an item from the safety attitudes scale asked, *"If I worried about safety all the time I wouldn't get my job done"*. It is not possible for a supervisor to rate their employee on such questions. Additionally, wording of the scales in the supervisor questionnaire was edited to accommodate completion by the supervisor about their employees. For example, where the employee questionnaire stated, "*I ensure* the

highest levels of safety when I carry out my job" the supervisor item wording was changed to, "*Ensures* the highest levels of safety when they carry out their job", (Appendix E wording changes between employee and supervisor questionnaires).

Employee Materials

Puzzle Design

The first task of the study required employees to complete a series of ten spot the difference puzzles. The set of puzzles were designed specifically for the purposes of this study. Each puzzle (image) was a depiction of a different setting, including two office scenes (hazards and unsafe behaviours), household behaviour, fall safety (outdoor scene), boating safety (outdoor scene), beach and water safety (outdoor scene), road and street safety (outdoor scene), forestry safety, and two workshop safety scenes (hazards and unsafe behaviours). Spot the differences puzzles are often coloured images that are placed side by side, or on top of one another. The two images, or photographs are almost identical however the object of the puzzle is to locate the number of specified differences between the two images. When a difference is located on the puzzle the participant must circle or click this to show that they have spotted the difference. An example of a spot the difference puzzle is provided in Figure 2.

Figure 2. *Example spot the difference puzzle*

A purpose built computer program was designed for this study in order to run the spot the difference puzzles. The program presented two almost identical puzzles side by side to employees on a computer screen. There were a total of ten differences between the two puzzles. Half (five) of the differences were neutral based changes – including alterations in colour, shape and object. The remaining five differences were safety-based differences – including additions of unsafe conditions, behaviours and hazards. The ten differences were spread over the entire area of the puzzle. The computer program was designed so that a square vector surrounded each of differences. In order for the differences to be accepted as correct, the participants were required to make this click within a square vector area that surrounded each difference. Vectors were not visible to participants until the area was correctly selected, in which case, the square vector appeared on the image in green light, as a notification that the difference was correct. Space surrounding the differences was counted as error.

Each of the differences were labelled 1 -10, with five safety and five neutral differences. The numbering of safety and neutral differences changed across the ten puzzles. For example in the Beach Safety scene the safety differences were numbered 2, 3, 6, 8 and 10, with the neutral differences being 1, 4, 5, 7 and 9. In the Falls Safety scene, safety differences were numbered 2, 3, 5, 9 and 10, while neutral differences were numbered 1, 4, 6, 7, and 8. Numbering of the differences was done in order to calculate how many safety, and how many neutral differences were found. This also allowed timing and order scores to be calculated, differentiating between safety and neutral differences.

Puzzle Presentation

Two almost identical puzzles were presented to participants on a computer monitor (19 inch). The puzzles were presented in the centre of the screen with a white

border above and below each image. The only other information on the screen, other than the puzzle image, was a square button down the bottom right hand corner. This gave the employees an option to “Give Up”. Each image remained on the screen until the employee either selected the “Give Up” option, or used all ten clicks available to them.

Puzzle procedure

The study took place on the construction sites where the employees and supervisors worked. In order to control for conditions such as sound, light, dust, and interference from others, the study was run in a van, rented for the purposes of this study. The van was set up with an inverter running a computer screen and laptop, which ran the spot the difference puzzle program, and recorded all scores. Employees were required to sit on a seat in front of a desk where the computer screen and mouse was set up for their use. Prior to beginning the first task (puzzle task) each employee was briefed on the purpose of the study and presented with the instructions for the task:

> “Your involvement in this project will be to complete a series of “spot the difference” puzzles on a computer program. You will use the computer mouse to select the difference areas on one of the two puzzles. There are a total of 10 puzzles, each with 10 differences. You have the right to withdraw from the project at any time, including withdrawal of any information provided without penalty. It is estimated to take 30 minutes to complete the series of puzzles.
>
> As a follow-up to this investigation, you will be asked to complete a self report measure which will be used to relate the information collected from the puzzle information processing task to your work experiences. This task will take approximately 10 minutes to complete”.

Once the employees had given their consent to participate in the study they were instructed to click the screen when they were ready to start. Employees were instructed to use the mouse in order to navigate the puzzles and click on the difference region. The employees were required to click on the right hand puzzle where they spotted a difference. The order in which the puzzles were presented to employees was randomised across all 40 subjects.

The first screen presented the employees with instruction on how the "Spot the Difference" task was to be completed. Within the task, puzzles were set to be presented in a randomised order across all employees:

> "You will see two almost identical images side-by-side. Your task is to find the differences between the two displayed images. There are a total of 10 DIFFERENCES in each puzzle. At the beginning of each puzzle, the mouse cursor (+) will be in the bottom centre of the screen.
>
> The Task - You have a total of 10 ATTEMPTS (mouse clicks) to find the differences. Please move the computer mouse cursor over the difference on the RIGHT-HAND puzzle, and click on the difference with the left-hand mouse button. If the difference is correct a green indicator box will be displayed. If an error occurs, the selected area will not be highlighted, and you will be able to try again. It is important to place the middle of the mouse cursor (+) directly over the difference. Once your 10 attempts to find the differences are completed you will be moved on to the next puzzle. If you are stuck and cannot find more differences, please choose "Give Up" to move onto the next puzzle. Once you have moved on to the next puzzle, you won't be able to return to previous puzzles. Please repeat this process until all 10 puzzles have been completed".

Puzzles scores

The computer program recorded 50 individual scores for of each of the ten puzzles. Scores were taken from five different measures: total number of correct differences, total time taken to attempt the puzzles, time taken between each click, click region, and a give up score.

Puzzle data

An equation was used in order to establish number of *safety differences* and number of *neutral differences* that were found in each puzzle. This equation counted each difference (associated with a safety vector), and each difference (associated with a neutral vector). This gave each of the 39 participants a total safety differences found, and total neutral differences found score, across each of the ten puzzles. Excel was then used to calculate a *safety order* score for each of the participants on each puzzle. Ten clicks were available to participants on each puzzle, this translated into a click order from 1^{st}-10^{th}. An equation was used to count the order (1^{st}-10^{th}) that each of the safety differences were selected. These order placing's were added up and divided by the number of correctly identified safety differences (e.g. Differences may have been clicked (Vector 1) 2^{nd}, (Vector 2) 1^{st}, (Vector 3)3^{rd}, (Vector 4) $9^{th,}$ (Vector 5) 6^{th},(Vector 6) 7^{th}, (Vector 7) 8^{th} , (Vector 8)10^{th} (Vector 9) missed, and (Vector 10) 4^{th}. If 3, 6, 7, 8 and 9 were the actual safety differences, then the *safety order score* for this participant on this puzzle is 3+7+8+10 / 4, as only four of these were correct safety differences). A lower *safety order* score would indicate that safety differences were found before neutral differences.

Data from total time taken to attempt puzzles, total differences found, safety differences found, neutral differences found, and safety order scores were entered straight into SPSS.

Employee Questionnaire

The employee questionnaire (Appendix D) contained a total of 64 items from nine scales (not including demographic information). Demographic information required data on the employee's age, length of tenure in the current job, and length of tenure in that occupation. The questionnaire contained 64 items from established safety scales. Measures were taken for bending the rules, considerate and responsible employees scale, reactions to new team members, safety knowledge, safety motivation, safety voicing behaviours, safety attitudes, and perceived job risk, safety compliance, and safety participation. The final five items were frequency measures of the individual's accidents history within their working career.

Safety Participation and Compliance

A measure was taken of the employee's safety participation and compliance. These two behavioural components were measured using a section of Neal and Griffin's (2000) 6-item scale. Examples of the items included: "*I ensure the highest levels of safety when I carry out my job"*, and "*I put in extra effort to improve the safety of the workplace"*, for compliance and participation, respectively. High scores on the 5-point Likert scale indicated greater compliance and participation. The three Participation item scores, ranging from 1 -5, when summed gave an overall Participation score between 3-15. The same was done for the three Compliance items. The 5-point scale ranged from Never = 1, to Always = 5. The two subscales, compliance and participation were reported by Burt, Banks and Williams (2010) with the respective Co-efficient Alpha's as α =.93, and α =.86. This study reported the alpha for the Safety Participation items at α =.83, and Compliance was reported at α=.85.

Considerate and Responsible Employee Scale

A measure was taken on employee's attitudes towards co-worker caring. This dimension was measured using a shortened version of the scale designed by Burt, Gladstone, and Grieve in (1998), the Considerate and Responsible Employee Scale, (CARE). The 15 items with the highest factor loadings from the original scale were used in this study's adapted version. Example items of this scale included: *"Workers should point out hazards to co-workers"* and *"Co-workers should discuss changes that could improve safety"*. This shortened version of the scale had a possible range of scores from 15-75. The 5-point scale ranged from Strongly Disagree = 1, to Strongly Agree = 5. Individual scores were summed to give a measure of the employee's co-worker caring, with a higher score indicating a greater level of caring. The original scale by Burt et al., (1998) had a reported internal consistency, Co-efficient Alpha ranging from α=.81 - .91. This study found the Co-efficient Alpha for the self-report measure to be α=.94.

Safety reactions to new team members Scale

A measure was taken on the employee's reactions to new team members in their job. These 6-items were taken from a scale developed by Burt, Chmiel, and Hayes (2009). All of the original six items were used within this study. Example items for this measure included, *"It is important for crew safety for me to find out the safety history of a new member"* and *"It is important for safety for me to encourage a new crew member to ask about safety procedures"*. This scale had a total possible score ranging from 6-30. The 5-point scale ranged from Strongly Disagree = 1, to Strongly Agree = 5. Individual scores were summed to give a measure of the employee's reactions to new team members. A high score within this scale suggested that the employee is concerned with, and proactive where new team member safety is concerned. The original scale developed by Burt, Chmiel and Hayes (2009) reported a

coefficient alpha of α=.70, while the coefficient alpha for this study was reported at α=.81.

Safety Knowledge Scale

A measure of the employee's safety knowledge was taken based on the scale developed by Neal, Griffin and Hart (2000). This was a four-item measure and included items such as; " *I know how to perform my job in a safe manner*" and *"I know how to use safety equipment and standard work procedures"*. Scores for these four items were summed to give a total Safety Knowledge score ranging from 4-20. The 5-point scale ranged from Strongly Disagree = 1, to Strongly Agree = 5, with a higher score suggesting a high degree of safety knowledge for that individual. The original scale by Neal et al. (2000) reported a coefficient alpha of α=.90, while this study reported the alpha at α=.87.

Safety Attitude Scale

A measure of the employee's safety attitude was also taken. These five items were taken from Donald and Canter's (1993) Safety Attitudes Questionnaire. Example items for this scale included: *" Safety works well until we are busy then other things take priority"* and *"There is little point in reporting potential safety hazards"*. Scores for these five items were summed to give and overall Safety Attitude score ranging from a possible 5-25, with a lower scoring representing a better safety attitude within the workplace. The 5-point scale ranged from Strongly Disagree = 1, to Strongly Agree = 5. No coefficient alpha was found for the original scale by Donald and Canter (1993), however this study reported α=.83 for the five item measure.

Safety Motivation Scale

A measure of employee safety motivation was taken using the items from Neal et al. (2000) Safety Motivation scale. This was a 4-item scale developed to

assess individual motivation to perform safety related activities and procedures. Example items included; " *I feel that it is worthwhile to put in effort to maintain or improve my personal safety*" and "*I believe that it is important to reduce the risk of accidents and incidents in the workplace"*. Scores from the four items were summed giving a total possible score ranging from 4-20. The 5-point scale ranged from Strongly Disagree = 1, to Strongly Agree = 5. A higher score on this scale represents a strong positive attitude towards safety motivation within the workplace. The original scale by Neal et al. (2000) reported a coefficient alpha of α=.93, while this study found a coefficient alpha of α=.96.

Bending the Rules Scale

A measure was taken on the propensity for the participant to breach safety rules and procedures within the workplace. These items were taken from Chmiel's (2005) 4-item Bending the Rules Scale. This scale was reworded from an original scale designed by Cox and Cox (1991), which measured Safety Scepticism. All four items from Chmiel's developed scale were used for this study. Example items from this measure included: "*I sometimes cut corners if it makes the task easier"* and *"Work pressures mean that I bend safety rules"*. The summed employee score had a possible range of 4-20 providing a measure of the employee's propensity to break rules and breach safety procedures. The 5-point scale ranged from Never = 1, to Always = 5. For this scale a higher score would suggest that the participant is less likely to comply with the rules and safety procedures within their jobs. The original scale by Chmiel (2005) had a reported coefficient alpha of α=.82 . This study found the coefficient alpha for the employee measure to be α=.78.

Safety voicing scale

A measure was taken on the employee's safety voicing behaviours. A 5-item measure was used, originally developed by Tucker, Chmiel, Turner, Hershcouis, and

Stride (2008). These items were designed to measure the extent to which truck drivers spoke up about safety concerns with their co-workers, management and their union. Original item wording was adapted for the purposes of this study, for example where the original item stated "I discuss new ways to improve *safe driving* with my colleagues or boss", a change was made to "I discuss new ways to improve *safety* with my colleagues or boss" (all references to driving and driving hazards were thus removed). Example items from the scale included, *"I tell colleagues who were doing something unsafe to stop"* and *"I discuss new ways to improve safety with my colleague or boss"*. Scores for the five items were summed to give a possible overall score of 5-25. The 5-point scale ranged from Never = 1, to Always = 5. A high score on the Safety Voicing Scale would suggest that employees are proactive and informative in voicing safety concerns around the workplace. The original scale developed by Tucker et al. (2008) reported a coefficient alpha for these five items of α=. 78. The coefficient alpha for this employee measure was reported at α=.84.

Perceived Job Risk Scale

A measure of Perceived Job Risk was taken from the employees with regards to their current job. This 10-item scale was developed by Hayes, Perander, Smecko and Trask (1998). The scale contained 10 words or short sentences, which the employees were required to rate in relation to the perceived risk in their job. All of the original 10 items were used within this scale, examples of these items included; *Hazardous, Dangerous, Risky, Safe and Chance of death.* A high score on each of the words indicated a higher degree of perceived risk within their job, with the exception of item 2 in the scale (Safe), which was a reverse coded item. The 5-point scale ranged from Strongly Disagree = 1, to Strongly Agree = 5. This study reported a coefficient alpha of α=.83. A recent study by Burt, Banks and Williams (2010) obtained a coefficient alpha of α=.85 for this scale.

Accident and Incident Frequency Measure

The final five items of the employee questionnaire took a measure of their accident history frequency rates. These items required the employee to report the frequency of; A near hit incident (which had it turned out differently, could have resulted in injury), A very minor injury (not requiring medical attention), A minor injury (requiring medical attention, though no time off work), A lost time injury (requiring time off work), and An increase in safety which was the result of your behaviour. These frequency ratings ranged from 0 upwards, and were based on the length of time the employee had worked within the industry.

Employee questionnaire procedure

Employee questionnaires were administered once the employee had completed the series of spot the difference puzzles. Administering the puzzles prior to the employee questionnaire was essential to ensure that no safety priming effects existed. The questionnaire was completed by the employees in the same controlled conditions as the puzzle task. The different scales within the questionnaire were randomized for each participant to control for order effects.

One item within the Employee Questionnaire (Perceived Job Risk scale) was reverse coded to reflect its true value. Demographic measures also required recoding, the ‘length of time worked within the industry’ and ‘length of time worked within this particular job’ values were both converted into months.

Supervisor Materials

Supervisor Questionnaire

The supervisor questionnaire (Appendix C) contained 28 items scale items, plus one measure requiring the *length of time* they had worked with/supervised that particular employee. The supervisors were required to answer one questionnaire for

each employee for whom they were responsible. The supervisor questionnaire contained 23 safety scale items. Measures were taken for bending the rules scale, safety knowledge, safety motivation and safety voicing behaviours, participation and compliance. The remaining five questions were frequency measures of their employees' accident history ratings. This required the supervisor to report how many times each of their employees had been involved in an accident, or incident, in the time they had been supervised/worked with that employee.

Safety Participation and Compliance

Neal and Griffin's (2000) scale was used in the supervisor's questionnaire to measure each supervisors perception of their employees' safety participation and compliance within the workplace. This was a six-item measure, split into three safety participation items and three safety compliance items. Wording between the employee questionnaire and supervisor questionnaire deviated somewhat; for example, where the self-report measure stated, *" I* use the correct safety procedures for carrying out my job*"* the supervisor measure stated, *"Uses* the correct safety procedures for carrying out *their* job*"* (See Appendix E). As with the employee scale, high scores on the 5-point Likert scale indicated greater compliance and participation for the employee being rated. The three Participation items scores ranging from 1 -5 were summed give an overall Participation score between 3-15. The same was done for the three Compliance items. The 5-point scale ranged from Never = 1, to Always = 5.

Safety Knowledge Scale

Neal, Griffin and Hart's (2000) scale was used in the supervisors' questionnaire to take a measure of the supervisor's perception of their employees' safety knowledge. The same four item measure from the employee scale was used in the supervisor scale. Again, the wording of the original scale was adapted in order to facilitate supervisor ratings. For example, where an item in the employee

questionnaire stated " *I* know how to perform my job in a safe manner" the supervisor measure stated "*They* know how to perform *their* job in a safe manner". An additional example item from this scale stated, *" They know how to maintain or improve workplace health and safety"*. The 5-point scale ranged from Strongly Disagree = 1, to Strongly Agree = 5. A higher score on this scale would suggest a high degree of perceived safety knowledge for that employee by the supervisor.

Safety Motivation Scale

Neal et al.'s (2000) scale was also used in the supervisor questionnaire to assess the supervisor's perception of their employee's safety motivation. The same four-item measure was used from the employee questionnaire. Wording of the original items was altered in order to facilitate their use in the supervisor measure. For example where the employee measure stated, " *I* feel that it is worthwhile to put in effort to maintain or improve my personal safety" the supervisor measure stated "*They* feel it is worthwhile to put in effort to maintain or improve personal safety". An additional example item for this scale stated,"*They believe that workplace health and safety is an important issue"*. The 5-point scale ranged from Strongly Disagree = 1, to Strongly Agree = 5. A high score on this scale would assume that the supervisor believes their employee has a strong positive attitude towards safety motivation in the workplace.

Bending the Rules Scale

Chmiel's (2005) Bending the Rules scale was used within the supervisor measure. This required supervisors to rate each of their employees on their propensity to breach safety rules and procedures. The same four items were used from the employee questionnaire. Wording of the original items was altered in order to accommodate completion by the supervisor about their employee. For example where the original item stated *"I* sometimes cut corners if it makes the task easier*"* the

supervisor item was changed to "*They* sometimes cut corners if it makes the task easier". The 5-point scale ranged from Never = 1, to Always = 5. A higher score on this scale suggested that supervisor believed their employee was less likely to comply with the rules and safety procedures within their jobs.

Safety voicing scale

Finally a measure was taken from the supervisors on their perception of their employee's safety voicing behaviours. The same five-item measure used in the employee questionnaire was used in the supervisor questionnaire. Items from Tucker et al.'s (2008) original scale were adapted in order to facilitate completion by the supervisors about their employees. For example "*I* make suggestions about how safety could be improved" was adapted for the supervisor measure to "*They* make suggestions about how safety could be improved". The 5-point scale ranged from Never = 1, to Always = 5. A high score on the Safety Voicing Scale would suggested that the supervisor believed the employee to be proactive and informative in voicing safety concerns around the workplace.

Accident and Incident Frequency Measure

The final five items within the supervisor questionnaire took a measure of their employees' accident history rates. These items required frequency ratings on the number of times the employee had been involved in; A near hit incident (which had it turned out differently, could have resulted in injury), A very minor injury (not requiring medical attention), A minor injury (requiring medical attention, though no time off work), A lost time injury (requiring time off work), and An increase in safety risk which was the result of their employees' behaviour. Ratings were made by the supervisor concerning each employee they were responsible for, and ranged from 0 upwards. Ratings were based on the length of time the supervisor had worked with or supervised that employee.

Supervisor questionnaire procedure

Once each employee had completed the series of ten spot the difference puzzles and the employee self-report questionnaire, their respective supervisors were administered with the supervisor questionnaire. Each supervisor was administered one questionnaire for each employee they were responsible for. In total 40 questionnaires were given out to the supervisors. Supervisors were given one week to complete the questionnaires before they were collected. Supervisors were instructed to complete the questionnaires as honestly as possible, and base their ratings on the entire time they had supervised/worked with each employee.

One variable required recoding in the supervisor measure. The 'length of time the supervisor had worked supervised/worked with that particular employee', was recoded to represent the time in months. No reliability analysis was conducted on the Supervisors measure as the sample size was too small, N=4.

Results

Data preparation

Results were analysed using SPSS version 20 (IBM Corporation, 2011). Data was entered for the 40 employees and four supervisors who participated in the study. This data was initially screened for outliers, after which one employee's data was removed based on timing data. Specifically, this employees (*total time taken to attempt* all puzzles score) was significantly lower than the other 39 employees. This resulted in the data analysis of, N= 39 employees, N= 4 supervisors.

Puzzle descriptive statistic analysis

Table 1 presents descriptive statistics for *total differences found*, *safety differences found*, *safety order scores,* and *total time taken to attempt the puzzles*,

including means, standard deviations, range scores, and percentage of employees who gave up, for each of the ten puzzles. Inspection of Table 1 shows that three *safety order* range scores had a minimum of zero. A zero *safety order* score may exist for three reasons. The employee may not have attempted to click any of the five safety differences, the employee may have clicked, but made errors where they intended to select safety differences, alternatively the employee may have selected the 'Give Up' option on the puzzle before selecting any of the differences.

Table 1. Means, Standard Deviations, Range values, and Percentage of employees who gave up, for each puzzle for total differences found, safety differences found, safety order scores and total time to attempt the puzzles.

	Total Differences Found *M (SD)* *Range*	Safety Differences Found *M (SD)* *Range*	Safety Order scores *M (SD)* *Range*	Total Time attempting puzzles (Minutes) *M (SD)* *Range*	Percentage of employees who gave up (%)
Beach	7.87 (1.45) 3-10	4.54 (0.75) 2-5	4.75 (0.79) 2.00-6.25	3.39 (1.49) 0.19-7.35	22.5
Boat	8.67 (1.46) 2-10	4.15 (0.96) 0-5	5.48 (1.56) 0.00-8.00	2.71 (1.05) 0.36-5.52	8.0
Falls	8.30 (1.30) 4-10	4.28 (0.72) 2-5	4.64 (1.01) 2.50-6.80	3.53 (1.49) 0.20-7.28	22.5
Forest	9.15 (0.99) 5-10	4.84 (0.54) 2-5	4.94 (1.10) 1.50-7.80	4.32 (1.43) 0.15-7.35	25.0
House	8.74 (1.14) 5-10	4.33 (0.81) 2-5	5.50 (1.09) 2.75-8.50	2.53 (1.35) 0.39-7.39	8.0
Office	8.56 (1.46) 3-10	4.36 (0.84) 3-5	4.86 (1.26) 2.00-7.00	4.29 (2.02) 0.37-8.40	32.5
Office Beh.	9.00 (1.05) 6-10	4.69 (0.52) 3-5	4.84 (1.04) 3.00-7.75	2.83 (1.12) 0.12-5.27	8.0
Street	8.13 (2.02) 0-10	4.46 (0.97) 0-5	4.32 (1.30) 0.00-8.00	3.14 (1.57) 0-6.89	20.0
Workshop	8.92 (1.80) 0-10	4.67 (0.95) 0-5	4.67 (1.41) 0.00-7.00	4.30 (1.88) 0-8.88	15.0
Workshop Gear	8.54 (1.52) 4-10	4.62 (0.63) 3-5	4.76 (1.20) 2.33-7.75	4.29 (1.58) 0.59-7.86	20.0
Overall	8.59 (.96) 5.60-9.80	4.49 (.42) 3.30-5.00	4.88 (.61) 3.58-6.07	3.50 (.86) 2.20-5.05	-

Safety scale descriptive statistics analysis

Table 2 presents means, standard deviations, and range scores for employee self-report safety scales, and their supervisor safety scale ratings. Employees completed a total of ten safety scales measuring ten different safety constructs. Supervisors were asked to rate each of their employees on a subset of these ten scales, specifically measuring employee's safety knowledge, participation, compliance, rule breaking, motivation and voicing behaviours. The additional four measures were only used in the employee self-report measure (co-working caring, safety attitudes, new team member attitudes and perceived job risk). Dashes in the table represent measures that were either not taken from the supervisors, or the employees. Mean results for employees and supervisors, indicate what was expected from the safety scale measures. Means from positive safety measures, (participation, compliance, knowledge, motivation, voicing, co-worker caring, and new team members) were high, while means from negative safety measures (attitudes, rule breaking and perceived risk) were low. These results are consistent with the suggestion that social desirability and impression management may influence responding to self-report scales.

Mean results varied between employee safety scale ratings and their supervisor ratings on these scales. Within the safety measures, employee's scored themselves more favourably on safety knowledge, rule breaking and motivation, while supervisor ratings were higher than employee self ratings on the safety participation, compliance, and voicing behaviours scales.

Table 2. Means, Standard Deviations, and Range values for employee and supervisor safety scale data.

	Employee Mean (SD) (Range) n=39	Supervisor Mean (SD) (Range) n=4
Safety Knowledge	4.54 (.46) 3.50-5.00	4.43 (.70) 1.50-5.00
Safety Motivation	4.58 (.72) 1.00-5.00	4.38 (.58) 2.75-5.00
Safety Compliance	4.46 (.51) 3.00-5.00	4.55 (.50) 3.67-5.00
Safety Participation	4.11 (.86) 1.33-5.00	4.32 (.74) 3.00-5.00
Safety Voicing	3.74 (.78) 1.60-5.00	3.84 (1.12) 1.20-5.00
Rule Breaking	1.56 (.52) 1.00-2.75	1.78 (.87) 1.00-4.50
Co-worker caring	4.54 (.44) 3.60-5.00	- - -
New Team member	4.04 (.57) 3.00-5.00	- - -
Safety Attitudes	1.90 (.79) 1.00-4.00	- - -
Perceived Risk	2.17 (.60) 1.00-3.50	- - -

Predictive value of self-report data

Within the safety scales measure, both employees and their supervisors completed six of the same scales. Hypothesis 1 suggested, that if employee self-report scales (participation, compliance, knowledge, motivation, voicing behaviours, and rule breaking) are valid, results from these scales should be similar to those of the supervisor's ratings. Distortion between the results of these two groups may suggest that social desirability and impression management not only influence self-report ratings, but also supervisor perceptions of their employees. To test hypothesis 1, correlations were calculated between employee safety scale ratings and supervisor safety scale ratings, along with a paired samples t-test comparing the means of the two groups. Results from the paired samples t-test, presented in Table 3 showed no significant differences between the supervisor and employee safety scale ratings. Although results from the correlations suggest there are some inconsistencies between ratings on these six constructs.

Table 3. Paired samples t-test comparing employees means on the six safety scales, with Supervisor means on these same six scales.

	Correlation	t	df	Sig. (2-tailed)
Safety Participation	.13	1.21	38	.23
Safety Compliance	.16	.82	38	.42
Safety Knowledge	.06	-.83	38	.41
Safety Motivation	-.25	-1.20	38	.24
Safety Voicing	.27	.54	38	.59
Rule Breaking	.31	1.62	38	.11

*p<0.05, **p<0.01

Predicting job applicant's safety behaviour - The following sections attempt to determine if accident history, safety puzzles and self-report scales show any ability to predict safety behaviour.

Past Accident and Incident as predictors of future accidents

Hypothesis 2 suggested a relationship should exist between employee self-reports of accident history, and the accident history in their current job, as reported by their supervisors. A measure of accident history may be taken as part of the job applicant's recruitment process, based on the logic that past accident history may be used as a predictive measure of future accident behaviour. Table 4 presents correlations between employee accident history (Near Hits, Minor Injury not requiring medical attention, Minor Injury requiring medical attention, Lost Time Injury, and An Increase in Safety Risk) based on their whole working career, and supervisor's reports of the individuals accident history in their current job, based on the length of time they have supervised/or worked with that employee. Results indicate no significant relationships between employee and supervisor ratings on the five measures of accident history. The disparity between employee and supervisor ratings, suggests accident history may not be a useful predictive measure of future accidents.

Table 4. Employee means on accident/incident reports and supervisor mean ratings of employee's on these same measures.

	Employee mean scores (Based on time of whole working career) (SD) n=39	Supervisor mean scores (Based on time they have supervised/worked with that employee) (SD) n=4	Correlation
Near hit, could have resulted in injury	37.83 (107.85)	0.30 (.65)	-.03
Minor Injury – no medical attention	22.28 (54.23)	0.25 (.71)	-.12
Minor Injury – requiring medical attention	4.50 (16.09)	0.08 (.38)	-.06
A Lost Time Injury	1.15 (2.67)	0.00 (.00)	.b
An increase in Safety Risk	10.68 (44.06)	0.03 (.16)	-.04

*p<0.05, **p<0.01, b. Cannot be computed because at least one of the variables is constant.

Relationship between puzzle scores and accident history

To determine if the safety puzzles were associated with the accident measures, overall puzzle scores were correlated with the employee and supervisor responses to the accident history measures. Table 5 presents results from the correlations between employee and supervisor accident history ratings and overall puzzle scores. Results indicate no relationships between the measures.

Table 5. Pearson Correlations between employee and supervisor accident history ratings and overall puzzle scores.

Employee Accident ratings	Total Differences Found	Safety Differences Found	Safety Order scores	Total Time taken to attempt puzzles
Near hit, could have resulted in injury	.17	.19	.06	.22
Minor Injury – no medical attention	.09	.07	.19	.18
Minor Injury – requiring medical attention	.15	.15	.14	.19
A Lost Time Injury	.16	.16	.17	.26
An increase in Safety Risk	.18	.18	.07	.26
Supervisor ratings				
Near hit, could have resulted in injury	.28	.21	-.29	.11
Minor Injury – no medical attention	.07	-.01	-.13	.02
Minor Injury – requiring medical attention	.18	.20	-.38*	.13
A Lost Time Injury	.b	.b	.b	.b
An increase in Safety Risk	.04	.04	-.05	-.02

Correlation is significant at the 0.05 level (2-tailed), ** Correlation is significant at the 0.01 level (2-tailed), b. Cannot be computed because at least one of the variables is constant.

Self report relationships with accident reports

Table 6 presents correlations between employee and supervisor safety scales, and employee and supervisor accident history ratings. Results indicate several significant correlations between employee ratings of their accident history and ratings on the self-report safety scales. Safety knowledge produced significant correlations with both Minor Injuries (not requiring medical attention) and Lost Time Injury ratings. In addition, safety motivation produced a significant correlation with Minor Injuries (not requiring medical attention). One significant relationship was also found between supervisor ratings of accident history (Minor Injury – not requiring medical attention), and supervisor ratings of safety motivation. Thus, there is some evidence shown in Table 6, that questioning a job applicant about their safety knowledge and safety motivation could have some ability to predict safety outcomes.

Table 6. Pearson Correlations between employee and supervisor safety scales, and employee and supervisor accident history ratings

Employee Safety scales	Employee - Near hit, could have resulted in injury	Minor Injury – no medical attention	Minor Injury – requiring medical attention	A Lost Time Injury	An increase in Safety Risk	Supervisor- Near hit, could have resulted in injury	Minor Injury – no medical attention	Minor Injury – requiring medical attention	A Lost Time Injury	An increase in Safety Risk
Safety Participation	.10	-.07	-.04	.03	.07	.14	.08	.23	.b	.11
Safety Compliance	-.15	**-.39***	-.30	-.26	-.07	-.07	-.09	.09	.b	-.15
Safety Motivation	.14	.07	.14	.12	.10	.17	.05	.13	.b	.04
Safety Knowledge	-.20	**-.38***	-.28	**-.37***	-.27	-.08	.05	.10	.b	.08
Safety Voicing	-.06	-.14	-.10	-.13	-.13	-.08	-.02	.07	.b	-.03
Co-worker caring	-.28	-.27	-.19	-.29	-.26	-.03	-.10	-.01	.b	.18
New Team Member	-.14	-.20	-.17	-.24	-.19	-.15	.05	.01	.b	.09
Safety Attitude	.12	.11	.16	.21	.14	-.08	-.32	-.20	.b	-.02
Rule breaking	.19	.17	.24	.20	.09	.18	.10	-.17	.b	.06
Perceived Risk	.07	.06	-.09	-.04	.02	.03	.20	.30	.b	-.07
Supervisor Safety Scales										
Safety Participation	-.21	-.11	-.26	-.16	-.15	-.15	.06	.07	.b	-.07
Safety Compliance	-.30	-.10	-.19	-.18	-.26	-.18	-.26	-.15	.b	-.18
Safety Motivation	-.05	.06	-.11	-.05	-.00	**-.44****	-.07	-.08	.b	-.11
Safety Knowledge	.03	.08	-.04	.12	-.01	-.11	-.16	-.14	.b	-.04
Safety Voicing	.09	.14	-.00	.05	.05	-.23	.09	.03	.b	-.04
Rule Breaking	.19	.12	.22	.20	.15	.31	-.05	-.03	.b	.04

*Correlation is significant at the 0.05 level (2-tailed), ** Correlation is significant at the 0.01 level (2-tailed), b. Cannot be computed because at least one of the variables is constant.

Puzzle scores and Safety Scales

Bivariate correlations were calculated to test Hypotheses 3 and 4 concerning positive safety measures; participation, compliance, motivation, knowledge, voicing, co-worker caring and reactions to new team members, and negative safety measures; safety attitudes and rule breaking, with safety scores from each of the ten puzzles. Pearson product moment correlations were calculated between positive safety measures and several scores from each puzzle (*total differences found, safety differences found,* and *safety order scores*). Hypothesis 3 predicted that these scores should positively correlate if the puzzles were a valid measure of the safety constructs measured. Results are presented in Tables 7, 8, and 9 for *total differences found*, *safety differences found*, and *safety order* respectively.

Results varied across *total differences found* and positive safety measures. As Table 7 shows, a number of significant correlations were found between, safety motivation and *total differences found* within the, Falls, Forest, Office, Workshop and Workshop Gear puzzles, supporting hypothesis 3. Safety motivation was also moderately correlated with, *total differences found* within the Boat and Street puzzles, though results were not significant. A moderate, but non-significant correlation was produced between safety compliance, and *total differences found* within the Boat puzzle.

Table 7. Pearson Correlations between Total differences found and Positive Safety measures.

	Safety Part.	Safety Comp.	Safety Mot.	Safety Know.	Safety Voicing	Co-worker caring	New Team Member
Beach	.03	.14	.07	-.11	-.21	-.22	-.35*
Boat	-.01	.26	.24	.10	-.25	-.15	-.24
Falls	.04	.01	**.48****	.03	-.08	-.16	-.20
Forest	-.08	-.11	**.66****	.02	.05	-.13	-.26
House	-.14	-.40*	.19	-.28	-.15	-.28	-.53**
Office	-.04	.11	**.63****	-.04	-.08	-.13	-.40*
Office Beh.	.03	-.02	.06	.04	-.21	-.20	-.21
Street	-.05	-.03	.22	-.09	-.08	-.27	-.23
Workshop	-.17	.02	**.34****	-.16	-.12	-.21	-.41**
Workshop Gear	-.01	-.06	**.51****	-.06	.01	-.27	-.38*
Overall	-.06	.01	.50**	-.09	-.17	-.31	-.48**

*Correlation is significant at the 0.05 level (2-tailed), ** Correlation is significant at the 0.01 level (2-tailed)

Table 8 presents correlations between positive safety measures and *safety differences found*. As Table 8 shows, several significant correlations in the hypothesised direction were found between, safety motivation and *safety differences found* scores in the Beach, Boat, Forest, Office and Workshop Gear puzzles, supporting hypothesis 3. Several moderate correlations were found between, safety compliance and the *safety differences found* in the Office puzzle, as well as the safety knowledge scale with *safety differences found* in the Boat puzzle.

Table 8. Pearson Correlations between Safety differences found and Positive Safety Measures.

	Safety Part.	Safety Comp.	Safety Mot.	Safety Know.	Safety Voicing	Co-worker caring	New Team Member
Beach	.05	.05	**.36***	-.12	-.29	-.33*	.08
Boat	.04	**.39***	-.01	.25	-.16	-.02	.04
Falls	.08	-.01	.28	.08	-.15	-.16	-.13
Forest	.00	-.09	**.79****	.05	.04	-.06	-.17
House	-.21	-.32	.05	-.11	-.13	-.24	-.37*
Office	-.01	.22	**.32***	-.05	-.06	-.08	-.19
Office Beh.	.18	.09	.02	.13	-.06	-.08	-.19
Street	-.22	-.02	-.03	-.27	-.18	-.28	-.34*
Workshop	-.19	.06	.27	-.18	-.13	-.27	-.44**
Workshop Gear	-.11	-.12	**.38***	-.04	.00	-.20	-.30
Overall	-.17	.05	.40*	-.07	-.22	-.31	-.43**

*Correlation is significant at the .05 level (2-tailed), **Correlation is significant at the .01 level (2-tailed)

Table 9 presents correlations between positive measures of safety and *safety order scores*. Note that a lower safety order score indicates that the safety differences were identified before neutral differences. Therefore negative correlations were required to find covariation with positive safety measures. As Table 9 shows, several significant relationships were found in support of hypothesis 3. Significant correlations were found between safety participation and *safety order scores* on the Forest, Office and Workshop puzzles. Significant correlations were also produced

between the safety knowledge scale and *safety order scores* in the Workshop puzzle, and the co-worker caring scale with *safety order scores* in the Workshop puzzle.

Table 9. Pearson Correlations between Safety Order found and Positive Safety Measures.

	Safety Part.	Safety Comp.	Safety Mot.	Safety Know.	Safety Voicing	Co-worker caring	New Team Member
Beach	-.03	-.08	.15	.01	.13	-.12	-.12
Boat	-.13	.38*	.05	-.09	-.05	-.14	-.16
Falls	.02	.02	-.13	.11	.00	.11	.21
Forest	**-.34***	-.30	.35*	-.18	.01	-.28	-.16
House	.17	-.00	.02	-.08	-.05	.08	.17
Office	**-.36***	-.30	.06	-.22	-.00	-.22	-.23
Office Beh.	.07	.09	-.05	.07	.18	.17	.23
Street	-.03	.11	.15	-.10	.07	-.07	-.16
Workshop	**-.32***	-.12	.13	**-.36***	-.06	**-.41****	.42**
Workshop Gear	-.08	-.04	.22	-.10	.08	-.23	-.29
Overall	-.23	-.02	.19	-.21	.04	-.25	-.21

*Correlation is significant at the .05 level (2-tailed), ** Correlation is significant at the .01 level (2-tailed). Note a smaller *safety order score* indicates safety differences were found before *neutral differences.*

Negative measures of safety and Puzzle scores

Pearson correlations were also used to test hypothesis 4. Results from negative safety measures (safety attitudes and rule breaking), and puzzle scores (*total differences found* and *safety differences found*) are presented in Table 10 and 11 respectively. Hypothesis 4 predicted that negative safety measure scores should

correlate negatively with puzzle scores. Note – a higher score on these negative safety scales represented a negative attitude towards safety. As seen in Table 10, the correlations between negative safety measures and *total differences found* were not significant, thus hypothesis 4 was not supported. However, one moderate negative correlation was found between safety attitudes and *total differences found* in the Beach puzzle.

Table 10. Pearson Correlations between Total Differences found and Negative Safety Measures.

	Safety Attitudes	Rule breaking/ breaching procedures
Beach	-.23	.07
Boat	.19	.29
Falls	.13	.23
Forest	.12	.03
House	-.04	.16
Office	.08	.15
Office Beh	.00	.31
Street	.15	.26
Workshop	.08	.25
Workshop Gear	-.06	.21
Overall	.07	.30

*Correlation is significant at the .05 level (2-tailed), ** Correlation is significant at the .01 level (2-tailed)

Table 11 presents the correlations between negative measures of safety and *safety differences found*. Table 11 indicates that no significant correlations were

produced between *safety differences found* and negative measures of safety, thus hypothesis 4 were not supported. Three small to moderate correlations were found between safety attitudes and *safety differences found* on the Beach, House and Workshop puzzles.

Table 11. Pearson Correlations between Safety Differences found and Negative Safety Measures.

	Safety Attitudes	Rule breaking/ breaching procedures
Beach	-.13	.32*
Boat	.04	.10
Falls	.02	.08
Forest	.15	.13
House	-.11	.25
Office	.03	.04
Office Beh	.10	.04
Street	.16	.25
Workshop	.16	.27
Workshop Gear	-.18	.11
Overall	.05	.30

*Correlation is significant at the .05 level (2-tailed), ** Correlation is significant at the .01 level (2-tailed)

Final results

Results from the previous correlations conducted between *total differences found, safety order, total time to attempt puzzles, safety differences found,* and positive safety measures, identified a subset of puzzles producing the most significant relationships. Scores from *total differences found* in the Falls, Forest, Office,

Workshop and Workshop Gear, puzzles were all significant when correlated with safety motivation. Three of these puzzles, Forest, Office and Workshop Gear. also produced significant results when scores from *safety differences found* were correlated with the safety motivation scale. *Safety order* scores from the Workshop puzzle were also significant when correlated with safety knowledge and co-worker caring scales. Correlations were then calculated for the subset of five puzzles, overall (composite) puzzle scores, and the three safety constructs that contained significant relationships. Table 12 provides these correlational results, indicating four significant, and one moderate correlation in support of hypothesis 3. These results suggest that the five puzzles that may be used as a valid measure of safety knowledge, motivation and co-worker caring.

Table 12. Pearson correlation between puzzle metrics and self-report scale scores

Puzzle	*Total Safety Differences* Found & Safety Motivation	*Total Differences Found* & Safety Motivation	*Total Time to Attempt Puzzles* & Safety Motivation	*Safety Order* and Co-worker Caring	*Safety Order* and Safety Knowledge
Falls	.28	.48**	.16	.11	.11
Forest	.79**	.66**	-.09	-.28	-.18
Office	.32*	.63**	.43*	-.22	-.22
Workshop	.27	.34**	.29	-.41**	-.36*
Workshop Gear	.38**	.51**	.42*	-.23	-.09
Composite of Five Puzzles	.60**	.65**	.43*	-.33*	-.24

*Correlation is significant at the .05 level (2-tailed), ** Correlation is significant at the .01 level (2-tailed). Note a smaller *safety order score* indicates safety differences were found before neutral differences

Discussion

Although a number of behavioural and attitudinal measure of safety constructs such as participation and compliance (Neal & Griffin, 2006), considerate and responsible employees (Burt et al., 1998), safety knowledge (Neal et al., 2000), and safety motivation (Neal et al., 2000) have been developed, this is the first study to utilise spot the difference puzzles as an objective measure of safety orientation. The aim of the research was to validate the use of the spot the difference puzzles as a measure of safety. The validation process was conducted in order to address the question of whether the puzzles (or a subset of them) could be used as an objective measure of a job applicants safety orientation.

Summary of Findings

Puzzles and self-report scale scores:

Response variance in self-report scales

Ratings of employee safety behaviours and attitudes (participation, compliance, knowledge, motivation, rule breaking and safety voicing) were taken from self-report scales, and supervisor ratings. T-test results showed no significant differences between the mean ratings of these two groups. However, correlational results indicated inconsistencies between employee and supervisor ratings. These findings may have resulted due to the true variance in a construct, which should account for similar responses between the employee and supervisor ratings within each construct measured. In contrast, error variance in responses, attributable to biases such as social desirability and impression management, might explain the inconsistencies that were found. As Spector (2006) reported, error variance in self-report responses, particularly in measures of socially sensitive topics, can often be attributed to such biases. Further research on response biases states that, employees understand that their responses to

sensitive issues, such as occupational health and safety, will have a direct impact on how they are perceived by their organisation. When these self-report measures are used during recruitment as a means of predicting future performance, organisations may get a biased and inaccurate measure of an applicants safety orientation. Employing applicants who do not possess the right safety attitude, may prove costly for organisations, particularly in high risk work environments.

Secondly, a measure of the employee's accident history was taken from the employees, and their supervisors. A measure of accident history can be taken as part of the job applicant's recruitment process, based on the logic that past accident history may be used as a predictive measure of future accident behaviour. Employee ratings of accident history were taken based on their whole working career, while supervisor ratings were made based on the time they had supervised/worked with that employee. Hypothesis 2 suggested that a relationship should exist between the employee accident history reports, and supervisor accident history ratings. Correlational results indicated no significant relationships between the employee and supervisor ratings on the five measures of accident history. Disparity between these results of accident history suggest this may not be a useful predictor of future accidents.

Further, the shift in safety literature from a focus on individual non-compliance, to an emphasis on organisational safety climate, may have an influence on employee safety accident history (Reason, 1990). That is, an employee with a good safety accident history will benefit the most by joining an organisation with a positive safety climate. An employee or applicant with a good safety accident history who joins an organisation with a poor safety climate, may get frustrated resulting in a possible increase of accidents. Further, an employee with a poor safety accident history who joins an organisation with a positive safety climate may increase the frequency of accidents, while posing a danger to co-workers and themselves. This is

another factor that may influence the predictive validity of accident history as a measure of future safety performance.

Although Sutherland and Cooper (1991) showed that personality traits such as extraversion and neuroticism were drivers in the occurrence workplace accidents, research by Greenwood and Yule (1920), provided an alternative explanation. This, along with the research from Visser et al. (2007) suggests that 'accident proneness' theories do exist. If these theories are proven to exist then measures of personality during recruitment may be void. That is, a certain personality disposition may not predict accident involvement, a certain proneness to accidents may.

Self-report scales and puzzle scores

Hypothesis 3 examined the prediction that, if the puzzles were valid measures of safety they should correlate with employee self-report ratings (they should show some relationship with the true variance component in the scale scores). Correlations were conducted between the ten self-report safety scales and a series of puzzle scores including; *total differences found, safety differences found, safety order scores, and total time taken to attempt puzzles.* Results identified a subset of puzzles, which may be used as a valid measure of three safety constructs. Significant correlations were produced between measures of safety motivation and *total differences found*, safety motivation and *safety difference found*, safety knowledge and *safety order* scores, and co-worker caring and *safety order* scores. Within the results, a clear association was made between five of the ten puzzles; Falls, Forest, Office, Workshop, Workshop Gear, and the safety constructs; motivation, knowledge and co-worker caring. These results can be interpreted as the subset of puzzles predicted the true variance in the employee's scores on safety knowledge, motivation, and co-worker caring. These results also may suggest that an employee who is motivated by safety may look

harder within the puzzles to identify any hazards. While employees with greater safety knowledge may be more aware of the safety aspects within the puzzles.

Safety scales and accidents history ratings

Employee safety scale ratings were also correlated with employee accident history ratings. Results indicated several significant relationships between the measures. Specifically, safety motivation and safety knowledge were shown to be the most significant predictors of employee accident history. Safety motivation and knowledge both produced significant negative relationships with measures of Minor Injuries (not requiring medical attention), while safety motivation also produced a significant negative relationship with Lost Time Injury ratings. It is likely that the true variance within safety knowledge and motivation scales responses created the association with accident history ratings. Thus, if the puzzle test can predict the key constructs of safety motivation and knowledge, and as found these constructs are linked to accident reduction, then the puzzles have the potential to be very useful in the recruitment process.

Together these results provide some evidence that a subset of the puzzles, Falls, Forest, Office, Workshop and Workshop Gear, can be used as a valid measure of the safety constructs, motivation, knowledge and co-worker caring. If the subset of puzzles can provide a valid measure of an employees safety motivation, and knowledge, which in turn provides some ability to predict safety outcomes, then the puzzles may be used as a valid tool in predicting safety outcomes of new employees.

Practical and theoretical implications

It is important for organisations to hire employees with the right safety attitude, who will fit with the current safety culture of that organisation. During recruitment interviews and testing, organisations may take a measure of an applicants safety behaviours and attitudes. This is done in order to predict the applicant's safety

orientation. However, results from this study identified inconsistencies between employee and supervisor ratings on a number of safety measures. One suggestion is that response biases such as impression management and social desirability may have had an effect on scale responses. Research suggests that self-report questionnaires directed towards measures of safety behaviours and attitudes are often subject to biases. For organisations to ensure that a valid measure of the employee's safety orientation is taken during the recruitment stages, a more objective tool, free from biases, is required. The spot the difference puzzle tool, specifically the subset of five successful puzzles, may provide this objective measure free from biases, which may be used in recruitment by organisations.

For organisations in high-risk occupations, it is essential to hire employees with the right safety attitude. Another option for organisations to measure an applicant's safety orientation during recruitment is past accident history. However inconsistencies in the results from this study were inline with research which suggests that, accident and incident frequency reports, are generally inaccurate (Sato & Kawahara, 2011). Cognitive psychology has also shown that retrospective recall of an employee's accident history, is often distorted, and that information from negative events, such as workplace accidents, are generally exaggerated or under-reported (Sato & Kawahara, 2011). Lalande and Bonanno (2011) describe these effects as memory recall biases, which often occur following a potentially traumatic event. Inaccurate accident history results, affected by memory recall biases may prove costly, particularly where organisations use an employee's accident history as a predictive measure of future safety performance. An additional issue that organisations face, is measuring an applicants accident history when they have no previous work experience. This is often the situation that recruiters are faced with, especially where new recruits are coming straight from a tertiary or high school environment with no previous work experience

or history. Organisations may benefit from using a more objective tool, such as the spot the difference puzzles, as a predictive measure of safety orientation, which may also be utilise with applicants who have no accident history.

The five puzzle images, identified as the most significant predictors of safety motivation, knowledge, and co-worker caring were all orientated towards occupational settings. This may have had an impact on whether the employees noticed the safety differences. If organisations were to use the puzzle set as a measure of safety orientation at recruitment, it would be suggested that they use the whole set of ten puzzle, then look at the subset of scores which were found to be valid. Using all ten of the puzzles could help to ensure that applicants do not pick up that the task is about safety.

Limitations

Throughout the study it was apparent that a number of the participants (construction workers) were not familiar with simple use of a computer. Though the task only required participants to click areas of difference, unfamiliarity with a computer mouse caused a number of errors to be made at the beginning of the task. For example, some employee's expressed that they could not find the mouse cursor when beginning some puzzles, they therefore they used a number of clicks to locate the cursor, and these clicks were subsequently counted as error. It would therefore be beneficial to test the use of the spot the difference puzzles on a different work sample. Results from different work samples may identify more puzzles as significant predictors of safety.

Another limitation of the current study is that puzzle validation was only conducted on one sample. The study measured 39 construction workers, over a period of two weeks, from one organization. The generalizability of the study results, are therefore limited. Further research could measure whether job applicants coming straight from tertiary or secondary school education, or different work samples, would

produce a different subset of successful puzzles which could be used as a predictive measure of safety constructs.

Another limitation of the current study concerned the intended use of the puzzle tool. Validation of the puzzles was conducted with current employees of a construction company. However, the intended use of the puzzles is in recruitment, testing applicants who are applying for jobs involving safety. There were no implications, or consequences for employee's participation in the task. Participants completed the task to the best of their ability, with no requirements or consequences for their performance. Results may therefore be different to what we would expect to see if the tool was implemented in selection and hiring, where consequences of poor performance, may result in the applicant not being hired.

Future research

Given that the study was conducted with 39 employees from the one industry, it may be interesting to see the effects of a bigger sample size, within a range of occupations or levels of work experience. Future research could examine whether there are differences in the puzzle and safety scale correlations, between workers from different industries, other than construction? Specifically, whether any puzzles, other than the five successful in this study, produced significant relationships with different safety constructs. The findings would help determine whether the puzzle test could be used as a valid measure of safety orientation outside of the construction industry. Further, this study could be carried out as a longitudinal design to improve the accuracy of the findings. This would involve measuring the employees and supervisors on the safety constructs first, then after a certain period of time, testing those same employees on the puzzle set. Thus, the study would be more predictive than concurrent in nature. In addition, puzzle scores, and in particular (safety

differences found, and safety order scores), could be less influenced if a time lag was introduced between the two measures.

Finally, results produced significant relationships between puzzle scores (falls, forest, office, workshop and workshop gear) and safety scales (motivation, knowledge and co-worker caring). In addition, significant relationships were found between safety scales (motivation and knowledge) and accident history ratings (minor injuries not requiring medical attention and lost time injuries). However, accident history ratings had no significant relationship to puzzle scores. Future research may also examine some interesting effects that occurred in this study. It could be tested to see whether the safety constructs have a mediating effect on the relationship between puzzle scores and accident history ratings.

Finally, future research could look at the relationship between personality as a measure of safety and the puzzle scores. As Sutherland and Cooper (1991) showed in their research, there is evidence associating personality traits such as extraversion and neuroticism, with the driving behaviours in the involvement of accidents. It would be interesting to test the puzzles with these personality traits as a measure of safety.

Conclusion

The present study aimed to validate the use of the ‘spot the difference puzzles’ as a measure of employee safety orientation. The study confirmed that safety differences found, total differences found, safety order, and total time to attempt puzzle scores, on the Falls, Forest, Office, Workshop and Workshop Gear puzzles, had significant relationships with safety motivation, co-worker caring, and safety knowledge constructs. These five validated spot the difference puzzles could provide employers and organisations with the means to screen job applicants on, safety motivation, safety knowledge, and co-worker caring.

References

Burt, C.D.B., Chmiel, N., Hayes, P. (2009). Implications of turnover for safety attitudes and behaviour in work teams. *Safety Science* 47, 1002–1006.

Burt, C.D.B., Gladstone, K., Grieve, K. (1998). Development of the Considerate and Responsible Employee (CARE) scale. *Work and Stress* 12 (4), 262–369.

Burt, C.D.B., Stevenson, R.J. (2009). The relationship between recruitment processes, familiarity, trust, perceived risk and safety. *Journal of Safety Research* 40, 365–369.

Cadieux, J., Roy, M. & Desmarais, L. (2006) A preliminary validation of a new measure of occupational health and safety. *Journal of Safety Research* 37, 413-419.

Chmiel, N. (2005). Promoting health work: Self-reported minor injuries, work characteristics, and safety behaviour. In C. Krunka, P. Hoffmann, & A Bussing (Eds.), Change and quality in human service work (p 277 – 288). Mering: Rainer Hampp Verlag.

Chung, J., & Monroe, G. S. (2003). Exploring social desirability bias. *Journal of Business Ethics*, *44*(4), 291-302.

Clarke, S. (2003). The contemporary workforce: implications for organisational safety culture. *Personnel Review* 32 (1), 40–57.

Clarke, S. (2003). Safety culture: underspecified and overrated? *International Journal of Management Reviews*, *2*(1), 65-90.

Clarke, S. (2006). Contrasting perceptual, attitudinal and dispositional approaches to accident involvement in the workplace. *Safety Science*, *44*(6), 537-550.

Clarke, S., & Robertson, I. (2005). A met analytic review of the Big Five personality factors and accident involvement in occupational and nonoccupational settings. *Journal of Occupational and Organizational Psychology*, *78*(3), 355-376.

Clissold, G., Buttigieg, D. M. & De Cieri H. (2012). A psychological approach to occupational safety. *Asia Pacific Journal of Human Resources* 50, 92-109.

Conchie, S. M. & Burns, C. (2009). Improving occupational safety: using a trusted information source to communicate about risk. *Journal of Risk Research,* Vol. 12, Issue 1, 13-25.

Cox, S. and Cox, T. (1991). The Structure of employee attitudes to safety: a European example. *Work and Stress*, 1991, Vol. 5, No. 2, 93-106.

DeArmond, S., Smith, A. E., Wilson, C.L., Chen, P. Y. & Cigularov, K. P. (2011) Accident Analysis and Prevention Individual safety performance in the construction industry: Development and validation of two short scales. *Accident Analysis and Prevention* 43, 948-954.

Dedobbeleer, N. & Beland, F. 1991, 'A safety climate measure for construction sites', *Journal of Safety Research*, vol. 22, no. 2, pp. 97–103.

Didla, S., Mearns. & Flin, R. (2009) Safety citizenship behaviour: a proactive approach to risk management. Journal of Risk Research, Vol 12. Issue 3-4, 475-483.

Donald, I., & Canter, D. (1993). Attitudes to safety: Psycho- logical factors and the accident plateau. *Health and Safety Information Bulletin*, 215, 5–8.

DuBrin, A. J. (2010). *Impression Management in the Workplace: Research, Theory, and Practice*. Routledge.

Fastame, M. C. & Penna M. P. (2012): Does Social Desirability Confound the Assessment of Self-Reported Measures of Well-Being and Metacognitive Efficiency in Young and Older Adults?, *Clinical Gerontologist*, 35:3, 239-256

Flin, R., Mearns, K., O'Conner, P. & Bryden, R. 2000, 'Measuring safety climate: Identifying the common features'. *Safety Science*, vol. 34, pp. 177–92.

Fugas, C.S., Meliá, J.L., Silva, S.A., 2011. The "is" and "the ought": how perceived social norms influence safety behaviors at work? *Journal of Occupational*

Health Psychology 16 (1), 67–79.

Goodman, P. S. & Garber, S. (1988). Absenteeism and accidents in a dangerous environment: Empirical analysis of underground coal mines. *Journal of Applied Psychology*, Vol 73(1), 81-86.

Greenwood, M. & Yule, G. (1920). An inquiry into the nature of frequency distributions representative of multiple happenings, with particular reference to the occurrence of multiple accidents or disease or repeated accidents. *Journal of Royal Statistical Society, 83*, 255.

Griffin, M.A., & Neal, A. (2000). Perceptions of safety at work: A framework for linking safety climate to safety performance, knowledge and motivation. *Journal of Occupational Health Psychology*, *5*(3), 347-358.

Griffin, M.A., Burley, N. & Neal, A. August. (2000). 'The impact of supportive leadership and conscientiousness on safety at work', paper presented at the 25th annual meeting of the *Academy of Management*, Toronto.

Hansen, C.P. (1989). A causal model of the relationship among accidents, biodata, personality and cognitive factors. *Journal of Applied Psychology* 74, 81–90.

Hayes, B. E., Perander, J., Smecko, T., & Trask, J. (1998). Measuring perceptions of workplace safety: Development and validation of the work safety scale. *Journal of Safety Research, 29*(3), 145-161.

Hayes, B.E., Peranda, J., Smecko, T. & Trask, J. (1998). 'Measuring perceptions of workplace safety: Development and validation of the workplace safety scale', *Journal of Safety Research*, Vol. 29, No. 3, pp. 145–61.

Hofmann, D. A., Griffin, M. A., & Gavin, M. B. (2000). The application of hierarchical linear modeling to organizational research. In K. J. Klein & S. W. J. Kozlowski (eds.), Multilevel theory, research, and methods in organizations: Foundations, extensions, and new directions (pp. 467-511).

Holtgraves, T. (2004). Social desirability and self-reports: Testing models of socially desirable responding. *Personality and Social Psychology Bullettin*, 30, 161–172.

Hofmann, D. A., Morgeson, F. P., & Gerras, S. J. (2003). Climate as a moderator of the relationship between leader-member exchange and content specific citizenship: safety climate as an exemplar. *Journal of Applied Psychology*, *88*(1), 170.

International Labour Organisation, International Labour Office Occupational Safety Statistics (n.d), retrieved from http://www.ilo.org/global/topics/safety-and-health-at-work/lang--en/index.htm.

Johnson, T. & Fendrich, M. (2005) Medeling Source of Self-report Bias in a Survey of Drug Use Epidemiology. *Annals of Epidemiology*, Vol 15. Issue 5, 381-389.

Iverson, M. A., & Reuder, M. E. (1965). Personality Impressions of Self-Punitive and Extrapunitive Stimulus Persons. *The Journal of Social Psychology*, Vol. *65*(1), 67-83.

Kapp, E. A. (2012). The influence of supervisor leadership practices and perceived group safety climate on employee safety performance. *Safety Science* 50, 1119-1124.

Lalande, K. M. & Bonanno, G. A (2011). Retrospective Memory Bias for the Frequency of Potentially Traumatic Events: A Prospective Study. *American Psychological Association*, Vol 3, No. 2, 165-170.

Lamm, F. (2002). Occupational health and safety in small busisnesses. In M. Lloyd (Ed.), *Occupational health and safety in New Zealand*: Contemporary social research (pp. 93-117). Palmerston North, New Zealand: Dunmore Press.

Maudgalya, T., Genaidy, A. & Shell, R. (2008). Productivity–quality–costs–safety: A sustained approach to competitive advantage—a systematic review of the

national safety council's case studies in safety and productivity**.** *Human Factors and Ergonomics in Manufacturing & Service Industries.* Vol. 18 (2) 152–179.

Macky K and Johnson G, Managing Human Resources in New Zealand (second edition), McGraw-Hill Australia, 2003, p 192,349.

Mearns, K., Flin, R., Gordon, R. & Fleming, M. 1998, 'Measuring safety climate on offshore installations', *Work and Stress*, Vol. 12, No. 3, pp. 238–54.

Ministry of Business, Innovation and Employment. Labour Information, New Zealand Department of Labour Occupational Health and Safety Research (2012), retrieved from http://www.dol.govt.nz/whss/state-of-workplace/sowh-2012

Ministry of Business, Innovation and Employment. Labour Information, New Zealand Health and Safety Act (1992), retrieved from http://www.osh.govt.nz/services/enforcement.shtml

Neal, A. & Griffin, M. A. (2002). Safety climate and safety behaviour. *Australian journal of management, 27 (Special issue)*, 67-75.

Neal, A. & Griffin, M. A. (2006). A longitudinal study of the relationships among, safety climate, safety behavior, and accidents at the individual and group levels. *Journal of Applied Psychology, 91,* 946-953

Neal, A., Griffin, M. A., & Hart, P. M. (2000). The impact of organizational climate on safety climate and individual behavior. *Safety Science, 34*(1-3), 99-109.

Paulhus, D. L. (1984). Two-component models of socially desirable responding. *Journal of Personality and Social Psychology*, 46, 598–609.

Podsakoff, P. M., Mackenzie, S. B., Lee, J.-Y., & Podsakoff, N. P. (2003). Common method biases in behavioral research: A critical review of the literature and recommended remedies. *Journal of Applied Psychology, 88*, 879–903.

Posthuma, R. A., Morgeson, F. P., & Campion, M. A. (2006). Beyond employment interview validity: A comprehensive narrative review of recent research and trends over time. *Personnel Psychology*, *55*(1), 1-81.

Probst, T. M., & Estrada, A. X. (2010). Accident under-reporting among employees: Testing the moderating influence of psychological safety climate and supervisor enforcement of safety practices. *Accident Analysis & Prevention*, *42*(5), 1438-1444.

Quinlan, M., Bohle, P., & Lamm, F. (2010). *Managing occupational health and safety*. Palgrave Macmillan.

Reason, J. T. (1997). *Managing the Risks of Organisational Accidents.* Aldershot: Ashgate.

Reason, J. (1990). *Human Error.* Cambridge University Press, Cambridge.

Sato, H. & Kawahara, J. (2011): Selective bias in retrospective self-reports of negative mood states. *Anxiety, Stress & Coping: An International Journal*, 24:4, 359-367.

Schlenker, B. R. (1980). Impression management: The self-concept, social identity, and interpersonal relations. Monterey, CA: Brooks/Cole Publishing Company.

Siu, O., Phillips, D.R., & Leung, T.W. (2003). Safety climate and safety performance among construction workers in Hong Kong: the role of psychological strains as mediators. *Accident Analysis and Prevention* 36, 359–366.

Specht, M., Chevreau, F.R. & Denis-Remis. C. (2006). Dedicating management to cultural processes: Toward a human risk management system. Journal of Risk Research 9: 525–42.

Spector, P. E. (2006). Method variance in organizational research truth or urban legend?. *Organizational research methods*, *9*(2), 221-232.

Sutherland, V. J., & Cooper, C. L. (1991). Personality, stress and accident involvement in the offshore oil and gas industry. *Personality and Individual Differences, 12*(2), 195-204.

Tedeschi, J. T. & Norman, N. (1985). Social power, self-presrvation, and the self. In B. R. Schlenker (Ed). The Self and Social life, 293-322. New York, McGraw-Hill.

Tjosvold, D., Yu, Z. & Hui, C. (2004). Team learning from mistakes: The contribution of cooperative goals and problem-solving. *Journal of Management Studies*, 41, 7, 1223-1245.

Tucker, S., Chmiel, N., Turner, N., Hershcovis, S., & Stride, C. B. (2008). Perceived organizational support for safety and employee safety voice: The mediating role of co- worker support for safety. *Journal of Occupational Health Psychology, 13*(4), 319- 330.

United States Department of Labor, Bureau of Labor Statistics. United States Occupational Safety Statistics (n.d), retrieved from www.bls.gov/news.release.

United States Environmental Protection Agency. Summary of the United States Occupational Safety and Health Act (2012), retrieved from www.epa.gov/lawsregs/laws/osha.

Visser, E., Pijl, Y., Stolk, R., Neeleman, J. & Rosmalen, J. (2007). Accident proneness, does it exist? A review and meta-analysis. *Accident Analysis and Prevention*, 39, 556-564.

Webb, G. R., Redman, S., Wilkinson, C., & Sanson-Fisher, R.W. (1989). Filtering effects in reporting work injuries. *Accident Analysis And Prevention, 21*(2), 115-123.

Zohar, D. (1980). Safety climate in industrial organizations: Theoretical and applied implications. *Journal of Applied Psychology, 65*(1), 98-102.

Appendices

Appendix A (i): Employee Information Sheet

Department of Psychology

INFORMATION SHEET

"Spot the difference" puzzle information processing study

You are invited to participate as a subject in the research project "Spot the difference" puzzle information processing study. The purpose of this project is to investigate how people process information in puzzles.
Your involvement in this project will be to complete a series of "spot the difference" puzzles on a computer program. You will use the computer mouse to select the difference areas on one of the two puzzles. There are a total of 10 puzzles, each with 10 differences. You have the right to withdraw from the project at any time, including withdrawal of any information provided without penalty. It is estimated to take 30 minutes to complete the series of puzzles.

As a follow-up to this investigation, you will be asked to complete a self report measure which will be used to relate the information collected from the puzzle information processing task to your work experiences. This task will take approximately 10 minutes to complete.

In addition to this your direct supervisor will be asked to complete a series of questions about you and your work experiences. You are entitled to see your own individual information from the supervisor at the conclusion of the study. The information that is obtained from your supervisor's about you will be directly related to the research and will have no consequence on your job whatsoever.

There will be inducements offered for participation in this research. If you wish to be in the draw for the inducements personal information (such as a phone number or email address) will be needed in order to contact you.

The results of the project may be published, but you may be assured of the complete confidentiality of data gathered in this investigation: the identity of participants will not be made public without their consent.

I understand also that I may at any time withdraw from the project, including withdrawal of any information I have provided without penalty.

The project is being carried out as a requirement of a Master's of Science in Applied Psychology by Elizabeth Shaw under the supervision of Dr. Chris Burt, who can be contacted via email at christopher.burt@canterbury.ac.nz. He will be pleased to discuss any concerns you may have about participation in the project. The project has been reviewed ***and approved*** by the University of Canterbury Human Ethics Committee. Ethics Committees, University of Canterbury Private Bag 4800, Christchurch 8140, New Zealand.

Appendix A (ii): Supervisor Information Sheet

Department of Psychology

INFORMATION SHEET

"Spot the difference" puzzle information processing study

INFORMATION

You are invited to participate as a subject in the research project. The purpose of this section of the project is to get ratings on a number of aspects of safety for each of your employees.

Your involvement in this project will be to complete a series of questions regarding different dimensions of your employees safety on the job. In addition you will be asked to provide an objective measure of the number of accidents/incidents that each employee has been involved in over the period of time you have worked with/supervised that employee.

The results of the project may be published, but you may be assured of the complete confidentiality of data gathered in this investigation: the identity of participants will not be made public without their consent.

The project is being carried out as a requirement of a Master's of Science in Applied Psychology by Elizabeth Shaw under the supervision of Dr. Chris Burt, who can be contacted via email at christopher.burt@canterbury.ac.nz. He will be pleased to discuss any concerns you may have about participation in the project.

The project has been reviewed ***and approved*** by the University of Canterbury Human Ethics Committee. Ethics Committees, University of Canterbury Private Bag 4800, Christchurch 8140, New Zealand.

Appendix B: Consent Form

Elizabeth Shaw

Department of Psychology

CONSENT FORM

"Spot the Difference" Puzzle Information Processing Study

I have read and understood the description of the above-named project. On this basis, I agree to participate as a subject in the project, and I consent to publication of the results of the project with the understanding that anonymity will be preserved.

I understand also that I may at any time withdraw from the project, including withdrawal of any information I have provided.

I note that the project has been reviewed ***and approved*** by the University of Canterbury Human Ethics Committee.

NAME (please print): ……

Signature:

Date:

Appendix C: Supervisor Questionnaire

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

Supervisor safety measure

Please complete one safety measure questionnaire for each employee that you are responsible for.

You will be required to complete questions on the employee's safety participation/ compliance, their propensity to break/bend rules and procedures, their safety knowledge, their attitudes towards safety motivation, their safety voicing behaviours, and finally an objective measure of the number of accidents/incidents that the employee has been involved in whilst working under your supervision.

Employee name_____

How long (in years/months) have you worked with or supervised this employee _____

Supervisor safety measures

These questions are about **the employees** safety **participation and compliance** on the job. **For each item please circle the number which indicates the extent to which they engage in each behaviour**

	Never	Rarely	Occasionally	Frequently	Always
Uses all the necessary safety equipment to do their job	**1**	**2**	**3**	**4**	**5**
Uses the correct safety procedures while carrying out their job	**1**	**2**	**3**	**4**	**5**
Ensures the highest levels of safety when carrying out their job	**1**	**2**	**3**	**4**	**5**
Promotes the safety program within the organisation	**1**	**2**	**3**	**4**	**5**
Puts in extra effort to improve the safety of the workplace	**1**	**2**	**3**	**4**	**5**
Voluntarily carries out tasks or activities that help to improve workplace health and safety	**1**	**2**	**3**	**4**	**5**

These questions are about **the employees** propensity to **break rules and breach procedures** on the job. **For each item please circle the number which indicates the extent to which they engage in each behaviour**

	Never	Rarely	Occasionally	Frequently	Always
They sometimes cut corners if it makes the task easier	**1**	**2**	**3**	**4**	**5**
Their work pressures mean that they sometimes bend the rules	**1**	**2**	**3**	**4**	**5**
Occasionally they bend the rules when they know it is safe to do so	**1**	**2**	**3**	**4**	**5**
The worker is more flexible with which procedures they follow when I am not around	**1**	**2**	**3**	**4**	**5**

These questions are about the employee's **safety knowledge** in the workplace. **For each item please circle the number which indicates the extent to which you disagree or agree**

	Strongly disagree	Disagree	Neither agree/ disagree	Agree	Strongly agree
They know how to perform their job in a safe manner	**1**	**2**	**3**	**4**	**5**
They know how to use safety equipment and standard work procedures	**1**	**2**	**3**	**4**	**5**
They know how to maintain or improve workplace health and safety	**1**	**2**	**3**	**4**	**5**
They know how to reduce the risk of accidents and incidents in the workplace	**1**	**2**	**3**	**4**	**5**

These questions are about the employees **safety voicing behaviours** within their job. **For each item please circle the number which indicates the extent to which they engage in each behaviour**

	Never	Rarely	Occasionally	Frequently	Always
They make suggestions about how safety could be improved	**1**	**2**	**3**	**4**	**5**
They tell colleagues who are doing something unsafe to stop	**1**	**2**	**3**	**4**	**5**
They discuss new ways to improve safety with their colleagues or me	**1**	**2**	**3**	**4**	**5**
They inform me when they notice a potential hazard	**1**	**2**	**3**	**4**	**5**
They report to me if their colleagues brake any safety rules	**1**	**2**	**3**	**4**	**5**

These questions are about the employees **attitudes** towards **safety motivation** in the workplace. **For each item please circle the number which indicates the extent to which you disagree or agree.**

	Strongly disagree	Disagree	Neither agree/ disagree	Agree	Strongly agree
They believe that workplace health and safety is an important issue	**1**	**2**	**3**	**4**	**5**
They feel that it is worthwhile to put in effort to maintain or improve their personal safety	**1**	**2**	**3**	**4**	**5**
They feel that it is important to maintain safety at all times	**1**	**2**	**3**	**4**	**5**
They believe that it is important to reduce the risk of accidents and incidents in the workplace	**1**	**2**	**3**	**4**	**5**

Finally these questions require you to detail how many times the employee has had an **accident or incident** while working under your supervision

Safety Incidents	Number of times
A near hit incident, which had it turned out differently, could have resulted in injury	
A very minor injury not requiring medical attention	
A minor injury requiring medical attention (e.g. first aid treatment or a visit to a doctor), though no time off work	
A Lost Time Injury (LTI) that required them to take time off work	
An increase in safety risk which was the result of their behaviour	

Please check that you have answered all questions.
Thank you for taking the time to participate in this study.

Appendix D: Employee Questionnaire

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

Safety self report measure

The items included in this questionnaire are used to measure your safety participation/compliance, your propensity to break/bend rules and procedures, safety attitudes, your co-worker caring attitudes, safety skepticism, your attitudes towards new team members, safety knowledge, safety motivation, safety voicing behaviours, your perceived job risk, and finally an objective measure of the number of accidents/incidents you have been involved in within the past 12 months.
Please note that this research is not anonymous, but is confidential and information you provide in this survey will not be seen by your company/supervisor or any other employees.
Your scores from the information processing task will be matched to scores recieved within this self-report measure. For that reason it is impossible to keep the study anonymous, however information will be kept strictly confidential.

Your name_____
Age_____
Gender: M / F
How long (in years/months) have you worked in this industry_____
How long (in years/months) have you worked in this particular job_____

Self-report safety measures.

These questions are about your safety **participation and compliance** behaviours on the job. **For each item please circle the number which indicates the extent to which you engage in each behaviour**

	Never	Rarely	Occasionally	Frequently	Always
I use all the necessary safety equipment to do my job	**1**	**2**	**3**	**4**	**5**
I use the correct safety procedures for carrying out my job	**1**	**2**	**3**	**4**	**5**
I ensure the highest levels of safety when I carry out my job	**1**	**2**	**3**	**4**	**5**
I promote the safety program within the organisation	**1**	**2**	**3**	**4**	**5**
I put in extra effort to improve the safety of the workplace	**1**	**2**	**3**	**4**	**5**
I voluntarily carry out tasks or activities that help to improve workplace health and safety	**1**	**2**	**3**	**4**	**5**

These questions are about your propensity to **break rules and breach procedures** on the job. **For each item please circle the number which indicates the extent to which you engage in each behaviour**

	Never	Rarely	Occasionally	Frequently	Always
I cut corners if it makes the task easier	**1**	**2**	**3**	**4**	**5**
Work pressures mean that I bend safety rules	**1**	**2**	**3**	**4**	**5**
I bend the rules when I know it is safe to do so	**1**	**2**	**3**	**4**	**5**
When my boss is not around I can be more flexible with which procedures I follow	**1**	**2**	**3**	**4**	**5**

These questions are about your attitudes towards **co-worker safety** on the job. **For each item please circle the number which indicates the extent to which you disagree or agree for your job**

	Strongly disagree	Disagree	Neither agree/ disagree	Agree	Strongly agree
Workers should point out hazards to co-workers	**1**	**2**	**3**	**4**	**5**
Workers should immediately remove hazards if possible	**1**	**2**	**3**	**4**	**5**
Safety depends on everyone following safety procedures	**1**	**2**	**3**	**4**	**5**
Co-workers should be warned when their actions are unsafe	**1**	**2**	**3**	**4**	**5**
Workers should assist each other with tasks to ensure safety	**1**	**2**	**3**	**4**	**5**
Co-workers should discuss changes that could improve safety	**1**	**2**	**3**	**4**	**5**
Crew leaders should be notified of hazards	**1**	**2**	**3**	**4**	**5**
Safety comes from worker cooperation	**1**	**2**	**3**	**4**	**5**
Co-workers' limitations should be recognised	**1**	**2**	**3**	**4**	**5**
Co-workers should give each other informal safety instruction	**1**	**2**	**3**	**4**	**5**
Supporting co-workers ensures everyone's safety	**1**	**2**	**3**	**4**	**5**
A worker should never be too busy to help a co-worker	**1**	**2**	**3**	**4**	**5**
Co-workers should discuss near-hits	**1**	**2**	**3**	**4**	**5**
Co-workers should discuss past accidents	**1**	**2**	**3**	**4**	**5**
Near-hits should be reported to management	**1**	**2**	**3**	**4**	**5**

These questions are about your attitudes towards **new team members** on the job. **For each item please circle the number which indicates the extent to which you disagree or agree for your job**

	Strongly disagree	Disagree	Neither agree/ disagree	Agree	Strongly agree
It is important for crew safety for me to find out the safety history of a new crew member	**1**	**2**	**3**	**4**	**5**
Immediately determining the safety attitudes of a new crew member is important for crew safety	**1**	**2**	**3**	**4**	**5**
It is important for safety for me to encourage a new crew member to ask about safety procedures	**1**	**2**	**3**	**4**	**5**
Everyone pays more attention to safety when a new member joins the crew	**1**	**2**	**3**	**4**	**5**
It is particularly important to watch out for the safety of a new crew member	**1**	**2**	**3**	**4**	**5**
It is safer to assume initially that a new crew member will not follow safety procedures	**1**	**2**	**3**	**4**	**5**

These questions are about your **safety knowledge** in the workplace. **For each item please circle the number which indicates the extent to which you disagree or agree for your job**

	Strongly disagree	Disagree	Neither agree/ disagree	Agree	Strongly agree
I know how to perform my job in a safe manner	**1**	**2**	**3**	**4**	**5**
I know how to use safety equipment and standard work procedures	**1**	**2**	**3**	**4**	**5**
I know how to maintain or improve workplace health and safety	**1**	**2**	**3**	**4**	**5**
I know how to reduce the risk of accidents and incidents in the workplace	**1**	**2**	**3**	**4**	**5**

These items are about your perceived risk on the job. **Listed below are words which might describe your job. For each word please circle the number which indicates the extent to which you disagree or agree for your job.**

My job is...	Strongly disagree	Disagree	Neither agree/ disagree	Agree	Strongly agree
Dangerous	**1**	**2**	**3**	**4**	**5**
Safe	**1**	**2**	**3**	**4**	**5**
Hazardous	**1**	**2**	**3**	**4**	**5**
Risky	**1**	**2**	**3**	**4**	**5**
Unhealthy	**1**	**2**	**3**	**4**	**5**
Could get hurt easily	**1**	**2**	**3**	**4**	**5**
Unsafe	**1**	**2**	**3**	**4**	**5**
Fear for health	**1**	**2**	**3**	**4**	**5**
Chance of death	**1**	**2**	**3**	**4**	**5**
Scary	**1**	**2**	**3**	**4**	**5**

These questions are about your **safety voicing behaviours** within your job. **For each item please circle the number which indicates the extent to which you engage in these behaviours**

In my job ……	Never	Rarely	Occasionally	Frequently	Always
I make suggestions about how safety could be improved	**1**	**2**	**3**	**4**	**5**
I tell colleagues who were doing something unsafe to stop	**1**	**2**	**3**	**4**	**5**
I discuss new ways to improve safety with my colleagues or boss	**1**	**2**	**3**	**4**	**5**
I inform the boss when I noticed a potential hazard	**1**	**2**	**3**	**4**	**5**
I report to my boss if my colleagues break any safety rules	**1**	**2**	**3**	**4**	**5**

These questions are about your **attitude towards safety** on the job. **For each item please circle the number which indicates the extent to which you disagree or agree for your job**

	Strongly disagree	Disagree	Neither agree/ disagree	Agree	Strongly agree
Safety works well until we are busy, then other things take priority	**1**	**2**	**3**	**4**	**5**
I believe safety procedures are more for the organization to meet its legal requirements than for my personal safety	**1**	**2**	**3**	**4**	**5**
I only pay lip service to safety	**1**	**2**	**3**	**4**	**5**
If I worried about safety all the time I wouldn't get my job done	**1**	**2**	**3**	**4**	**5**
There is little point in reporting potential safety hazards	**1**	**2**	**3**	**4**	**5**

These questions are about your **attitudes** towards **safety motivation** in the workplace. **For each item please circle the number which indicates the extent to which you disagree or agree for your job**

	Strongly disagree	Disagree	Neither agree/ disagree	Agree	Strongly agree
I believe that workplace health and safety is an important issue	**1**	**2**	**3**	**4**	**5**
I feel that it is worthwhile to put in effort to maintain or improve my personal safety	**1**	**2**	**3**	**4**	**5**
I feel that it is important to maintain safety at all times	**1**	**2**	**3**	**4**	**5**
I believe that it is important to reduce the risk of accidents and incidents in the workplace	**1**	**2**	**3**	**4**	**5**

Finally these questions require you to report how many times you have had an **accident or incident** within **your** working career

Safety Incidents	Number of times
A near hit incident, which had it turned out differently, could have resulted in injury	
A **very minor injury** not requiring medical attention	
A **minor injury** requiring medical attention (e.g. first aid treatment or a visit to a doctor), though no time off work	
A **Lost Time Injury (LTI)** that required you to take time off work	
An increase in safety risk which was the result of your behaviour	

Please check that you have answered all questions.

Thank you for taking the time to participate in this study.

Appendix E: Changes in Scales

Changes in scales

Supervisor measure

Safety *participation*

- I use all the necessary safety equipment to do my job *(Uses all necessary safety equipment to do their job)*
- I use the correct safety procedures while carrying out my job (*Uses the correct safety procedure while carrying out their job)*
- I ensure the highest levels of safety when carrying out my job (*Ensures the highest levels of safety when carrying out their job)*

Safety *compliance*

- I promote the safety program within the organisation *(Promotes the safety program within the organisation)*
- I put in extra effort to improve the safety of the workplace (*Puts in extra effort to improve the safety of the workplace)*
- I voluntarily carry out tasks or activities that help to improve workplace health and *safety (Voluntarily carries out tasks or activities that help to improve workplace health and safety)*

Propensity to *break rules* and *breach safety procedures*

- I sometimes cut corners if it makes the task easier (*They sometimes cut corners if it makes the task easier)*
- Work pressures mean that I sometimes bend the rules (*Their work pressures mean that they sometimes bend the rules)*
- Occasionally I bend the rules when I know it is safe to do so *(Occasionally they bend the rules when they know it is safe to do so)*
- When my boss is not around I can be more flexible with which procedures I follow *(The worker is more flexible with which procedures they follow when I am not around)*

Safety *knowledge*

- I know how to perform my job in a safe manner *(They know how to perform their job in a safe manner)*
- I know how to use safety equipment and standard work procedures (*They know how to use safety equipment and standard work procedures)*
- I know how to maintain or improve workplace health and safety (*They know how to maintain or improve workplace health and safety)*
- I know how to reduce the risk of accidents and incidents in the workplace *(They know how to reduce the risk of accidents and incidents in the workplace)*

Safety voicing behaviours

- I make suggestions about how safety could be improved *(They make suggestions about how safety could be improved)*
- I tell colleagues who are doing something unsafe to stop *(The tell colleagues who are doing something unsafe to stop)*

- I discuss new ways to improve safety with my colleagues or boss (*They discuss new ways to improve safety with their colleagues or me)*
- I inform the boss when I notice a potential hazard *(They inform me when they notice a potential hazard)*
- I report to my boss if my colleagues broke any safety rules (*They report to me if their colleagues brake any safety rules)*

Attitudes towards safety motivation

- I believe that workplace health and safety is an important issue (*They believe that workplace health and safety is an important issue)*
- I feel that it is worthwhile to put in effort to maintain or improve my personal safety *(They feel that it is worthwhile to put in effort to maintain or improve their personal safety)*
- I feel that it is important to maintain safety at all times *(They feel that it is important to maintain safety at all times)*
- I believe that it is important to reduce the risk of accidents and incidents in the workplace *(They believe that it is important to reduce the risk of accidents and incidents in the workplace)*

Accident and incident reports

- A Lost Time Injury (LTI) that has required you to take time off work *(A Lost Time Injury (LTI) that required them to take time off work)*
- An increase in safety risk which was the result of your behaviour (*An increase in safety risk which was the result of their behaviour)*

Participant measure

Accident and incident reports

- A very minor injury not requiring medical attention (NEW item)
- A Lost Time Injury (LTI) that has required you to take time off work (A Lost Time Injury (LTI) that required you to take time off work)