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Additional Information:
- This is a conference paper.

Metadata Record: https://dspace.lboro.ac.uk/2134/17340

Version: Accepted for publication

Publisher: ARCOM

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Please cite the published version.
CONSTRUCTION ACTOR SAFETY BEHAVIOUR: ANTECEDENTS, CURRENT THINKING AND DIRECTIONS

Babajide Talabi¹, Francis Edum-Fotwe and Alistair Gibb

¹ School of Civil and Building Engineering, Loughborough University, Leicestershire, UK

Procedures, regulations, and safety management systems (SMS) have reduced the incidence of occupational accidents, but they still occur. Current methods have enjoyed some success however these methods mostly address aspects of safety that are not behaviour-related. Researchers have argued that construction actors’ behaviours account for most accidents and so understanding and being able to modify behaviour should be crucial to improving the occupational safety and health (OSH) performance of the industry. In reference to behaviour, antecedents precede behaviours whilst consequences succeed behaviours and researchers argue that both direct construction actors’ behaviour. It is therefore important to study and use them strategically to increase and decrease the frequency of safe and unsafe behaviours respectively. Some antecedents (e.g. training and ergonomics) and some consequences (e.g. saving time and convenience) of construction actors’ safety behaviours are discussed. Further, modification techniques (e.g. classical and operant conditioning) that can improve these behaviours are also examined. Researchers have also argued that safety culture and safety climate influence construction actor’s safety behaviours and the relationship between the two are discussed as well. According to the theory of planned behaviour and the theory of reasoned action, there seems to a misalignment between perceived and actual behaviours; this paves way for further research. This paper summarises the findings of a literature review on behavioural safety and discusses several techniques to modify behaviours and potential areas for further research.

Keywords: behaviour modification, climate, culture, safety behaviour, safety performance.

INTRODUCTION

Ample opportunities exist to improve safety performance in the construction industry. Over the last five years, the construction industry has been responsible for an average of 53 fatal injuries to workers (Health and Safety Executive (HSE) 2013), with an increase being recorded last year (2013/14) in comparison with the previous year (2012/13) from 39 to 42. Although the current rate of accidents in construction shows a marginal reduction compared to the rate in previous years, the problem of unacceptable occupational safety and health (OSH) performance persists and appears to be plateauing and not reducing fast enough. It is clear that OSH management needs to be more effective. Perhaps a different way to look at safety, to reduce accidents further in the construction industry, is required.

¹ B.O.Talabi@lboro.ac.uk
This paper therefore discusses methods to further reduce accidents that cause harm and incidents that do not cause harm and also sustain and improve this reduction so that the chances of relapse are reduced. Pybus (1996) developed a model that categorises safety management into three phases: traditional phase, transitional phase and innovative phase; this model is adapted for this paper. Causes of accidents are placed into three broad classes – systems, people and force majeure. ‘Systems’ broadly cover the aspects of safety that deal with rules, processes, procedures, regulations, technology and engineering, and this parallels the traditional and transitional phases of the Pybus model. ‘People’ broadly covers human behaviours, and this parallels the innovative phase of the Pybus model where safety and health is integrated into all the decisions that people make. Lastly, force majeure deals with occurrences beyond human control such as adverse weather conditions. This paper focuses on the ‘people’ aspect of OSH management and makes links with the systems aspect as their interaction is inevitable; one does not work properly without the other (Anderson 2005; Hopkins 2006; Reason 2009; HSE 2009). Also, the safety aspect of OSH management is given more attention than the health aspect.

The current UK safety legislation proposes minimum standards that organisations must adhere to but perhaps ought to tackle safety behaviour specifically. In complex problem solving where people and systems interact, there is no one size fits all approach (DeJoy 2005). Sherratt (2014) argues that the problem with the construction industry lies with the people that operate within it. Accordingly, it appears that some of the current systems can be revised to take account of factors that affect safety behaviour. The argument for behaviour-based safety (BBS) is too important to be ignored or taken with a pinch of salt (see Sulzer-Azaroff and Austin 2000).

Behaviour-based safety (BBS) has been instrumental in reducing accidents and increasing the overall safety performance in several industries (Sulzer-Azaroff and Austin 2000; Geller 2011) and it can also have a positive impact on productivity (Geller 2011). Cooper (2010) argues that the benefits of BBS outweigh its costs, which would suggest that there should be no reason why all UK construction companies do not employ this strategy of reducing accidents.

At this juncture, clarification will be made between people-based safety (PBS) and behaviour-based safety (BBS). Geller (2011) states that PBS emanates from BBS and includes “cognition, perception and person states”. In this paper, BBS and PBS are considered to be the same as behaviours are viewed with the theoretical lens that considers internal and external influences, which PBS purports to incorporate.

SAFETY BEHAVIOUR

Behaviour, and by extension, safety behaviour, is influenced by activators/antecedents and consequences (Miltenberger 2012). Figure 1 presents the ABC model of behaviour, which shows relationship between activators (referred to as antecedents in the rest of the paper), behaviours and consequences; antecedents precede and direct behaviour while consequences result from the behaviour and can motivate the behaviour (Geller 2011).

Antecedents and consequences have varying impacts on safety behaviour and some authors (e.g. Jankiewicz and Horne 2000) argue that consequences are stronger influencers of behaviour than antecedents. Reliance on antecedents is traditionally the norm however; it may be more beneficial to pay closer attention to consequences more often because positive consequences drive the reoccurrence of behaviours
Jankiewicz and Horne (2000) discuss three factors that determine the strength of consequences – its positivity or negativity, the time that lapses before it occurs (after the behaviour) and the certainty or uncertainty of its occurrence. They claim that consequences which are more positive, sure to occur and manifest quicker yield the best results; this is in contrast with the blame culture that Baiden et al. (2006) claim that the construction industry traditionally has. Bolt et al. (2012) argue that experience from the London 2012 Olympic Park construction showed that a culture of trust was needed to change from the blame culture prevalent in the industry.

Figure 1: ABC of Behaviour

To change behaviour, barriers like poor communication, which hinder construction actors from engaging with safe behaviours, have to be weakened and overcome (Garlapati et al. 2013). Garlapati et al. (2013) argue that natural consequences such as ‘saving time’ and ‘convenience’ reinforce unsafe behaviours and are often too strong; therefore they have to be altered and re-directed to favour safe behaviours. For example, one of the consequences of successfully using an unsecure ladder is likely to be the time saved. On the other hand, a different consequence may be an accident. To an experienced operative who has done this for many years, complacency becomes a valid factor that can creep in (HSE 2009). In contrast, Fernández-Muñiz et al. (2012) argue, based on their study of 606 OHSAS (Occupational Health and Safety Assessment Series) 18001-certified organisations, that work pressures do not affect safety behaviours in OHSAS 18001-certified organisations as the work pressures in such organisations are ostensibly lower and their managers are more devoted to and prioritise safety.

Additionally, Peltzer and Renner (2003) argue that overconfidence correlates positively with at-risk or risky behaviours. This overconfident characteristic comes from carrying out an activity repeatedly therefore becoming experienced at it (HSE, 2009). HSE (2009) explain that overconfidence can reduce an individual’s perception of a risk, which is critical to reducing the amount of incidents or accidents that occur because people who assess and view activities as ‘low risk’ tasks tend to have greater rates of accidents. According to HSE (2009), it is common for people to view the risks involved with their jobs as lower than that of others and therefore frequently assess the risk wrongly thereby underestimating it; an approach to improve risk perception is by education (HSE 2009).

Antecedents like training and ergonomics (McDermott et al. 2007) play a huge part in materialising more frequent safe behaviours; training equips people with the right skills to successfully execute their tasks and ergonomics (e.g. correct height of a worktop) makes people feel more comfortable carrying out their tasks. Leading indicators (e.g. training) proactively deal with safety management as opposed to lagging indicators (e.g. lost time injuries), which are reactive. Leading indicators are as valuable as, and arguably more valuable than lagging indicators of safety (Zwetsloot et al. 2014). Waiting for a dangerous occurrence is a reactive way of
dealing with occupational safety and as such, unsafe behaviours need to be changed prior to the manifestation of such occurrences.

Zin and Ismail (2012) highlight the need to enforce antecedents sometimes, which can aid compliance and ultimately reduce incidents and accidents. Some authors (e.g. Jankiewicz and Horne 2000; Daniels 2000; Geller 2005) argue that getting employees to want to engage in safe behaviours is better and more valuable than forcing employees to comply. For this change from compliance to self-ownership to occur, Geller (2005) claims that people have to be more responsible and Jankiewicz and Horne (2000) claim that their needs have to be met.

Zin and Ismail (2012) further explain that factors such as safety leadership, management commitment and good communication can help to achieve higher compliance rates. Fernando et al. (2008) adds that employee involvement and effective safety feedback improves safety compliance as well. Further, skills, specifically non-technical skills (NTS), which can be considered to be antecedents, have been found to reduce accidents (Reader and O’Connor 2013). These skills deal with individuals’ cognitive and social abilities that support safe performance in high-risk environments (Flin et al. 2008).

Situational awareness, which can be said to be an NTS, has also been linked heavily with abating accidents (Stanton et al. 2001). This concept is still increasing in popularity (Patrick and Morgan 2010) and is defined by the HSE (2012) as “being aware of what is happening around you in terms of where you are, where you are supposed to be, and whether anyone or anything around you is a threat to your health and safety”. In short, it is ‘knowing what you are doing, what you should be doing, what should be happening as you are doing it and what should eventually happen when it is done’.

Resilience, another antecedent, is considered to be the ability to successfully adapt to a change in circumstances. Resilient organisations have the ability to predict, monitor, learn and react to challenges (Praetorius et al. 2012). Further, Hollnagel (2008) argues that managers should regard people and their dynamic ability as assets rather than liabilities. Perhaps, being resilient tackles the latent condition pathways to accidents that Reason (2009) refers to in his accident causation model to an extent, in that, if an organisation is resilient, it should be better equipped to predict and mitigate unplanned developments.

Safety capability, which Griffin et al. (2014) define as the “capability to maintain the safety of complex systems operating in uncertain and interdependent environments”, is also important in preventing accidents. In order to achieve this capability, employees need to understand the intricacies of work processes rather than follow rules or instructions blindly (Woods and Hollnagel 2006).

The next section explores various behaviour modification techniques that researchers have suggested can be used to alter behaviours.

**BEHAVIOUR MODIFICATION**

The psychologist Bandura (1977) claims that behaviours are learned and McAfee and Winn (1989) explain that improvements in safety behaviour and performance have occurred through the use of psychologically based methods known as “Applied Behaviour Analysis” (APA), which involves using various behaviour modification techniques (BMTs) to change behaviour.
Locke (1974) argues that when a baby is born, his/her mind is totally blank, a state commonly known as *tabula rasa*, and the baby’s mind begins to acquire knowledge from experiences and or learning. To this end, Bandura (1977) argues that it follows that if human beings are exposed to unsafe behaviours, they are likely to emulate them; this is commonly known as the social learning theory. On the contrary, some researchers have argued that Locke’s *tabula rasa* is flawed (Duschinsky 2012).

**Classical conditioning**

The psychologist Thorndike (1898) introduced the ‘Law of effect’ theory. This theory explains that any behaviour that is accompanied by pleasant consequences will probably be repeated and any behaviour that is accompanied by negative consequences will probably reduce or stop. For example, if an untrained person operates a dumper without having an accident or any negative repercussion and perhaps saves time (pleasant consequence), this person is likely to operate the machine again without training in future.

Pavlov (1902) developed classical conditioning and it involves the association of a neutral stimulus (NS) to an unconditioned response (UR); this technique has been and is still being successfully applied to modify behaviours. Table 1 shows the four key terms associated with this BMT namely, unconditioned stimulus (US), unconditioned response (UR), conditioned stimulus (CS) and conditioned response (CR) and are explained.

Pavlov (1902) shows that this technique applied to animals and Watson and Rayner (2000) later show that it can be applied to humans as well when they conducted the ‘Little Albert’ experiment.

**Operant conditioning**

Skinner (1938) agrees that human beings do indeed have minds, however he believed that it is more practical and valuable to study their behaviours rather than their internal minds because this is more tangible and observable. Skinner believed that the principal way to study behaviour is by observing the causes of an action and its consequences. This, he called “Operant Conditioning”. Accordingly, he alleges that the study of behaviours is scientific and not abstract and believes that behaviours are affected by consequences and can therefore be derived. Hollnagel (2008) alludes to the importance of learning from successes and failures (consequences) in order to increase good behaviours and reduce bad behaviours. Table 1 shows 3 elements (reinforcement, punishment and extinction) that have varying effects on behaviour under this conditioning technique. Reinforcement and punishment can be positive and negative however, in any case, reinforcement aims to increase the frequency of behaviour and punishment aims to decrease the frequency of behaviour.

Garlapati et al. (2013) argue that positive reinforcement, such as praise, is more effective in the long term than rewards. They further explain that incentives like money may be good, however, satisfaction from feeling highly regarded is more likely to lead to positive behaviours that are long lasting and natural. Positive reinforcement encourages people to go over and beyond their job duties as well as take reasonable care of their safety and the safety of others. Positive reinforcement ensures people are working towards good ideals as opposed to trying to avoid negative repercussions. Skinner (1972) advises that extra caution must be taken when using punishment because this technique can be construed to limit freedom and choice and can therefore backfire and propel people to carry out more unsafe behaviours or in worse scenarios.
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lead to theft and vandalism. Extinction burst, which is the initial increase in frequency, duration and intensity, may occur when previously reinforced behaviours are being extinguished (Miltenberger 2012).

Table 1: Classical and Operant Conditioning

<table>
<thead>
<tr>
<th>Classical Conditioning</th>
<th>Operant Conditioning</th>
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<tbody>
<tr>
<td>US – Stimulus that automatically provokes a response. For example, arrival of a boss.</td>
<td>Reinforcement – Increases the frequency of behaviour; it can be positive or negative. In other words, positive reinforcement (addition) and negative reinforcement (removal). For example, increasing a workers bonus after he/she engages in safe behaviours can increase the frequency of the safe behaviour.</td>
</tr>
<tr>
<td>UR – Response that is triggered automatically when the US is present. For example, carpenter begins to work.</td>
<td>Punishment – Decreases the frequency of behaviour; it can be positive of negative. In other words, positive punishment (addition) and negative punishment (removal). For example, reducing a workers bonus after he/she engages in unsafe behaviours can reduce the frequency of the safe behaviour.</td>
</tr>
<tr>
<td>CS – Initially neutral stimulus (NS), which later triggers a response when paired with the US. For example, buzzer that sounds when the boss arrives.</td>
<td>Extinction – Decreases the frequency of a previously reinforced behaviour. For example, if working without steel-toe cap boots on site was previously reinforced, enforcing a strict compulsory steel-toe cap boots policy is likely to reduce the behaviour of wearing regular boots without steel-toe caps.</td>
</tr>
<tr>
<td>CR – Response that is triggered by association with the CR over time. For example, carpenter begins to work when the buzzer is heard, even without seeing the boss.</td>
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Social conditioning

Social conditioning is a BMT that relates to the sociological influences that urge people to behave in certain ways. Two main theories that support this are ‘The Theory of Reasoned Action’ (Fishbein and Ajzen 1975) and ‘The Theory of Planned Behaviour’ (Ajzen 1991). The latter, which is more recent and somewhat supersedes the former, purports that behaviour is influenced by intention, which is influenced by attitudes, social norms and perceived behavioural controls; it is also argued that perceived behavioural control can have direct impact on behaviour.

Dijksterhuis and Bargh (2001) explain that the “perception – behaviour” connection leads to a default proclivity to act in the same way as those around. For example, a bricklayer who is used to stacking bricks on scaffolding without a brickguard gets a new job with another organisation and soon realises that every other bricklayer in the new establishment uses a brickguard. The bricklayer is likely to adapt and start using brickguards. This form of conditioning is aided by peer pressure and positive safety culture. HSE (2009) argue that the things people see around them are major influences of behaviour. Other social influences such as leadership style and culture are believed to change thoughts, beliefs and values, and many researchers constantly have the nature vs. nurture debate, in the belief that either one or sometimes both define how human beings develop (Duschinsky 2012). Another type of reinforcement, known as vicarious reinforcement, is worthy of mention under this category (Miltenberger 2012); this reinforcement type is less direct. For example, if the bricklayer realises that people who do not use brickguards get fired, he/she is likely start using a brickguard provided that the job is important.
Thus far, the internal aspects of a human being have not been considered. It is possible that the carpenter in Table 1 does not begin to work when the boss arrives because he/she is not happy with the work conditions. This leads to the cognitive aspect of behaviour. In contrast to Thorndike and Skinner who focus on external factors, Neisser (1967) argues that human behaviour is affected by both external factors like reinforcement and internal factors like beliefs and feelings. Figure 2 shows external (outside circle) and internal (inside circle) arrows, which indicate external and internal influences respectively on human behaviour, which is represented by the circle.

Figure 2: Internal and external influences on human behaviour

From Figure 2, it is logical for senior management to aim to move all their employees to the bottom-right quadrant, where the external and internal influences encourage safe behaviours. Safety climate and safety culture are two key external factors, amongst others like work pressures, work resources and education, which influence behaviours.

SAFETY CLIMATE AND SAFETY CULTURE

In recent times, one of the debates about safety has been related to climate and culture; safety climate vs. safety culture, both of which influence safety behaviour (HSE 2009).

Safety climate

Safety climate has been linked to psychological attributes of employees (i.e. the way people feel, their values, attitudes and perceptions) with regards to safety within an organisation (Human Engineering, 2005). In a sense, it is the way employees appreciate safety in the workplace. It is common for organisations to boast a good safety climate at the corporate level, however if their employees feel that safety is not treated with utmost regard, the organisation’s safety climate is considered to be poor (Cooper and Phillips 2004). Signs of poor safety climate are high staff turnover rates, high absenteeism or sickness rates, high direct human-related accidents, low levels of obedience to safety rules and high levels of protests from staff about working conditions (HSE 2009).

Geller (2011) argues that BBS imbibes a reporting climate into an organisation and this can lead to reduced incidents and accidents. It is only logical that reducing the number of incidents will leads to a reduction in the number of accidents, hence it is imperative to instil a ‘reporting’ climate to encourage employees to report any issues or incidents that occur so that learning can transpire.
Safety culture

Safety culture has become a common tool used to ameliorate safety performance (Finneran and Gibb 2013) and a core part of behaviour-based safety is the culture in which it is bred. The Advisory Committee for Safety in Nuclear Installations (ACSNI) Human Factors Study Group (1993) provide the following definition for the phrase, perhaps the most widely accepted: “The safety culture of an organisation is the product of individual and group values, attitudes, perceptions, competencies, and patterns of behaviour that determine the commitment to, and the style and proficiency of an organisation’s health and safety management”. They go further to state that “organisations with a positive safety culture are characterised by communications founded on mutual trust, shared perceptions of the importance of safety and confidence in the efficacy of preventive measures.”

Cooper (2002) explains that safety culture is a subcomponent of corporate culture that relates to the job, organisation and individual (JOI) elements that affect and influence safety. According to Reason (2009), culture determines the efficiency and effectiveness of safety management systems (SMS). Positive safety behaviour will only thrive in an organisation where the culture permits hence, organisational culture, more specifically, safety culture has to be properly considered and investigated to ensure it is appropriate for positive safe behaviours to grow and be sustained. Good safety culture can therefore help to reduce accidents, ensure that adequate attention is given to safety and increase commitment to safety (Cooper 2002).

According to Reason (2009), culture can be socially engineered and it takes deliberate efforts to achieve good culture; senior management is responsible for ensuring that a good safety culture is ingrained within the organisation (Fernández-Muñiz et al. 2012; National Oil Spill Commission 2011; Hopkins 2006). A safe culture must be an informed one (Reason 2009) and Borys et al. (2009) apprise that an informed culture is made up of four interrelated subcultures: reporting culture, learning culture, just culture and flexible culture. Some critical factors required to achieve a safer culture are trust, accountability and information (Hudson 2007).

LINK BETWEEN SAFETY CLIMATE AND SAFETY CULTURE

Figure 3 shows the distinction and link between safety climate and safety culture.

![Diagram showing the relationship between safety climate and safety culture](image)

Figure 3: Relationship between safety climate and safety culture

From Figure 3, safety culture is decided at the corporate level by senior management whilst the ‘heads’ of the individual constituting departments decide the safety climate.
for their departments. For example, a construction company may have 6 sites as in Figure 3. The company’s senior management will generally influence the safety culture and it should be fairly constant at any point in time, whilst the sites will have different safety climates, which will depend on various factors, such as safety management systems, technology and people. These people such as clients, project managers and employees are the construction actors affiliated with the site.

To achieve excellent safety performance on a site, the safety climate, which underpins the site’s core functioning ability and the safety culture from the corporate level, have to be at the maximum. The culture is the underpinning factor, which sets the potential for climate; good culture should lead to good climate, ceteris paribus, and vice versa. Safety culture is the true value and intention of the organisation towards safety, whilst safety climate can be explained to be the perceived values of an organisation towards safety; ‘perceived’ is not always the same as ‘true’ (Sherratt 2014).

**Sustaining safety behaviour**

Trying to change behaviours can prove challenging especially when the safe behaviour to be engaged in is not known. Geller (2005) places behaviour into three classes: behaviours that are directed by others, behaviours that are directed by one’s self and behaviours that are not directed consciously but based on reflex. In theory, people have to be taught and educated on the correct safe behaviour to engage in and with repetition (Stanley 2010), the new behaviour should move from being directed by others through to self-directed and eventually automatic. Once the behaviour is automatic, it is likely to be sustained. Geller (2011) argues that it is sometimes good for behaviours to occur out of habit, however it is better to engage in most safety related behaviours after some form of cognitive reasoning because situations vary and therefore solutions may have to be adapted. Garlapati et al. (2013) highlight the effect that climate has on performance stating that good climate is the medium that allows for the best performance.

**DISCUSSION**

This paper is the first stage in a study that explores the relationship between what people in the construction industry perceive and what they actually do. It is envisaged that the understanding of this perception versus actual behaviour relationship will shed more light on the barriers that prevent people from engaging in safe behaviours.

It appears that a ‘one fits all’ approach to safety will not work as people vary vastly based on factors such as their beliefs, experience, knowledge and perception of risk. To this end, it is critical to explore reasons why people do what they know is wrong. The second stage of this research investigates the perceived and actual value systems of construction actors as well as examines the barriers that prevent the alignment of safety culture and safety climate. Crucial to this study is the understanding of ‘The Theory of Reasoned Action’ and ‘The Theory of Planned Behaviour’, which can shed some light on the attitude-behaviour relationship. The next phase of this study will involve observing construction actors in their natural work environments; interviews will then follow to understand the reasoning behind their actions.

**CONCLUSIONS**

It appears that if the ‘people’ problem is solved, many, if not most occupational accidents can be eliminated. Behaviour modification techniques ought to be more frequently employed to nudge people to engage in safe behaviours. A key to ensuring
more frequent safe behaviours lies within the safety culture and safety climate of an organisation. It is known that the safety culture and the safety climate are not always in alignment and resolving this disparity may be the solution to achieving better safety performance. Once the barriers that prevent this gap from being closed are realised and resolved, the ‘people’ issue becomes yet smaller therefore fewer accidents will occur because more people will engage more frequently in safer behaviours.

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