COMPLACENCY AS A CAUSAL FACTOR IN ACCIDENTS – FACT OR FALLACY?

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Complacency is often cited as a major contributor to accidents, where it is often seen as deviant behaviour by those at the sharp end. However, it is unclear whether there is an underlying psychological model of this phenomenon, making it difficult to develop an effective preventative strategy against it. Additionally, using a negative term such as 'complacency' may predispose investigators towards blaming an individual and result in a disproportionate focus on the immediate causes of accidents. This paper argues that rather than applying an ill-defined label such as complacency, it would be better to frame this behaviour in terms of the perception of, and tolerance to, risk. These concepts are readily understood, more grounded in theory and offer the opportunity to develop individual and collective strategies to mitigate its effects.

Understanding the ways in which people, technical systems and organisations fail is one of the main sources of insight for preventing further incidents and designing safer systems. Accident investigations and their findings are an essential source of information in this pursuit. Reports investigating some of the major disasters to have occurred in the past few decades (e.g. the Piper Alpha oil rig explosion in 1988, Ladbroke Grove rail accident in 1999, Columbia space shuttle accident in 2005, and the Deepwater Horizon explosion in 2010) have emphasised the complex nature of accident causation. Disasters such as these are not the result of a few coinciding independent errors; they occur due to the accumulation of a variety of human errors stretching back in time (Flin, 2003; Kletz, 2004; Rasmussen, 1997; Reason, 1990).

The majority of accident models conceptualise failure in linear terms (i.e. cause and effect), whereby people's poor decisions (or other failures) break through barriers provided by system defences. While the investigation may report systemic issues that have facilitated the accident, it is the behaviour of the operators that is often seen as the last line of defence which is breached by erroneous action or inaction. Thus, unreliable, erratic or deviant behaviour of individuals working at the sharp end is frequently seen as the final cause precipitating the failure. Complacency is one aspect of operator behaviour that is often cited as a major contributing factor to accidents and its threat is often discussed in management literature (Denning, 2011; Parasuraman & Manzey, 2010). Our understanding of complacency has implications for accident investigations, and through that, accident prevention. This paper argues that our understanding of complacency is not yet sufficient for the purposes of generating useful strategies to improve safety within most contexts, and instead, to re-frame this behaviour as one of perception of, and tolerance, to risk.

WHAT IS COMPLACENCY?

The existence of the term 'complacency' in the everyday vernacular leads people to believe that they understand what it means and that others have a similar understanding. In everyday usage complacency is often used to suggest wilful and ill-advised neglect on the part of an individual. Some of the common symptoms suggested in accident reports include ignoring warning signs, over confidence, assuming the risk decreases over time, neglecting safety procedures, becoming satisfied with the status quo, the erosion of the desire to remain proficient and accepting lower standards of performance. One of the earliest descriptions was put forward by Weiner (1981):

> *"Complacency is caused by the very things that should prevent accidents, factors like experience, training and knowledge contribute to complacency. Complacency makes crews skip hurriedly through checklists, fail to monitor instruments closely or utilize all navigational aids. It can cause a crew to use shortcuts and poor judgement and to resort to other malpractices that mean the difference between hazardous performance and professional performance." (Wiener, 1981)*

However, we can see that this description and the symptoms listed above do not define 'complacency' as a singular behaviour, but describe it in relation to other constructs. Within the literature, various definitions and usages abound with remarkably little consensus as to what complacency is and the psychological mechanisms that underlie its existence (Prinzel et al., 2001; Dekker & Hollnagel, 2004; Bagheri & Jamieson, 2004; Moray & Inagaki, 2000; Moray 2003). The lack of a singular, coherent definition combined with the perceived intuitiveness of the concept can result in individuals having entirely different understandings of the term 'complacency'.

Much of the empirical research into complacency has focused on the performance of an operator while monitoring an automated system and refers to the ensuing decline of that monitoring performance (Farrel & Lewandowsky, 2000; Bahner, Huper & Manzey, 2008). Complacency in this context (known as automation-induced complacency) has been defined as "self-satisfaction which may result in

non-vigilance based on an unjustified assumption of satisfactory system state" (Parasuraman et al., 1993, quoting NASA definition). Complacency has also been defined in relation to boredom, overreliance, overconfidence, contentment, a low index of suspicion (studies quoted in Dekker & Hollnagel, 2004), workload and resource allocation (Parasuraman et al., 1993), trust in automation (Parasuraman, Sheridan & Wickens, 2008) and attention (Parasuraman & Manzey, 2010).

Whilst the body of scientific and empirical literature on automation-induced complacency is growing (Parasuraman & Manzey, 2010), the current knowledge about the characteristics, underlying determinants and possible performance consequences of complacent behaviour is limited (Bahner et al., 2008). The working definition provided by Parasuraman and Manzey (2010) was developed from research into automation-induced complacency and posits three core features of complacent behaviour:

- It involves a human operator monitoring an automated system.
- The frequency of the monitoring behaviour is lower than some optimum.
- The deficient monitoring results in an observable effect on system performance, for example, an operator fails to observe a system malfunction.

The very specificity of this definition limits its application to instances in which an individual is monitoring an automated system, the optimal behaviour is known and is able to be related to system performance.

The research suggests that complacency effects are most likely to occur when operators interact with automated systems that are perceived to be highly reliable (Parasuraman & Manzey, 2010; Bahner et al., 2008) and are escalated in situations with high task demands (Parasuraman et al., 2003). Highly reliable systems can result in increased levels of trust in the system and subsequently, the rational decision to reduce monitoring behaviour and the overall workload. This suggests that the behaviour is not merely an absence of monitoring, but a calculated decision determined by evaluating the perceived benefits and risks of the behaviour. In the above example, the operator weighs the perceived benefits of reduced monitoring behaviour (lower workload) against the perceived cost (risk of an automation failure). This deconstruction of the components and mechanisms of complacent behaviour refers to other well-known psychological contrasts, namely attention, risk perception, resource allocation and trust.

The limited understanding of complacency in conjunction with the similarity of complacency to attention, risk perception, trust and so on leads to an important question; is it necessary to distinguish complacency from other well established constructs? In a critique of the concept of complacency, Dekker and Hollnagel (2004) argued that the existing definitions fail to articulate the psychological mechanisms that underlie complacency and merely explain it by referring to other concepts. They regard complacency as an abstract term used to describe a set of behaviours. As such, Dekker and Hollnagel (2004) posit that complacency should not be regarded as an objective cause of anything. Instead, the component behaviours, such as faulty perception, diverted attention, deficient decision making, and insufficient information acquisition, hold greater explanatory power in regard to the observed behaviours. Without an understanding of the mechanisms of how complacent behaviour arises, development and implementation of strategies to minimise and mitigate against its effects are difficult.

IS 'COMPLACENCY' A USEFUL CONCEPT?

Our understanding of complacency has implications for accident investigations, and through that, accident prevention. The majority of research into complacency has been conducted in regard to monitoring of automated systems whereby a missed signal constitutes complacent behaviour. Extrapolation of these findings to other contexts and has led to a tendency to over-generalise and draw very broad conclusions for which the theoretical and empirical basis is far removed. For example, it is difficult to find the evidence to support the postulation that an individual who fails to wear a hard hat and gloves when working on a construction site is simply complacent. The narrow context in which 'complacent' behaviour has been researched in conjunction with a nebulous understanding of its mechanics involved calls the usefulness of the concept into question.

With the benefit of hindsight, accident investigations often attribute an undesirable outcome to 'complacency', where it is often seen as deviant behaviour by those at the sharp end. Using a negative term such as 'complacency' may predispose investigators towards blaming an individual and result in a disproportionate focus on the "immediate cause" of an accident. However, the literature tells us that people are resilient and are able to adapt to changes in the system (Dekker, 2011; Hollnagel, Woods & Leveson, 2006). They recognise when the system is becoming unsafe and react to recover from the negative consequences (Dekker, 2011; Hollnagel, Woods & Leveson, 2006). The view that operators at the sharp end are the main source of unreliability in an otherwise successful system leads to misunderstanding of the nature of system safety and potentially to blame those that can contribute to the resilience of the system.

Rather than applying an ill-defined label such as complacency, it would be better to frame this behaviour in terms of the perception of, and tolerance to, risk, and how these influence an individual's decision to behave or act in a certain way. These concepts are readily understood, more grounded in theory and offer the opportunity to develop individual and collective strategies to mitigate its effects.

RE-FRAMED WITH REGARD TO RISK PERCEPTION AND RISK TOLERANCE

Risk perception and risk tolerance are constructs that present compelling explanations for behaviours that result

in incidents and accidents. All organisations operate with some level of risk. Outcomes are rarely predetermined, and failure is often a possibility. It is the behaviour of individuals within organisations that ultimately determine success or failure. One explanation for behaviour that leads to an undesirable event is that the individual did not perceive the risk inherent in the situation, and consequently did not undertake actions to avoid or mitigate the risk. Another explanation is that while an individual may correctly perceive the risks involved in a situation, they may choose to continue if they perceive the risk is not sufficiently threatening. Those individuals would be described as having a greater tolerance or acceptance of risk, compared to others.

RISK PERCEPTION

Decision theory is concerned with how individuals make rational and optimum decisions in environments which are uncertain, complex and changing. One theory, Expected Utility Theory, posits that the behaviour of an individual, collective group or organisation is based on the perceived risk, our tolerance for risk and the perceived ability to prevent the hazard from occurring. An individual makes a decision about their behaviour by systematically and consciously weighing up the various options against relevant criteria (e.g. time, effort, cost etc). In essence, decisions are made based on a cost-benefit analysis such that the benefits of an action are weighed up against its risks with the eventual choice being the one that is deemed to provide the greatest benefit for the least cost. For example, if the benefits of not following safety procedures (e.g. getting the job done, meeting a deadline, saving time, easier ways of working) are greater than the risks (e.g. sanctions/punishments, injury to self or others, accident), then it is likely that the safety protocols will be violated.

This model of decision-making assumes that individuals have full access to information about the available courses of action, including the benefits, outcomes, and probabilities of success and are able to rationally assess and choose between them. However, this would require a massive amount of cognitive resources and plenty of time. In reality, decision-making calls for judgements under uncertainty, ambiguity and time pressure. What matters is an individual's understanding and perception of the situation.

Many studies have shown that an individual's behaviour is determined by perceived, rather than actual, risk. Risk is relative to the observer; it is subjective and depends on information available to the individual. Perceived risk, or the subjective assessment of the probability of a negative event occurring and how concerned we are with its consequences, is often very different from the real risk that exists regardless of whether we are aware and/or concerned about it. It is this subjective perception of risk that an individual will use to determine whether the level of risk involved in a particular action or decision is acceptable to them or not.

However, our ability to perceive and analyse complex and risky situations is very poor and is often disproportionate to the actual risk of the hazard occurring. For example, in the face of extremely unlikely events, people either overestimate the probability of their occurrence (e.g. terrorism) or discount it completely (e.g. a meteorite striking the earth). The level of risk perceived is dependent on a number of characteristics of the risk including the familiarity of the risk, the controllability of the risk, the degree to which it can be foreseen and the magnitude of the consequences (Sandman, 1993; Slovic, 1987, 1992). Continuing the example provided above, terrorism is often perceived to be a great risk. It is unusual, uncontrollable, unavoidable, catastrophic, and an individual cannot choose whether to expose themselves to the 'hazard' or not. In comparison, heat is seen to be relatively harmless, yet it kills many people every year. As a hazard, heat is familiar, well understood, and somewhat controllable and preventable. These factors serve to decrease our perception of the riskiness of the hazard.

Safety interventions can also impact on an individual's perception of risk. Contrarily, the presence of a physical barrier (e.g. wearing personal protective equipment (PPE)) or the introduction of a safety procedure may increase the occurrence of risky behaviour. While these measures are designed to reduce the likelihood of an incident, knowledge of their existence can lower the level of risk perceived by an individual and subsequently increase the likelihood of risky behaviour. For example, an individual working at height with fall protection may have a lower perception of the risks involved (in comparison to working without fall protection) and thus be more inclined to engage in risky behaviour.

When determining their behaviour, it is an individual's perception of the risks involved that are used in the decision-making process when weighing up the benefits and costs of a particular course of action. At its most basic, we take additional precautions if we perceive the risk to be high and fewer precautions if the perceived risk is low. This relationship is also moderated by the individuals perceived ability to prevent the hazard from being realised (Wilde, 1994).

The perceived ability to prevent negative consequences is based on experience and skill. For example, a novice operator may be less familiar with the task, the equipment and the environment and may have a lower skill level in comparison to more experienced operators. As a result, they are likely to have a higher perception of the risk and take more care. Operator experience increases familiarity with the system and improves their skills and ability to resolve emerging problems. Experience may have also taught them about the consequences of certain actions and the limits to which they can push the system. This may lower the perceived risk, leading to people feeling safer about the situation, and more and greater risks may be taken (Hunter, 2006).

One mechanism by which experience leads to lowered perceptions of risk is through exposure to near-miss events. Near-misses offer organisations opportunities to learn from their mistakes; as they are evidence of both success in terms of the ultimate outcome (accident prevented) and a failure in regard to system vulnerability (accident narrowly averted). However, Dillon and Tinsley (2008) have shown that managers who have experienced a near-miss event, firstly, are more likely to have a lower perception of the risk of a hazard occurring and secondly, exhibit riskier decision-making in comparison to managers who have not experienced a near-miss. Over time, individuals and organisations become accustomed to their apparently safe state, thus misperceiving risk and allowing themselves to drift into greater vulnerability, until accidents temporarily introduce greater risk awareness. The resulting pattern is one of irregular oscillations, often leading to disaster.

The level of risk perceived is determined both by characteristics of the situation and characteristics of the individual. Individuals must therefore accurately perceive not only the risk the hazard poses, but also their personal capabilities to respond and deal with the situation. Underestimation of the hazard combined with an overestimation of personal capability leads to a misperception of the risk posed by the hazard. Risk perception may therefore be conceived as a cognitive activity, involving the accurate evaluation of internal and external states (Hunter, 2002). Unfortunately, the accurate perception of risks does not always result in the desired safety behaviour. Some individuals, even when they perceive the risks adequately, may still choose to go ahead with their decision and operate with higher risk. For example, some motorcyclists wear helmets and high visibility clothing, while others do not. These individuals could be described as exhibiting higher risk tolerance.

RISK TOLERANCE

Risk tolerance can be defined as the amount of risk an individual, or an organisation, is willing to accept in pursuit of a goal. Individuals and organisations vary in their disposition towards risk; some are more conservative when it comes to taking chances, while others are more likely to accept it, perhaps even seek it.

At an individual level, identification and understanding of risk tolerance may not be enough to influence behaviour. Research has shown that while people differ in their aversion to risk, high risk tolerance is not always a predictor of involvement in hazardous activities (Hunter, 2002, 2006). These studies concluded that it is an individual's risk perception, or rather, risk misperception that is predominantly associated with increased risk taking behaviour. However, individual behaviour can be regulated through the collective organisations tolerance of risk. A risk-averse organisation can influence individual behaviour by a number of means including active monitoring of risk, procedures and policies to minimise exposure to risk, established consequences for unsafe behaviour, and a collective safety culture in which risk taking is unacceptable.

WHAT CAN BE DONE?

Understanding the way in which individuals and organisations engage in risky behaviour offers the opportunity to develop individual and collective strategies to mitigate its effects. It has been argued here that the decision to undertake risky behaviour is contingent on a misperception of the risk posed and/or a misperception of an individual's capability to deal with the consequences and moderated by an organisations tolerance for risk. Accordingly, strategies to reduce the likelihood of risky behaviour should focus on three areas:

1. Improve the perception of risk
2. Improve the perception of an individual's capability to deal with the consequences
3. Lower the organisation's tolerance for risk

Deficiencies in the skill of risk perception may be addressed through a variety of training interventions. The mechanisms for developing and delivering these interventions are well established and understood. Risk perception workshops serve to heighten awareness of the actual risk, and enable individuals to focus on the real, rather than perceived, risk, and to overcome familiarity. However, research acknowledges that information alone does not lead to behavioural change. Risk communication studies have shown that success increases when messages specified the probability and severity of the risk in addition to describing risk reduction and mitigation measures (Morrow, 2009).

Additionally, educating individuals about how perceptions of risk can change over time can aid the detection of changing risk beliefs and contribute to the avoidance of "risk creep" (Dillon & Tinsley, 2008). Training in the ability to gather relevant information, identify hazards, and recognise the cues associated with conditions of high risk will more closely align the perceived risk with the actual risk. Consideration should also be given to disguising safety interventions, where possible, to avoid decreasing risk perception due to knowledge of safety barriers. Proactive monitoring of risk and analysis of behaviour can be used to identify the current exposure to risk and to identify any disparity between perceived and actual risk.

Improving an individual's perception of their ability to deal with the consequences of their decisions can be achieved through improved self-awareness and knowledge of their skills. Regular training and involvement in simulated failure scenarios can facilitate this. Critical analysis of past events, whether incidents or near-misses, can provide valuable information regarding behaviours and decisions that resulted in success and those that resulted in failure. Research has shown that encouraging counterfactual thinking (i.e. thoughts of how things could have been different) results in a greater understanding of near-miss events (Kray & Galinsky, 2003; Kray, Galinsky & Wong, 2006), improving both an individual's perception of the risks

involved and their understanding of how decisions impacted the end result. Dillon and Tinsley (2008) also posit that this, in turn, may promote more risk-averse decisions.

The organisations tolerance for risk can be lowered through a number of means. Implementation of procedures and policies to minimise exposure to risk, in conjunction with established consequences for unsafe behaviour can impact on individual perception of risk, through changing the benefits and costs associated with the expressed behaviour. Similarly, establishment and maintenance of a collective safety culture in which risk taking is unacceptable serves to lower the collective tolerance for risk.

CONCLUSION

While research has demonstrated that a mental condition some call 'complacency' exists within particular contexts, the problem is whether it can be endowed with explanatory power. The mechanisms by which 'complacent' behaviour occurs are unclear, and any causal link to accidents has not been established. In comparison, risk perception and risk tolerance are readily understood psychological concepts, with studies able to demonstrate that failure to accurately perceive risks contributes to accident involvement. As such, using these concepts to enable organisations, accident investigators, managers and practitioners to better understand how individuals make decisions that (in some cases) leads to unintended consequences.

Research has shown that individual and collective perception of risk is subjective, and often inconsistent, with the actual risk. In our pursuit to continuously improve safety performance and minimise the risk of accidents, it is necessary to focus on the human aspect and individual differences. The internal and external factors that combine to influence risk perception and decision-making must be considered when encouraging safe behaviour in the workplace.

Our understanding of how these underlying psychological processes contribute to faulty decision-making and accidents offers the opportunity to develop individual and collective strategies to mitigate its effects. In comparison, our current understanding of complacency is limited in its ability to describe the underlying mechanisms by which it occurs and subsequently impedes our ability to develop effective preventative strategies. Risk may be ubiquitous, but with improved ability to perceive and identify risk, organisations and the individuals within them, are better able to manage the inherent risks and subsequently prevent accidents.

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