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Involuntary automaticity: a work-system induced risk to safe health care

Brian Toft* **and Hugo Mascie-Taylor†**

**Risk Consulting Practice, Marsh Ltd, London; †The Leeds Teaching Hospitals NHS Trust, St James' University Hospital, Leeds*

Automaticity is the term given by psychologists to the skilled action that people develop through repeatedly practising the same activity, for example driving a car. Usually, automaticity is discussed in terms of the benefits it brings to people, such as the reduction in the degree of conscious attention a person needs to pay to such skilled activities. However, there is evidence to suggest that substantial costs may also be associated with such learned behaviour.

Managing patient safety is a difficult task and one of the ways in which health-care professionals seek to accomplish it is through the use of verbal challenge–response protocols. However, it is argued in this paper that it is possible for the negative effects of automaticity to involuntarily capture those using such verbal checklist techniques and cause them to erroneously believe that the treatment that they are about to administer to a patient is safe when it is not. This phenomenon does not, however, seem to have been recognized by the health-care community nationally or internationally. We conclude that patient safety could be significantly improved worldwide if the organizational arrangements which appear to induce involuntary automaticity were to be robustly addressed by the management of all health-care organizations.

Introduction

In an attempt to manage patient safety within the health-care profession, one of the techniques used is that of verbal double-checking safety protocols, sometimes referred to as 'witnessing', the expectation being that if one person misses an error the other will detect it. For example, just prior to the administration of drugs, a blood transfusion or the provision of radiotherapy to a patient in hospital, the staff involved will carry out such a check in an effort to ensure that the correct treatment is administered to the right patient. Indeed, the verbal witnessing procedure is a process used all over the world on countless occasions every single day with the aim of preventing serious adverse incidents occurring to patients.

Unfortunately, however, the verbal witnessing procedure does not always prevent errors from being made or serious adverse events from happening. For example, in a study undertaken by Krause *et al*. conducted over 46 weeks and 129,234 administered medications, the observed error rates for the administration of 1000 medications by two nurses, was 2.12, and for one nurse it was 2.98. However, while there is a statistically

Professor Brian Toft, Research Director, Risk Consulting Practice, Marsh Ltd, Tower Place, London EC3R 5BU, UK
Professor Hugo Mascie-Taylor, Medical Director, The Leeds Teaching Hospitals NHS Trust, St. James's University Hospital, Beckett Street, Leeds LS9 7TF, UK
Correspondence: Professor Brian Toft
E-mail: brian.toft@ntlworld.com

significant improvement using two nurses the error rate was still greater than two per 1000 doses.[1]

Furthermore, data contained in the *Annual Report of the Serious Hazards of Transfusion 2001–2002* (SHOT) were analysed for the number of incidents of incorrect blood components that had been transfused where two members of staff had been involved in the verbal checking procedures. Of the 307 incidents reported to SHOT during the period 1996–2001, 238 (i.e. 77% of the adverse events) involved at least two members of staff in carrying out the identification checks.[2]

In a similar vein, the International Atomic Energy Agency observed in one serious adverse radiotherapy incident that the oncologist prescription was '…misread ten different times [and that] Checks by three members of staff failed to detect the setup mistake'.[3]

The studies reported above demonstrate that failures of the verbal witnessing safety protocol appear to occur in different health-care settings. This raises the question of whether such failures are due to random chance events or if they could be due to inherent sociopsychological mechanisms that predispose people to make such errors. The latter of these two options is discussed below.

Conscious automaticity

The term 'automaticity' is a concept used in psychology and is generally described as being the '…property of a process that takes place largely independent of conscious control and attention'.[4] This cognitive process is particularly useful as it permits individuals to undertake a range of practised behaviours without using a great deal of conscious effort or attention. This is because on recognizing a familiar task the cognitive system, instead of processing the information one step at a time, automatically applies the appropriate rules to the procedure, reducing the demand made on working memory. The spare capacity made available by this procedure can then be used to process other tasks simultaneously.

For example, learning to drive a car is for most people a laborious process. However, when a person has practised sufficiently, their previous conscious and often awkward movements become replaced with efficient coordinated actions and the individual no longer needs to pay such close attention to the act of driving and may engage in other activities such as talking to a passenger at the same time. At this point the driver's behaviour can be characterized as having become 'automatized'. Typically however, the driver of a vehicle is consciously aware that the skill they are utilizing is being controlled in such a way.

Involuntary automaticity

Usually automaticity is discussed in terms of the benefits that it bestows on those who can reach such a level of skilful behaviour, for example individuals being able to carry out more than one task at once. However, it has also been observed that there is a price to be paid for human beings having the ability to improve their performance in such a way.[5,6]

Langer notes that one of the dangers of automatic behaviour or 'mindlessness' as she terms it is that '…we take in and use limited signals from the world around us…without letting other signals…penetrate as well'.[7]

While Barshi argues that:

> Automaticity has … a cost that manifests itself in procedures that are highly routinized but require close attention, such as verbal checklists procedures. In such procedures, errors occur because the routine leads to automaticity.[8]

For example, airline pilots carry out verbal double-checking safety procedures and to that end, similar to health-care professionals, employ a verbal challenge–response process. Thus, the pilot not flying the aircraft (PNF) will read out aloud the item to be checked by the pilot flying the aircraft (PF) from a printed checklist. Once the PF has checked the item named by the PNF, he or she verbally responds with their findings. This could be as straightforward as repeating the name of the item that was checked and saying the word 'checked' or reading out aloud the information provided by a cockpit instrument. However, using identical checking procedures repeatedly can inadvertently lead to the process becoming ritualized and checklist items begin to take the form of a litany, where eventually '…the literal meaning of the message may be ignored'.[9] Therefore, as such dysfunctional behaviour is not consciously intended, the routine that has been invoked, it can be argued, is both unconscious and involuntary. The evidence suggests that such a situation is more likely to develop:

> In cases in which the crew members know each other well and trust each other's professionalism, or under time pressures and distractions, the PNF is especially un-likely to check the PF's proper execution of the checked item, relying on the verbal response only…This reliance on the verbal exchange can easily lead to hazardous situations.[10]

The dangers associated with involuntary checklist automaticity are graphically illustrated by the example provided in Barshi's paper. A Boeing 737 aircraft was about to land at Casper, Wyoming on 23 March 1983, and the aircrew were going through their routine pre-landing checklist. The Captain who was not flying the aircraft called out to the Co-pilot that he should lower the landing wheels. Shortly afterwards, the Co-pilot verbally responded to the Captain that the landing wheels were now down. Thus, the subsequent wheels-up landing came as a considerable shock to the aircrew and passengers alike.

With regard to the dangers of involuntary automaticity in an aircraft cockpit Green *et al*. suggests that:

> It is tempting for the pilot to regard a rapid dismissal of checklist items as indicative of his skill and familiarity with the aircraft, but, if checklists are dealt with in this automatic way, it is very easy for the pilot to see what he expects to see rather than what is there.[11]

The United States Federal Aviation Administration (FAA) also warns that the use of verbal safety checklist may on occasions cause, …'crewmembers [to] see what they expect to see rather than what is actually accomplished or indicated'.[12]

Olcott reinforces the view that it is imperative that aircrews do not unconsciously ritualize their aircraft checks when he notes that one of the conclusions made by investigators following one fatal air crash was that, 'The air carrier crew at LGA (New York La Guardia Airport) went through the motions of reading a checklist but responded without being effective'.[13]

Similarly, French observed during a study of radiotherapy accidents where identical verbal double-checking safety protocols are constantly utilized that:

> …in a small number of situations, the system failed completely, the major errors went undetected despite independent verification checks at several points…[The evidence suggests this may have occurred because] radiation therapists mechanically followed procedures, whereby verification [of the x-ray machine settings was] completed but not performed effectively.[14]

Moreover, in a recent work undertaken by the authors, it was found that in one serious adverse radiotherapy accident a major set-up error in the treatment machines database went undetected for a considerable period of time even though a verbal double-checking safety procedure, which included a visual check of the incorrect treatment parameter, was undertaken on multiple occasions. And while the staff were convinced that they had carried out their checks diligently, the reality was, as in the case reported by French, that they not been performed effectively.

Reason and Mycielska suggest that such human errors:

> …are the price we pay for being able to carry out so many complex activities with only a small investment of conscious attention. They are the inevitable penalty of the necessary process of automatization.[15]

Thus, the evidence appears to suggest that where identical verbal double-checking safety protocols are repeatedly undertaken the performance of those carrying out such a task can be adversely affected without them realizing it, for the persons involved can unconsciously act in a manner that follows an expected pattern of behaviour rather than that actually required by the situation, and as a consequence form an erroneous but firm belief about the safety of the system they are operating. Once established, the erroneous belief that has been generated because of involuntary automaticity becomes 'reality' and it is that belief which then influences their conscious and deliberate actions.

However, such involuntary dysfunctional behaviour, it can be argued, may arise because although the task that is the subject of the verbal double-checking safety protocol actually requires close attention, once captured by involuntary automaticity, by definition only a superficial amount of attentiveness will be paid to the variables being checked. Therefore, if an error is present it is likely to be missed without the individuals carrying out the verbal double-checking protocol realizing it.

Ambiguous accountability

Yet another factor that could aid the inadvertent activation of involuntary automaticity during the use of a verbal witnessing protocol is that the 'Two members of staff may rely upon the other to be rigorous, resulting in neither giving the task their full attention'.[16]

Similarly, Linden and Kaplan observe that:

> Unless carefully configured to prevent it, in a system in which two people are responsible for the same task, neither person is truly responsible. Paradoxically, such safety procedures may provide less, rather than more assurance.[17]

Stress

There has been a great deal of research conducted on stress in health-care settings which has revealed that all those who work in such environments are often subjected to excessive amounts of stress.[18,19]

It is therefore of interest that Leape argues that:

> Although it is often difficult to establish causal links between stress and specific accidents, there is little question that errors (both slips and mistakes) are increased under stress.[20]

In a similar manner, Nguyen and Bibbings argue that:

> It is accepted and proven that errors lead to accidents and that stress can lead to errors. It follows logically, therefore, that stress must also contribute to accident causation.[21]

Moreover, they suggest that the stress factors that increase the likelihood of an error occurring include high workloads, distractions, interruptions, insufficient staffing levels and fatigue. And while some 'medical staff seem to deny the effect of stress and fatigue on performance' there appears to be a body of evidence to suggest the opposite.[22] Thus, such factors should not be dismissed as they could also play a part in creating the appropriate conditions for the adverse affects of involuntary automaticity to flourish.

Remedial measures

Stringent conscious application of one's attention to the task in hand is one way to reduce the likelihood of unconscious checklist automaticity. However, it is suggested by the FAA that another way that aircrews can attempt to reduce the number of errors made when using verbal safety checklists is by:

> Announcing the checklist item out loud (the challenge) stimulates the sense of hearing and helps focus attention on the task. The pilot-in-command responds by visually checking each item then actually touching (visual and tactile), operating, or setting the control or device and announcing (the response) the instrument reading or prescribed control position in question. The crewmember calling the challenge monitors and verifies the actions.[23]

Additionally, in a study published in 2003 by Turner, Casbard and Murphy into the use of barcode patient identification technology as a means of improving the safety of blood transfusions by reducing reliance on human judgement, it was found that:

> The baseline audit revealed poor practice, particularly in patient identification. Significant improvements were found in the procedure for the administration of blood following the introduction of barcode patient identification, including an improvement from 11.8 to 100 percent in the correct verbal identification of patients ($p \leq 0.001$)…[24]

Improvements were also found in a number of other important factors, such as the number of patients correctly identified before blood samples were collected and the number of blood samples labelled correctly.

It has been reported in the aviation industry that one way in which checklist errors have been made is through a pilot calling out several items at once, with the result that the other pilot responded to the challenge in the same way. Such behaviour clearly undermines the whole concept of the challenge–response method.[25] Therefore, another way in which checklist errors can be minimized is through the persons reading out the checklist calling out each item separately and waiting for the other person to respond to that request before moving on to the next item.

Yet another way of reducing checklist errors could be for the individuals involved in a verbal double-checking safety protocol to undertake the check or checks completely independently of the other person and, having

completed the process, report their findings back to their colleague since this would prevent the litany aspects of the phenomenon from occurring.

The techniques described above could be utilized in the process of undertaking verbal double-checklist protocols in many instances by health-care professionals.

Discussion

As noted above, members of the health-care profession in some respects work in an environment similar to that of commercial airline pilots. Thus, the mechanisms that create human errors in one group, it can be argued, are likely to have a similar effect in the other. Therefore, since involuntary automaticity can adversely affect the performance of pilots when performing a verbal checklist, it is reasonable to assume, given the evidence presented above, that it will also affect members of the health-care profession in a similar manner. Likewise, stress and fatigue are often found to have played a role in providing the conditions for human error to flourish in both aviation and medicine. Therefore, when such physiological factors are present, they may also increase the risk that verbal checklists protocols could be affected by involuntary automaticity.

For instance, pilots and health-care professionals are often well acquainted with their colleagues and trust their professional judgement. Equally, both professions use verbal double-checking safety protocols repeatedly and are subjected to stress in various forms, interruptions and distractions. Indeed, it can be argued that some health-care professionals will use verbal checking protocols far more than pilots and thus be more at risk of developing involuntary automaticity. For example, in a busy radiotherapy department a pair of radiographers, prior to switching on the treatment beam, might use the same final verbal witnessing protocol over 40 times day.

Furthermore, where the roles and responsibilities of those involved in using verbal witnessing protocols are not explicitly articulated, additional opportunities may be inadvertently created that promote the likelihood of involuntary automatic behaviour occurring. However, by preventing or reducing the conditions that appear to support the development of involuntary automaticity and the use of remedial measures such as those discussed above, the number of occasions on which it could affect health-care professionals can be minimized.

Conclusion

There appears to be evidence that suggests that some of the serious adverse incidents that occur within health-care settings do so because the verbal double-checking protocols used under certain conditions do not provide the level of safety envisaged. The problem seems to arise on these occasions because involuntary automaticity causes the health-care professionals who have carried out the checks not to recognize that an error is present in the system and thus they form a false hypothesis regarding the patients' safety.

However, as briefly discussed above, there are remedial tactics that can be deployed to help prevent or reduce the opportunities for involuntary automaticity to have an affect. Moreover, it should be noted that it is the environment of the operational system within which health-care professionals work that induces involuntary automaticity. Thus, as Leape observes:

> Physicians and nurses need to accept the notion that error is an inevitable accompaniment of the human condition, even among conscious professionals with high standards. Errors must be accepted as evidence of systems flaws, not character flaws.[26]

However, the potential harmful effect of the unconscious behaviour that health-care professionals appear to experience when affected by the phenomenon termed 'involuntary automaticity' in this paper does not seem to have been identified in the medical literature either nationally or internationally, thus raising the prospect that health-care professionals may currently or in the past have been unjustly blamed or found guilty of causing a serious adverse incident that was not a result of their negligence but of the systems environment in which they were working, which promoted involuntary automaticity: it was that to which they unconsciously succumbed. Perhaps more worryingly, because the circumstances surrounding this phenomenon do not appear to have been identified, there could be numerous situations globally where the conditions for involuntary automaticity already exist and a

serious adverse incident is just waiting to occur.

Thus we conclude that if the organizational arrangements which appear to induce involuntary automaticity, as discussed above, were to be robustly addressed by the management of all health-care organizations, the risk to patient safety could be substantially reduced worldwide.

However, at the moment, precisely which work system factors promote involuntary automaticity the most is unclear. But given the propensity for adverse events to take place in health-care settings following the use of verbal double-checking protocols, it would seem to be an area for research that could produce rewarding results for patients and those responsible for health-care management alike.

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