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Debiasing visual pilots' weather-related decision making

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ABSTRACT

Pilots who decide to continue a flight into deteriorating weather conditions, rather than turn back or divert, are a significant cause of fatal crashes in general aviation. Earlier research has suggested that cognitive biases such as the anchoring effect and confirmation bias are implicated in many decisions to continue into worsening weather. In this study, we explored whether a simple debiasing technique, 'considering the alternative', reduced the effect of these two potentially fatal biases. Despite the study being adequately powered, our attempts to reduce the effects of biases were both unsuccessful. Negative findings such as these are particularly useful in aviation, as they can provide information on what does not work in this high stakes industry, even though such strategies may work elsewhere.

The role of a pilot when flying an aircraft is seldom passive, even in the cruise phase of a cross-country flight; pilots are required to make a range of decisions, some of which may be complex, especially when made under conditions of uncertainty, when ambiguous information is involved or when there is limited time available. How pilots with visual flight rule (VFR) ratings make their decisions when approaching weather conditions unsuitable for visual flight is of particular interest, because when a VFR pilot gets this decision wrong and flies into instrument meteorological conditions (IMC), the consequences can be fatal (Wiggins, Hunter, O'Hare and Martinussen, 2012).

VFR flight into IMC is consistently the most common cause of general aviation (GA) weather-related accidents. In the United States in 2011, 86% of accidents attributable to VFR flight into IMC were fatal; a rate well above that experienced in all other types of GA accidents (Aircraft Owner and Pilots' Association, 2014). Flying into IMC, when visibility may be marginal or even non-existent, the pilot must rely upon the aircraft instruments, rather than a visual reference to the horizon, to maintain control of the aircraft. Flying an aircraft with sole reference to the internal instruments requires a higher level of training and skills, but, in principle, would provide pilots with the ability to avoid the illusions that can lead to loss of control of the aircraft or straightforward controlled flight into terrain. Despite the dangers of visual pilots flying into IMC, VFR flight into IMC remains a significant problem in GA (O'Hare et al., 2011).

Given the consequences that may arise from VFR flight into IMC, it is not surprising that research has focused on investigating the underlying cause(s) of this type of accident. The initial focus in this area was on pilot demographics, and operational and geographic factors (National Transport Safety Board [NTSB], 1989, 2005). More recently, the focus has been on psychological aspects of pilots' weather-related behaviour, in particular, the decision-making strategies used in adverse weather conditions. Ineffective or inappropriate pilot decision making has been highlighted as a significant factor in this type of accident, with several suggestions to explain why pilots make inappropriate decisions when approaching IMC. These include motivational factors such as the plan continuation error, a cognitive bias whereby people continue to follow an original plan despite conditions having changed since its instigation (Orasanu et al., 2001; Causse et al., 2013) and, specifically, investigating cognitive biases in decision making when approaching adverse weather conditions (Madhavan and Lacson, 2006; Wiggins et al., 1999; Walmsley and Gilbey, 2016).

Walmsley and Gilbey (2016) found evidence to suggest that when a VFR pilot is making a weather-related decision, they could be influenced by the anchoring effect and by confirmation bias. Pilots had a tendency to anchor and under-adjust on initial pieces of information and a tendency to favour confirmatory evidence when testing hypotheses. Considering the serious consequences that can arise from decision error, it is important to explore methods to help pilots accurately assess the weather conditions by reducing the impact of cognitive biases. Research into correcting or preventing cognitive biases (debiasing) has largely been overshadowed by

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cognitive bias research, but is a critical area for improving decision making (Larrick, 2004).

Although techniques suggested for use in debiasing have been varied, most have focused on encouraging a shift from intuitive decision-making processes to analytical decision-making processes (Clarkson et al., 2002). It has been suggested that when making decisions, individuals use one of two modes, either Type 1 (intuitive) or Type 2 (analytical) processes (Croskerry et al., 2013; Kahneman, 2011). Many of the decisions a person makes use Type 1 processes; Croskerry et al. (2013) suggested that about 95% of the time people make decisions in this manner. Type 1 processes tend to use heuristics and are largely automatic and fast, and usually effective. The main shortcoming of Type 1 processes is that they can be affected by cognitive biases, which, in turn, can lead to fallacious solutions. On the contrary, Type 2 processes, which use rules-based processes and are conducted under conscious control, are reliable and effective. However, Type 2 processes are likely to create a much higher level of cognitive workload. Debiasing techniques are therefore aimed at changing people's reliance on Type 1 processing (automatic, heuristic) to slower Type 2 processing (controlled, rule-based), allowing for a more careful analysis of the information (Arkes, 1991), and, ultimately, a choice that is not affected by cognitive bias.

One of the more effective techniques of debiasing is the 'consider the alternative' strategy (Fischhoff, 1982), a simple strategy that has been shown to reduce overconfidence bias, hindsight bias, confirmation bias and the anchoring effect (Larrick, 2004; Mussweiler et al., 2000). A number of cognitive biases (including the two explored in the current study) are partly caused by the decision maker focusing on a narrow range of information. The 'consider the alternative' strategy encourages a person to consider a broader range of information, on the premise that this may counter the effect of cognitive biases (Larrick, 2004). Essentially, this strategy encourages decision makers to consider reasons why their initial judgment might be wrong.

Debiasing, using the 'consider the alternative' technique, has had some success in the real-world environment. Arkes, Faust, Guilmette, and Hart (1988) used this technique to reduce hindsight bias among neuropsychologists. Mussweiler et al. (2000) encouraged experts to assess the value of a used car after being exposed to an anchor. Participants in the experimental group, who were prompted to list anchor-inconsistent arguments before making their judgment, were affected less by the anchor than were those who had not been exposed to the debiasing technique. Gilbey, Tani, and Tsui (2015) found that the 'consider the alternative' strategy decreased the effect of outcome bias on reporting intentions. However, not all studies of debiasing have been successful; for example, Weinstein and Klein (1995) were not able to reduce optimistic bias with this strategy. Interestingly, Roese's (2004) attempt at reducing optimistic bias by generating a long list of contrary reasons not only failed, but actually made the effect worse; one explanation was that if participants struggled to generate a large number of contrary reasons, they were more likely to convince themselves that their initial judgment must have been correct.

The primary aim of the current study was to investigate whether the potentially dangerous effects of two cognitive biases (anchoring effect and confirmation bias) in weather-related decision making can be prevented, or at least reduced, by using the 'consider the alternative' debiasing technique. If such a strategy is effective, teaching pilots how to avoid cognitive biases could enable them to make better informed decisions by making more accurate assessments of the dynamic weather environment, and could thus reduce the likelihood that they perform behaviours such as flying into deteriorating weather conditions when the judicious decision would be to turn back or divert.

As our aim was to investigate a debiasing strategy that could easily be incorporated into flight training courses, pre-flight briefings, or cross-country-checklists, for example, by flying schools, aero-clubs, or single operators, the debiasing technique used was relatively simple to implement. In the following two sections, we report our attempts to reduce the effect of two cognitive biases identified in earlier work as likely to encourage the decision to continue a flight into deteriorating weather conditions (Walmsley and Gilbey, 2016): anchoring effect and confirmation bias. Although we report each study separately, the studies were run concurrently using the same participants, which better reflects how attempts at debiasing pilots might work in the real world.

1. Study 1: debiasing the anchoring effect

When making decisions, people often make estimates based on a starting point or an anchor (Tversky and Kahneman, 1974). The initial piece of information (an anchor) may vary in the degree to which it is useful to the decision at hand. It could also be information that is completely irrelevant to the decision (Englich et al., 2006). Although this heuristic can be useful in reducing cognitive workload, especially when making complex decisions, the evidence suggests that people often fail to make appropriate adjustments from the initial value of the anchor even when circumstances are likely to have changed. Failure to reassess one's initial judgment leaves the final judgment biased towards the initial value (Epley and Gilovich, 2006; Tversky and Kahneman, 1974). In the context of pilots' decision making, placing too great an emphasis on earlier information may prove particularly hazardous, as weather conditions are highly dynamic (Wagtendonk, 2011). As the anchoring effect can have serious implications for the safety of a flight, exploring practical methods to support pilots in weather-related decision making is an important step to improve safety.

Walmsley and Gilbey (2016) presented evidence that pilots anchored and under-adjusted when assessing both cloud height and visibility during weather-related decision making. Exploring methods that reduce the anchoring effect may aid pilots to assess the weather conditions accurately. The aim of Study 1 was to explore debiasing of the anchoring effect in weather-related decision making. If the debiasing technique was successful, pilots would demonstrate a reduced tendency to anchor to the initial piece of information received. It was hypothesized that the anchoring effect on cloud and visibility assessments in weather-related decisions would be reduced after pilots received the debiasing intervention.

1.1. Method

1.1.1. Participants

One hundred and one pilots participated in this study. Participants were all enrolled in a structured flight training programme at one of the main flight training schools based in New Zealand, where they study for their commercial pilot's licence and also complete an academic programme of study. At the time of testing, participants had received 20–200 h of flying experience as part of the training programme, and many had additional flying time, gained prior to their entry in the programme. To protect confidentiality, ethical approval to conduct this study was obtained with the proviso that neither demographic information nor flying hours were collected, thus ensuring that no participant could be identified. Although the lack of demographic and flight experience data limited the scope of the data analysis, this was an important element of the study design needed to obtain ethical approval.

Using the randomization function available in Microsoft Excel,