White Paper: Mistaken-for-Game Hunting Accidents – A Human Factors Review

Prepared for Hunter Safety Lab

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1. Executive Summary

Hunting accidents can have devastating consequences. One of the most common causes of hunting fatalities in this country, and others, are target identification failures—mistaking people for game.

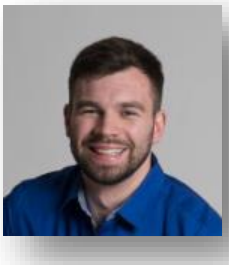
A golden rule in firearm safety is to identify your target beyond all doubt. Despite this message being constantly repeated, accidents are still occurring. Hunter education and awareness about high visibility clothing have reduced accident rates, but these statistics have since plateaued. Contrary to what most people think, the hunters committing these accidents are often experienced and considered to be safe and competent. Crucially, they often believe they have, 100%, correctly identified their target.

Psychology and human factors can provide insight into how these situations might occur. When interpreting information, we rely heavily upon mental rules of thumb called heuristics. Heuristics operate outside of our conscious awareness and are utilised even more in stressful or emotionally-charged situations. However, they can also make us susceptible to cognitive biases which may lead us astray—we underestimate the impact heuristics will have on our decisions. Attempts to manage heuristics and cognitive biases are often futile because we normally cannot detect them when they occur. Hunters are constantly told that they need to treat every sound or movement as human in an attempt to change their mind-set. However, given the difficulty in detecting cognitive biases, it is unlikely a hunter's conscious management of heuristics would be consistently possible in the long term.

Cognitive biases undoubtedly occur in hunting as in most activities we do. Analyses of accidents and anecdotal reports point to their involvement, as does research showing their involvement in other critical environments, including firearms operations in the military and the police. Given the impracticality of preventing heuristics and cognitive biases from affecting a hunter's target identification, an additional approach is required. One method to prevent mistaken-for-game hunting accidents may involve the use of objective warning systems, such as those used to prevent friendly fire in the military.

This white paper discusses four key cognitive biases which we believe play a role in mistaken-for-game hunting accidents: the availability heuristic, expectancy, confirmation bias, and optimism bias. We also present the assertion that experience may not safeguard a hunter, and may in fact do the opposite. Other contributing factors—buck fever, poor choice of clothing, and snap shooting—are discussed in relation to cognitive biases. However, there is currently a notable lack of research on the role of cognitive biases in hunting accidents per se. As a result, more work needs to be conducted to verify the conclusions of this white paper, for which a human factors approach must be taken.

2. Contributors to the report



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Karl has provided authorship, supervision and guidance for the completion of this white paper.

Contents

3. Introduction

This paper uses a human factors perspective to understand why responsible, experienced hunters may sometimes make seemingly inexplicable mistakes in target identification.

> *A man makes his way through the bush, sometime after splitting up with his hunting companion. A movement nearby captures his attention. He stops and sees what appears to be a deer, less than 40 metres away. This is what he has been waiting for. He carefully moves to a better position and again eyes his target. He can make out the head and the antlers of the deer and watches as it feeds; its head bobs up and down. It is definitely, 100% a deer and he prepares to shoot.*

This is not an uncommon chain of events in the lead up to a hunting accident. It can describe a classic case of mistaken target identity, which sources suggest is the most common type of fatal hunting accident in New Zealand[1] and elsewhere too.[2]

On average, a hunter is accidentally killed every nine months in New Zealand. To date in 2015, there have been two accidents where target misidentification was a factor, one of which was fatal. The majority of fatalities involving misidentified targets occur in big game as opposed to small game hunting.[3] In New Zealand the accidents primarily involve deer hunting. A 2003 report[1] by Inspector Joe Green of the New Zealand Police analysed 33 fatal deer hunting accidents occurring between 1979 and 2002. Incorrect target identification was by far the largest contributor (64%) in the cases examined, and figures from overseas appear to be similar, if not higher.[4]

On the face of it, it seems unlikely to hunters and non-hunters alike that a person could be mistaken for a deer. Furthermore, it seems *incomprehensible* that a hunter could truly believe he had correctly identified his target, as a deer, when in fact what he was seeing was a person—most often his own hunting companion.

One of the golden rules in firearm/hunter safety is "Identify your target beyond all doubt." Surely, for someone to wind up accidentally shooting their own hunting companion after mistaking them for a deer, they have violated this rule. Commonly it is thought that the hunter must have been inexperienced, reckless, or has "shot at sound" as opposed to properly identifying the target.

However, both the statistics and many anecdotal reports paint a different picture. Often the person committing this act is an experienced hunter. He is considered safe and competent. **Crucially, it**

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[1] See Green, J. (2003). *To Hunt and Return: Developing Safe Hunting Practice.* Wellington, New Zealand: New Zealand Police.
[2] See http://www.cdc.gov/mmwr/preview/mmwrhtml/00044112.htm, Table 1
[3] E.g. Junuzovic, M., & Eriksson, A. (2012). Unintentional firearm hunting deaths in Sweden. *Forensic science international, 216*, 12–18.
[4] See www.ihea.com

appears that they *have* identified their target *beyond all doubt*. To the shooter, there is no doubt, whatsoever, that their target is a deer.

The broader history of accidents over the last fifty years—through the influence of hunter training and then the inclusion of high visibility wear (hunter orange)—shows a steady rate of improvement in accident statistics. However in the past decade the statistics have plateaued, reflecting the limitations of education and high visibility clothing.

4. Insight from psychology

As to how this plateauing of improvement can be explained, the field of psychology can give us insight. A common misunderstanding[5] about how we, as humans, "see" things is that whatever light comes into our eyes is "seen" or perceived by us. This is not true. Our eyes take in visual information but then our brain, acting like a filter, determines what we actually perceive and what we become "aware" of.[6] The role of the brain in this, should not be underestimated. If we were aware of every bit of visual information that our eyes took in, our brains would be completely and utterly overloaded.

Research has shown that humans are often unable to detect large and seemingly obvious visual changes in the environment.[7] A well-known demonstration of this used by psychologists is a video where a gorilla walks onto a basketball court during a game in full view of the camera.[8] Observers are asked to focus on the basketball activity in the foreground and as a consequence they often fail to report seeing the gorilla. This scene is often used by psychologists to show how easy it is to miss obvious details when our attention is focused elsewhere. Furthermore, we tend to overestimate our ability to perceive such visual changes; we think there is "no way" we could miss such an obvious event in front of our very eyes.[9]

An important role of our brains is to "fill in" bits of information and make assumptions about what we are seeing. If we had to walk around our vehicle twice in the mall car park, carefully looking it up and down before deciding that it was indeed our vehicle, we would waste a lot of time. Luckily, upon returning to the car we have only to briefly glance at it from a distance to confirm it's ours. We remember the general area that we parked in and we quickly recognise the characteristic shape of the vehicle. However, most people will have, at one point or another, experienced trying to get into

[5] See Findlay, J.M., Gilchrist, I.D. (2003). *Active Vision: The Psychology of Looking and Seeing.* Oxford: Oxford University Press.
[6] This is the most commonly accepted theory. For a wider discussion see http://www.simplypsychology.org/perception-theories.html
[7] For a review on this see Simons, D. J. (2000). Attentional capture and inattentional blindness. *Trends in Cognitive Sciences, 4*, 147–155.
[8] See http://www.theinvisiblegorilla.com/videos.html
[9] See Levin, D. (2002). Change blindness: As visual metacognition. *Journal of Consciousness Studies, 9*, 111–130.

the wrong car. We wonder how we could have been so stupid. In reality, the same 'logic' that leads us back to our car in the carpark ninety-nine percent of the time, can fail us now and again.

The mistake of trying to get into the wrong car might be embarrassing, but it is insignificant—there is no harm done. We would certainly not trade this one-off situation for the cumulative time that we would have spent, methodically double-checking that we had correctly selected our car each time we walked back to it over the years.

The above is an example of how we use rules of thumb called "heuristics" to make sense of the world around us. They are evolved strategies which we rely upon heavily.[10] They make our behaviour smooth, fast, and efficient, and are therefore extremely useful to us.

5. Heuristics

Heuristics enable us to make correct decisions without actually having all of the information we technically need to make a decision. They allow unconscious mental processes to make up for the missing information and lead us to a decision that is, most of the time, correct. Our brain achieves this by making use of our prior experiences, memories, knowledge, and expectations. All of this occurs outside of our conscious awareness and so we are often oblivious to the impact of heuristics on our interpretations.[9] It is important to add that these are also processes that can work against us and contribute to poor decision making.[11]

The more familiar we become with certain tasks or environments, the more likely we are to use heuristics to make decisions in an efficient and automatic way.[12] We become better at recognising our environment and making predictions about it. "Experts" are often people who use heuristics in order to make effective decisions quickly or when there is little information to go on. Think about a sport or a specific task you are proficient at. When you first began, you were likely much slower and decisions were more deliberate and effortful. Compare this to now, where you are more efficient and, at times, operating in "autopilot" mode. Driving is a good example of this. Chess is another—people are often surprised to learn of the reliance on heuristics, rather than analytical thinking, by expert chess players.[13] Grandmaster chess players use "intuition" and "pattern recognition" far more often than amateur players. Instead of consciously analysing gameplay and carefully comparing the effects of different moves, experts quickly and automatically recognise patterns (e.g. the arrangement of the pieces) by drawing on memories from their extensive hours of past experience.

[10] See Kahneman, D. (2011). *Thinking, fast and slow.* Macmillan.
[11] See Thuraisingham, M. M. (2013). *The Secret Life of Decisions: How Unconscious Bias Subverts Your Judgement.* Gower Publishing, Ltd..
[12] See James, W. (2004). *The Principles of Psychology (Volume 1 of 2)*. Digireads.com Publishing.
[13] See DeCroot, A. D. (1965). Thought and choice in chess.

Indeed, MRI brain scans show that expert chess players use different areas of their brains to what non-expert players use.[14]

Drivers also rely heavily on heuristics. As an experienced driver, you can sometimes tell when a driver in the lane next to you is about to change lanes, before they even indicate. To recognise this, you are picking up on "cues," which are pieces of information that indicate the state of the other car beside you. You might find that the slight drift of their car within their lane serves as a visual cue, while the noise of their engine serves as an auditory cue. Together, these cues allow you to predict the driver's next move, after having seen other drivers do the same thing before. Just like expert chess players, you are using pattern recognition and intuition. One of these cues alone may not have led to your prediction, but the two combined have a cumulative effect.[15] Often you won't be able to tell exactly what cues you used to predict another driver's behaviour—you just "had a feeling."

We utilise heuristics even more in stressful or emotionally-charged situations.[16] Often it is these situations where decisions are the most time-pressured. Our prehistoric ancestors did not stand there stroking their beards in thought after seeing a flash of a predator in long grass nearby. And for any that might have done, it is unlikely that their genes are present in today's population.

6. The pitfalls of heuristics: Cognitive biases

A downside of heuristics is that they make us susceptible to "cognitive biases." For the majority, an unconscious phenomenon, cognitive biases can send us down the path of making an incorrect decision (e.g. the mall carpark example above). The resulting mistakes are usually only trivial in nature, and all things considered, we would not want to forgo our ability to use heuristics only to be stuck with the slow and inefficient alternative of careful reasoning (which of course, does have its place). However there are situations where the consequences of being led astray by a cognitive bias are severe. Furthermore, a number of factors make any attempt at "management" of cognitive biases challenging or even implausible. Firstly, they can be impossible to detect at the point of occurrence given that they operate outside of our conscious awareness. Secondly, being armed with the knowledge that we suffer from irrational biases does not prevent them from occurring. Unfortunately we cannot expect to be able to just take a step back and rein them in. This is why the well-intentioned hunting advice of "treat every sound or movement as human until proven otherwise" will not be as effective as one might expect. Finally, it is human nature to underestimate the impact they have on us. We overestimate the control we have over our judgements and

[14] See Wan, X., Nakatani, H., Ueno, K., Asamizuya, T., Cheng, K., & Tanaka, K. (2011). The neural basis of intuitive best next-move generation in board game experts. *Science, 331*, 341–346.
[15] See McCammon, I. (2004). Heuristic traps in recreational avalanche accidents: Evidence and implications. *Avalanche News, 68*, 42–50.
[16] See Easterbrook, J. A. (1959). The effect of emotion on cue utilization and the organization of behavior. *Psychological review, 66*, 183.

decisions, and underestimate the role that unconscious processes have. In essence our biggest failure is not admitting that we are fallible.

Another challenge we face in managing cognitive biases may come in the *aftermath* of an accident, when we attempt to determine the cause of a critical error. In medicine for example, when one radiologist is scrutinising another radiologist's performance after it has emerged that they failed to detect a tumour in a chest scan, the likelihood that the radiologist in question *should* have been able to see the tumour tends to be overestimated. This has been called a "visual hindsight bias" or "saw-it-all-along" effect.[17] Closely related to this is "fundamental attribution error" which describes how we often place the blame solely on supposed factors within the person (such as recklessness or carelessness) rather than considering the circumstance as a whole and whether in the same circumstances, a person of similar training and experience might have done the same thing.[18] So whilst it may be easy for many to pass a quick judgment on a hunter who has fired in error, the reality is that those judging are often completely unable to understand the unconscious processes that have led to the hunter making the mistake in target identification.

7. Heuristics and cognitive biases in hunting

The fact that heuristics and cognitive biases occur in hunting is without question. A hunter who was unable to use heuristics would not be a very successful hunter. Hunters sometimes speak of other successful hunters as being better at "seeing deer." They probably won't quite be able to put their finger on what is responsible for this though. They may put it down to knowing where to look and then to being better able to pick a deer out from its surroundings. Heuristics and cognitive biases are responsible for this.

For an experienced hunter who has shot many deer, the cues that signal the presence of an animal are all too familiar—they become ingrained into their psyche. For a start, they know what to look for. Subtle signs of browsing, a smell of deer on the breeze that a novice may not have picked up on, let them know that a deer has been in the area. A barely audible crack of a twig rouses them—they nod to their novice hunting partner, who didn't hear it. The difference is that the experienced hunter was already half-expecting to hear a deer browsing; they were "primed" to hear it. Combined with the size of the prints they'd just seen in the mud, the experienced hunter was able to use their past experiences to deduce that it had to be a stag.

A fellow hunter might tell you about a time they were watching a "deer," waiting for it to stand up. After a period of time though, and upon getting closer, the "deer" turned out to be a log, a stump, or perhaps a nikau palm frond. It is not uncommon to see deer features in inanimate objects, and even to then collectively transform these objects into an actual deer. It is only after the hunter realises

[17] See Harley, E. M., Carlsen, K. A., & Loftus, G. R. (2004). The" saw-it-all-along" effect: demonstrations of visual hindsight bias. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 30*, 960.
[18] See Green, M. (2006). Human error vs. design error. *Trial, 42*, 60.

that they were actually looking at an inanimate object that they wonder how they could have been mistaken—now it seems so obvious that it is just a log. Moments earlier though, it was a different story.

Some might suggest that hunters should just elect to use conscious reasoning instead of heuristics during target identification. The biggest problem with this is that it is not really possible—heuristics operate outside of our awareness, so even when we think we are using deliberate reasoning, we may not be.[19] Even if we could there would be another problem (although you would expect people would happily embrace this, if it guaranteed them of never mistaking another hunter for game); by the time we had made a decision using conscious reasoning, the deer we were looking at would probably have moved on and be out of shooting position.

Cognitive biases occur in hunting, just as they do in every other facet of our lives. The question is, how significant is their contribution, in this country and others, to the recurrent cause of hunting fatalities, namely mistaken target identification?

In 2012 Henry Worsp shot his hunting companion and good friend. He was experienced, well aware of safe hunting practice, and considered himself to be a safety-conscious hunter—his peers held this view about him also.

Figure 1 - Line of sight reconstructed by New Zealand Police

[19] See Green, M. (2006). Human error vs. design error. *Trial, 42*, 60.

Worsp's account details a chain of events and pre-existing factors that likely contributed to the devastating end result. The two hunters hadn't intended to split up, but had lost sight of each other about 30 minutes beforehand. Worsp knew it was possible for someone to mistake a human for a deer, but thought it was unlikely to happen to him. He said that he had a "low perceived risk of this happening."[20]

Worsp saw what he thought was a deer on a game trail, with its head bobbing up and down as it fed. At that point he was certain it was a deer, however he moved position to get a better view, checking and re-checking. The image above shows us Worsp's approximate line of sight, as reconstructed by New Zealand Police. When he pulled the trigger he was 100% certain he was looking at a deer.

There are several pieces of information that Worsp recalled which point to the involvement of cognitive biases. Investigators suggested that the antlers of a fallow deer which Worsp perceived were likely to be fern fronds (see Figure 1). This suggests that from Worsp's vantage point, the victim's head was beside or below the fern fronds. Couple this with Worsp's comment that it looked as if the "deer" was feeding, moving its head up and down. Perhaps movement by the victim had caused the ferns to move at the same time, further contributing to a visual effect which could have been mistaken for a deer head and antlers moving up and down. Investigators also suggested that the victim's camouflaged backpack was mistaken for the back of a deer, while the victim's hair may have appeared similar in colour to the coat of a deer.

The president of the New Zealand Deerstalkers Association, Bill O'Leary, talks of how people might do this, saying "they see little pieces of what they think is a deer and they convince themselves what they see is a deer."[21] The Mountain Safety Council says that "Hunters should sight the head, neck, and shoulder of the animal all at the same time, or at least sufficient of the animal to confirm target identification."[22]

The concerning part about this is that it appears these shooters *believe they have* identified these parts of the animal. In the case of Worsp, pieces of the environment surrounding the victim were perceived as being part of the head of the deer. Combined with the victim's backpack and red hair, Worsp had three pieces of information that could have been interpreted as confirming evidence of the presence of a deer (see "confirmation bias" below).

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[20] See http://www.stuff.co.nz/national/8433027/Hunter-who-killed-friend-was-certain-he-was-a-deer

[21] See http://www.stuff.co.nz/southland-times/news/67500123/Deerstalkers-boss-urges-hunters-to-change-mindset

[22] See Mountain Safety Council Media Release, 22 March, 2012: http://www.mountainsafety.org.nz/files/20120322---Firearms---Mountain-Safety-Council-warns-hunters-to-be-safe-this-deer-hunting-season.pdf

Previous research (such as Green's) combined with numerous media reports are able to give us a picture of the typical situation involving a fatal hunting accident. The "typical" situation is very much like a "typical" hunt. Usually both the hunter and the deceased are males and they are experienced hunters. Green's 2003 report found that hunters involved in accidents are generally not members of hunting associations, however several recent accidents have involved prominent members of hunting associations in New Zealand. The vast majority of the accidents occur during the day in an area with some degree of bush cover and after the hunters have separated. The hunter who eventually fires the fatal shot is often expecting to see a deer, sometimes because they have seen a deer in the area not long beforehand. They were not expecting to see the victim however. They notice movement and see the victim who they perceive as a deer. The average distance is about 35 metres. Sometimes the shot is taken relatively quickly, but often the hunter studies the target for several minutes or longer. The hunter perceives multiple features of a deer. They identify their target beyond all doubt—in other words, they have no doubt that what they are looking at is a deer.

Both the anecdotal reports and Green's research point to a role of cognitive biases in target identification accidents.

Hunters often experience excitement, which may be anywhere within the range of a subtle increase in anticipation right up to a phenomenon known as "buck fever." Research in numerous fields demonstrates that increases in arousal levels (e.g. elevated heart rate and stress) are associated with an increased reliance on heuristics. Furthermore, there are optimal levels of arousal and when levels surpass this, people experience a drop in decision-making performance.[23]

Skill development also coincides with increased use of heuristics and cognitive biases. There are clearly varying levels of skill in hunters. When we refer to "skilled" people in contexts, what we often mean is that they have transitioned from slow and consciously-controlled behaviour to more automatic behaviour. Development and use of heuristics are integral to this—performance would not increase without the help of heuristics.[24]

The uncertainties in hunting likely play a role too. As Green & Boyes[25] state, "Hunting as an adventure activity contains some inherent uncertainties particularly when sighting an animal in terrain where an incomplete view is available because of bush cover or terrain." We know that heuristics and cognitive biases occur even more when information is uncertain. Trevor Dyke, former President of the New Zealand Deerstalkers Association, appears to allude to this when he says "The eye sees something and in a flash the brain fills in the missing pieces."[26] When vision is partially

[23] See Hebb, D. O. (1955). Drives and the CNS (conceptual nervous system). *Psychological review, 62*, 243.
[24] See Green, M. (2006). Human error vs. design error. Trial, 42, 60.
[25] See Green, J., & Boyes, M. (2006). Deer hunting in New Zealand: Safety lessons from the field. *New Zealand Journal of Outdoor Education Ko Tane Mahuta Pupuke, 2*, Issue 1, June.
[26] See *Hunting Accidents* (Carnachan, 2003) - http://www.investigatemagazine.com/jul03hunt.htm

obscured, as it often is when a hunter is searching for game (e.g. by bush or scrub), a person (unknowingly) relies, more than usual, on heuristics in order to interpret what they are looking at.[27]

8. Specific cognitive biases in mistaken-for-game hunting accidents

8.1 Availability heuristic

The availability heuristic refers to our tendency to use or draw upon information that is recent, more available, or "comes to mind" easier.[28] This contributes to our efficiency; often more recent information is going to be more relevant and useful to us. Also, mentally accessing it is less effortful compared to retrieving less recent information. Consider the below image (Figure 2): the hunter who has just arrived home after going duck shooting may be more likely to see a duck, whereas the opposite is true for the rabbit shooter. Once the viewer perceives one of these animals, it can be difficult to "un-see" that animal and see the other. Additionally, it is not possible to see both at the same time.

Figure 2 - Kaninchen und Ente (Duck or rabbit), Fliegende Blatter (1892)

8.2 Expectancy

When we expect to hear or see something, our brain prepares or primes us to hear or see that very something. This allows us to be quicker at interpreting that information and still able to perceive it even when it is doesn't stand out. The hunter who has seen actual deer feeding in a particular spot several times before may expect to see a deer next time they are in the area. This will help them to recognise a deer, which is particularly useful if they are difficult to see in that spot. By the same token however, they are more likely to *mistakenly* see a deer, when there is not one there.

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[27] See Green, M. (2005). Is it a gun or a wallet? Perceptual factors in police shootings of unarmed suspects. *Police Marksman, July/August, 52–54.*

[28] See Tversky, A., & Kahneman, D. (1973). Availability: A heuristic for judging frequency and probability. *Cognitive psychology, 5*, 207–232.

Indeed, this can be inferred from prior analyses of mistaken-for-game accidents: often the hunter will have heightened expectations of seeing a deer in the area because they either saw one not long before the accident, or they, or a hunting companion, shot one in the area on another occasion.[29]

8.3 Confirmation bias

Once we are primed and expecting to see or hear something, without realising it we look for or prioritise information or evidence that *confirms* that thing's occurrence. Furthermore, we tend to ignore or rationalise away any parts of the occurrence not consistent with our initial expectation-biased perception of the sighting or sound.[30] That is, these dismissal effects add to confirmation bias by reducing sensibility to any information that denies the expected occurrence. These effects continue to apply for information subsequently obtained. Unfortunately, the unaware victim of confirmation bias responds much better to flimsy supporting information. The phenomenon of confirmation bias also leads us to favourably process information that we *want to be true*, and dismiss information that we do not want to believe.

Confirmation bias partly explains how hunters wearing hunter-orange can still be mistaken for game. The bright and unnatural colour, that should be ringing alarm bells for a would-be shooter, can instead be unconsciously disregarded by them. Another example is the shooting of people carrying game. The hunter swears they were looking at a stag with antlers but in reality these were being carried upside down on the back of a hunter's pack. The information that seemed to confirm they were looking at a stag (e.g. antlers) was given priority, whereas the disconfirming information (e.g. that the antlers were upside down and moving in a non-typical fashion) was unconsciously ignored. It is important to understand that the hunter is not making a conscious decision as to which information is utilised and which is disregarded; these are unconscious processes.

8.4 "It won't happen to me"—Optimism bias

Individuals typically believe that there is less chance of something bad happening to them compared to others. This is known as "optimism bias." It can be seen in smokers, for example, who think that they are less likely to develop lung cancer than other smokers,[31] and drivers who think that they are less likely to have an accident than other drivers.[32] Note that experts tend to be just as susceptible to

[29] See Green, J. (2003). *To Hunt and Return: Developing Safe Hunting Practice*. Wellington, New Zealand: New Zealand Police.

[30] See Nickerson, R. S. (1998). Confirmation bias: A ubiquitous phenomenon in many guises. *Review of General Psychology, 2*, 175–220.

[31] See Williams, T., & Clarke, V. A. (1997). Optimistic bias in beliefs about smoking. *Australian Journal of Psychology, 49*, 106–112.

[32] See DeJoy, D. M. (1989). The optimism bias and traffic accident risk perception. *Accident Analysis & Prevention, 21*, 333–340.

optimism bias as novices, when comparing themselves to people with equal training and experience.[33]

For hunters, there appears to be a common belief, or "fallacy," that they could never mistake a person for a deer. This is often reflected in media reports following an accident, where the shooter describes having thought "it would never happen to me"[34] and equally (in more fortunate, non-fatal circumstances) where someone who was mistaken for game says they never believed that could happen to them.[35] This is closely related to the "over-familiarisation" effect, whereby after people are exposed to a hazard again and again their perception of the risks associated with the hazard are reduced,[36] reflecting a desensitisation of sorts.

9. The role of experience

Hunting accidents where people are mistaken for game appear to be more common among experienced hunters, which seems counterintuitive. Green's research showed that in over two-thirds of the cases, the shooter could be described as an "experienced hunter." Whether or not increased experience predisposes hunters to being more vulnerable to mistaken identity accidents remains to be seen, however it seems plausible when we consider what actually makes an expert an expert.

Becoming an expert involves the unconscious learning of cues. Experts learn which cues accurately predict events or behaviours and which cues are irrelevant. The experienced hunter knows exactly what cues signal "deer" and has long since ceased paying attention to the cues that have not successfully resulted in the detection of a deer. When asked about the cues they are using, they will be able to verbally express some but not others—the learning of cues is an unconscious process. Try for example to explain to somebody how you ride a bike or walk down a set of stairs[37]—how is it that you automatically make those fine adjustments to your balance that at one point in your life were so difficult? Experts rely heavily on their abundance of past experiences and their learned cues, which help to guide them as to what they can expect and thus make fast and accurate predictions. Research shows that experts can be even more susceptible to errors (such as inattentional blindness) resulting from cognitive biases than their less-skilled and less-practised counterparts.[38]

For the experienced hunter, a risk is that some of the cues that signal the presence of a deer to them are the very same cues that a human moving through the bush would display. Equally concerning is

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[33] See Waylen, A. E., Horswill, M. S., Alexander, J. L., & McKenna, F. P. (2004). Do expert drivers have a reduced illusion of superiority?. *Transportation Research Part F: Traffic Psychology and Behaviour, 7*, 323–331.

[34] See for example http://www.stuff.co.nz/national/8433027/Hunter-who-killed-friend-was-certain-he-was-a-deer

[35] See for example http://www.stuff.co.nz/national/67712846/hunter-recovers-after-being-shot-in-the-back-graphic-content

[36] See *Outdoor safety risk management for outdoor leaders*. Wellington, NZ: NZMSC (Haddock, 2004) p.38–9.

[37] See Green, M. (2006). Human error vs. design error. *Trial, 42*, 60.

[38] See Green, M. (2004). Inattentional blindness and conspicuity. In *Internet Seminar. Link: www.visualexpert. com/Resources/inattentionalblindness html*.

that the cues a hunter has learned to be irrelevant or less-useful over their years of experience may include cues which would, crucially, successfully differentiate their hunting companion from a deer—it is unsurprising that high hunter experience seems no protector against error.

10. The cumulative effects of cognitive biases

Research suggests that the more cognitive biases there are present in a critical situation, the higher the likelihood is that the situation will end with unexpected consequences.[39] Further, consider not only the biases that are involved in the lead-up to the accident, but also the biases that are present *after* the accident, when the public wonder "how on earth could that happen?" Cognitive biases are not just involved in the lead-up to and the time of target identification, but they also play a role *after* the event has occurred (see "visual hindsight bias" and "fundamental attribution error" described earlier), when outside observers attempt to answer the questions of "how" and "why."

11. Drift into failure

The work of Sidney Dekker[40] reveals how behaviours can gradually change, over a prolonged period of time, in the lead-up to critical accidents. "Drift into failure" may help explain how a hunter could gradually slip into a mode of functioning where he is making visual judgements that could potentially be incorrect.

Through numerous shots in the past, prior to the critical target misidentification accident, a hunter (or rather a hunter's *brain*) fine-tunes their process to maximise efficiency.

"*Success narrows perceptions, changes attitudes, reinforces a single way of doing business, breeds overconfidence in the adequacy of current practices, and reduces the acceptance of opposing points of view.*"[41]

In the context of target misidentification accidents, "success" can be thought of as each time a target was correctly identified, e.g. the target was not a human mistaken for game. For most hunters, this will include every shot they have ever taken.

The drift into failure is slow and changes occur incrementally such that people usually do not notice them occurring. Bad outcomes can be the result of what was considered to be "normal" functioning.

[39] See McCammon, I. (2004). Heuristic traps in recreational avalanche accidents: Evidence and implications. *Avalanche News, 68*, 42–50.
[40] See Dekker, S. (2014). *The Field Guide to Understanding 'Human Error'.* Ashgate Publishing, Ltd..
[41] From Weick, K. E., & Sutcliffe, K. M. (2011). *Managing the unexpected: Resilient performance in an age of uncertainty* (Vol. 8). John Wiley & Sons.

This may shed more light on how an experienced hunter, who is considered by not just them alone but others too to be safe and competent without ever having had an incident, could make a crucial error of target identification during "just another shot."

12. Existing research

Research examining these phenomena specific to hunting is sparse. Predominantly, researchers have used databases and statistics on hunting accidents to infer causality and attempt to offer solutions. However we found that existing reports on accidents are not well organised or easily accessible.

We were able to find just two notable pieces of research, both of which attempted to gauge the contribution of psychological factors to mistaken-for-game hunting accidents through a series of tests. The first details the observations of Maynard Marsh, a woods detective from Maine, USA, who analysed 219 hunting accidents where mistaken identity was implicated.[42] Marsh realised there was a clear trend apparent. The hunters committing these errors were not inexperienced. They were well-versed hunters and by all accounts they were considered safe—they were the last sort of people that would be expected to fire upon a fellow hunter. Through various psychological tests, Marsh found that one type of test stood out as being a differentiator—tests of visual perception. The shooters convicted in these woods killings were almost always quicker than average when they had to judge ambiguous images that gradually (over a period of minutes) became more discernible. Furthermore, these hunters were more likely to believe their reactions were calculated and deliberate as opposed to automatic and intuitive.

> *"What makes a good hunter is quick visual perception. And, unlike the greenhorn who must think his way through a new situation, the seasoned hunter has developed, through years of practice, a fine set of conditioned reflexes. Such gunners think they are being deliberate but, gauged by normal standards, they hear, see, and fire with deadly speed and accuracy."* – Dietz, 1954.

The second piece of research was a collaborative study in 1965 between Harvard University Scientists and the Massachusetts Division of Fisheries and Game. Similar tests to those used by Marsh were conducted. An article on the research was published in *Outdoor Life* magazine, with the headline "A Thing Called Early Blur – The Illusion That Kills."

> *"…the major cause of the tragedies are amazing hallucinations which make it possible for any intelligent person, given a combination of normal physical and mental factors, to see a deer where no deer exists*."[43]

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[42] See Dietz, L., *Woods Detective,* Sports Illustrated, November 08, 1954.
[43] From *Experiments Disclose Reasons for Accidents:* https://news.google.com/newspapers?nid=1298&dat=19651109&id=dflNAAAAIBAJ&sjid=bosDAAAAIBAJ&pg=2269,3649853&hl=en

While, fifty years on, we may not go as far as using the term “hallucinations” in this context, their conclusions are a reflection of the magnitude of the visual perception errors that hunters can make.

13. Research from other industries

While there is little existing research specific to hunting, there is an abundance of research on how cognitive biases contribute to critical accidents in other industries.

Take the example of a pharmacist who accidentally gave an infant a fatal drug overdose.[44] The pharmacist’s previous experience had primarily been with adult patients, and she was just covering another pharmacist’s shift. Her error was to misread the drug prescription, adding an extra zero to the dosage. This was despite double-checking the advised dosage by consulting a reference book, where she made the same error again. The problem was that she *expected* to see the extra zero on the number, because she was so used to reading adult dosages. Without her realising, her brain “filled in” this information, which would have been useful for her had she been administering an adult dosage, which she had done every other time in her life. This demonstrates how expectancy and confirmation bias can mislead a person, despite the person’s good intentions and the critical nature of their work, where they are fully aware that any mistakes can have serious consequences.

In the military a significant problem involving target identification is friendly fire accidents. Expectancy bias has been cited as major factor in some of these accidents.[45] Despite the extensive training soldiers receive, the rate of friendly fire casualties remains high. If firearms operators who receive that level of training are still susceptible to accidental shootings, can we really expect to "train these out" of civilians? Indeed, the failure of training and instructions following attempts to reduce the effects of biases have been documented.[46] Furthermore, experiments have shown that police officers can be significantly affected by pre-existing biases when they are approached by a possible assailant. For example, depending on their prior expectancies, officers can be more likely to “see” a handgun (and by extension, shoot the approaching person) when in fact the person is holding a wallet or some other nonthreatening object.[47]

The failures of other experts are also well documented. Mountaineers with more experience were shown to be just as, if not more, vulnerable to making critical errors in the detection of avalanche

[44] See Green, M. (2006). *Human error vs. design error.* Trial, 42(6), 60.
[45] See Greitzer, F. L., Andrews, D. H., Herz, R. P., & Wolf, M. B. (2010). *Training strategies to mitigate expectancy-induced response bias in combat identification: A research agenda* (No. AFRL-RH-AZ-BK-2010-0002). Air Force Research Lab.
[46] See Parasuraman, R., & Manzey, D. H. (2010). Complacency and bias in human use of automation: An attentional integration. *Human Factors, 52*, 381–410.
[47] See Green, M. (2005). Is it a gun or a wallet? Perceptual factors in police shootings of unarmed suspects. *Police Marksman, July/August, 52–54.*

risks. These errors were attributed to the experts being more susceptible to "heuristic traps" or cognitive biases. Similar findings have come from the examination of forensic experts:

"*Bias and other cognitive influences unconsciously affect hard-working, honest, and dedicated forensic experts, thus creeping in without the experts' awareness. This is a difficult and interesting problem, with generalizability across domains."*[48]

14. Other contributing factors to target misidentification

A variety of other contributing factors have been identified and discussed in research.[49] These factors include:

14.1 Buck fever

Buck or stag fever describes a heightened state of arousal in a hunter that can be brought on during a hunt. It is associated with increases in adrenaline and excitement, but to levels that are beyond what might be considered normal. Full-scale buck fever does not appear to have been present in any of the accidents Green looked at, although some degree of heightened arousal and excitement could not be ruled out. As discussed previously, this state would increase the likelihood of cognitive biases affecting decision making.

14.2 Clothing

A contributing factor is wearing clothing with characteristics that can be confused with game. However, while it is advisable to wear high visibility clothing (e.g. Hunter Orange), it should not be relied upon. Research out of Virginia revealed that well over half of deer hunters shot in mistaken-for-game accidents *were* wearing high visibility clothing to the legal requirement.[50] It appears that wearing high visibility clothing reduces the chances of being shot, however it by no means guarantees immunity.

14.3 Snap shooting

Snap shooting describes cases where a shooter sees a target, believes it to be game and fires upon it within one movement.[49] Avoiding this will undoubtedly reduce the chances of shooting another hunter, however it should be noted that many mistaken-for-game accidents involve cases where the shooter has carefully studied their target for several minutes or longer.

15. Careless use of a firearm?

[48] From Dror, I. E., & Cole, S. A. (2010). The vision in "blind" justice: Expert perception, judgment, and visual cognition in forensic pattern recognition. *Psychonomic Bulletin & Review, 17*, 161–167.
[49] See Green, J. (2003). *To Hunt and Return: Developing Safe Hunting Practice.* Wellington, New Zealand: New Zealand Police.
[50] See Gulliver, D. (2003). Dangers confronting hunters who fail to wear high vis orange. (pp. Personal communication with Joe Green regarding research project).

It is reasonable to assume that in the vast majority of mistaken-for-game accidents, the hunter was not being *deliberately* or *knowingly* careless. They may *think* that their process is deliberate and involves careful reasoning. We know that in fact they are utilising cues that they are often not consciously aware of, and operating in somewhat of an automatic manner—again, which they are probably not aware of. They are simply doing what has always worked for them, and have no reason to believe that this will not work for them the next time, and the time after that. While cognitive biases appear to be a cause of many mistaken-for-game accidents, they are not an excuse for these accidents. However, vilifying the hunters who make these mistakes, despite following best practices "by the book" may be a step too far, particularly when we consider how difficult it is to manage cognitive biases. The low number of hunters who even know of the possible role of biases within their hunting needs to be considered as well.

16. Current mitigation practices

Currently there are several recommendations for mitigating mistaken-for-game accidents. These are discussed below in relation to preventing unconscious human error.

16.1 Identify your target beyond all doubt

This should be a given for hunters. However despite this being practised, people are still incorrectly identifying their targets. This is not to say that they *haven't* identified their target beyond all doubt—in their mind they can be 100% certain that they are looking at game. As hunting representatives have said or implied in the media, the brain "fills in the missing pieces." This is indeed what the brain uses heuristics for, but when the "missing pieces" are incorrectly determined, the consequences can be severe.

16.2 Treat every sound or movement as human, until proven otherwise

This piece of advice is frequently advocated in the media by the New Zealand Deer Stalkers Association. Unfortunately it is not practical to expect a hunter to consistently do this given the role of unconscious processes in their decision making; years of unconscious habits will prevent this from happening.

16.3 Wear brightly coloured clothing

As discussed previously, wearing clothing that contrasts with the environment is advised, but it should not be relied upon. The phenomenon of confirmation bias can account for how certain visual features (such as colour) of a scene can be unknowingly ignored by a hunter who is expecting and/or wanting to see game.

16.4 Recognise the onset of buck fever and counteract it

Buck fever is an emotional response. Attempts at suppressing emotional responses can be difficult and may even have the opposite effect.[51] Furthermore, by the time we are experiencing excitement, heuristics and cognitive biases are already in full swing.

While the above recommendations are all useful in theory, and have no doubt contributed to the reduction in hunting accidents over the last fifty years, they will not prevent accidents caused by cognitive biases. Hunters should always follow safe hunting practices as well as they can, however the biggest problem with this is that heuristics can literally prevent us from being able to adhere to these recommendations. Additionally, those practices that we are able to follow "by the book," will not always prevent mistaken-for-game hunting accidents anyway—e.g. the wearing of high visibility clothing.

17. Professional bodies

Hunters are repeatedly told they need to change their mind-set and treat every sound or movement as human until proven otherwise. Given the research findings in the white paper, it is considered that this will prove ineffective. Simply trying to be more mindful in this sort of environment will not work.

Imagine, an incident occurring in a workplace setting. If no recognised root cause investigation embracing the human factor had taken place, and the person involved is simply told to concentrate more or "change your mind-set," this would be considered completely unacceptable. It would do nothing to prevent future incidents, and the workplace safety culture could be considered toxic. It is the culture that is the problem, and culture does not change overnight.

Transposing this back to hunting, it is clear that accidents by some of the most experienced hunters are not a case of conscious carelessness. Indeed the very presence of psychological phenomena outlined in this report indicates there are many forces that influence all of the senses we come to rely upon prior to pulling the trigger. Simply saying "concentrate more" or be more mindful is not the answer.

It is accepted that some hunter protections (such as high visibility clothing, training and communications) are partly effective—but then again so are hard hats and steel capped shoes. However accidents still happen—the current protections only work up until a point. At the moment the level of protection is insufficient and, too often, the heuristic-prone hunter becomes the last line of defence against an accident when things don't go according to plan.

[51] See Wegner, D. M., Schneider, D. J., Carter, S. R., & White, T. L. (1987). Paradoxical effects of thought suppression. *Journal of personality and social psychology, 53*, 5.

18. An objective warning for risk mitigation

If the role of cognitive biases is indeed as significant as we believe, mitigating mistaken-for-game accidents is a formidable challenge. Given the difficulty of preventing cognitive biases from occurring—which is perhaps a futile cause—an additional approach to prevent mistaken identity accidents is required. Technology could provide a useful addition to the existing methods.

For example, the military has a significant problem with friendly fire arising from target misidentification, and is seeking a technological, objectively-impartial warning system. One technology that shows promise for mitigating friendly fire is the Blue Force Tracking system, which uses GPS information to show soldiers the location of allies.[52] Other technologies include Identity-Friend-Foe systems, which commonly use radar and/or infrared systems to classify targets as foes or friends to the user of the system.[53]

19. The need for research

There is currently a notable lack of research into hunting accidents. While it is possible to take well-established and accepted knowledge of psychological phenomena and apply this to hunting, as has been done here, validation of the ideas here and definitive conclusions can only be reached after actual research and experimentation is conducted. It is important that any such research carried out is done with hunters, of a range of experiences, in a context that is not completely removed from the "real thing."

Simulations could offer one practical approach for hunting research. Military researchers often use these to create environments that are relatively high-fidelity or "life-like."[54] Equipment such as laser guns have been successfully used to replicate firearms in laboratory-based simulations where shooters are required to make shoot/no-shoot decisions.[55] Through controlled experimentation, it would be possible to gain a better understanding of the impact of cognitive biases on the shoot/no-shoot decisions that hunters face. We anticipate that the most effective research will be possible when there is collaboration between relevant organisations that jointly have industry and human factors expertise.

20. Conclusion

[52] See Bryant, D. J., & Smith, D. G. (2013). Impact of blue force tracking on combat identification judgments. *Human Factors: The Journal of the Human Factors and Ergonomics Society, 55*, 75-89.
[53] See Seah, C., & Deepan, M. (2012). Identification Friend or Foe: A Necessity On The Battlefield. *Journal of the Singapore Armed Forces, 38*, 59–66.
[54] See Patton, D. J. (2014). *How Real Is Good Enough? Assessing Realism of Presence in Simulations and Its Effects on Decision Making*. In Foundations of Augmented Cognition. Advancing Human Performance and Decision-Making through Adaptive Systems (pp. 245–256). Springer International Publishing.
[55] See Wilson, K., Head, J., & Helton, W.S. (2013). Friendly fire in a simulated firearms task. *Proceedings of the Human Factors and Ergonomics Society, 57,* 1244–1248.

Heuristics and cognitive biases are useful the vast majority of the time and they generally assist us greatly in our day-to-day lives. However, they can significantly contribute to serious human error. Target misidentification in hunting is one example of this. It is highly likely that cognitive biases—particularly availability heuristic, expectancy, confirmation bias, and optimism bias—play a prominent role in mistaken-for-game accidents. In many of these accidents, had the shooters not experienced these biases, the shots would probably never have been fired.

Without an understanding of the relevant psychological phenomena and the likelihood of their impacts upon these accidents, it is unwise to pass judgement on those involved. The idea that hunters just need to "change their mind-set" in order to prevent these accidents occurring is unrealistic. Trying to prevent cognitive biases can be near impossible, given the difficulty we have in detecting them and the fact that we consistently underestimate the impact they have upon us.

Current recommended safety practices, whilst effective to a degree, are simply not good enough to avoid the critical errors that are caused by these unconscious processes. Research specific to hunting needs to be conducted in order to better understand the involvement of cognitive biases in failures of target identification. Given that humans are not properly equipped to recognise the presence of cognitive biases, or to moderate their effects, we need to devise alternative strategies to deal with them. This may require introducing the impartiality of technology to mitigate the risks associated with cognitive biases in hunting.

> *A man makes his way through the bush, sometime after splitting up with his hunting companion. A movement nearby captures his attention. He stops and sees what appears to be a deer, less than 40 metres away. This is what he has been waiting for. He carefully moves to a better position and again eyes his target. He can make out the head and the antlers of the deer and watches as it feeds; its head bobs up and down. It is definitely, 100% a deer and he prepares to shoot.* ***What is there to stop him?***