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Review article

Protecting consumers from fraudulent health claims: A taxonomy of psychological drivers, interventions, barriers, and treatments

Douglas MacFarlane*, Mark J. Hurlstone, Ullrich K.H. Ecker

School of Psychological Science, University of Western Australia, Australia

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ABSTRACT

Objective: Fraudulent health claims—false or misleading claims used to promote health remedies that are untested, ineffective, and often harmful—cause extensive and persistent harm to consumers. To address this problem, novel interventions are needed that address the underlying cognitive mechanisms that render consumers susceptible to fraudulent health claims. However, there is currently no single framework of relevant psychological insights to design interventions for this purpose. The current review aims to address this gap.

Method: An integrative theoretical review was conducted across several relevant disciplines including criminology; behavioural economics; and cognitive, health, and social psychology.

Results: The current review presents a novel taxonomy that aims to serve as an agenda for future research to systematically design and compare interventions based on empirical evidence. Specifically, this taxonomy identifies (i) the psychological drivers that make consumers susceptible to fraudulent health claims, (ii) the psychological barriers that may prevent successful application of interventions, and (iii) proposes evidence-informed treatments to overcome those barriers.

Conclusions: The resulting framework integrates behavioural insights from several hitherto distinct disciplines and structures promising interventions according to five underlying psychological drivers: Visceral influence, Affect, Nescience, Misinformation, and Norms (VANMaN). The taxonomy presents an integrative and accessible theoretical framework for designing evidence-informed interventions to protect consumers from fraudulent health claims. This review has broad implications for numerous topical issues including the design and evaluation of anti-fraud campaigns, efforts to address the growing problem of health-related misinformation, and for countering the polarisation of politically sensitive health issues.

1. Introduction

For many consumers, so-called alternative health remedies can seem a worthwhile lottery: they come with low costs and promise large potential benefits. Yet, despite the incredible claims of their advocates, when tested, most alternative remedies would be more accurately described as health fraud—the marketing or selling of products that have not been proven safe or effective (U.S. Food & Drug Administration [FDA], 2019). Notable examples of such remedies include homeopathy, reflexology, and iridology (Australian Government Department of Health, 2015), as well as weight-loss scams and other debunked remedies such as ozone therapy, colloidal silver, and psychic surgery.

Many mainstream health practitioners seem to regard such alternative health remedies as nothing more than unscientific but mostly harmless placebos. Indeed, many doctors will acknowledge that certain alternative remedies may even provide benefits, irrespective of medical considerations, such as serving cultural or religious needs or a sense of belonging to a like-minded community. However, mounting evidence suggests the harms arising from alternative health remedies are largely underappreciated and, in many cases, outweigh the potential benefits. For example, in 2012, sales of dietary supplements in the U.S. exceeded $100 per person on average, which is roughly $30 billion or 9% of all out-of-pocket health care spending in the U.S. (U.S. National Institute of Health [NIH], 2016). Yet, extensive research indicates that most dietary supplements are ineffective (Guallar et al., 2013; Jenkins et al., 2018) and sometimes harmful. Vitamin supplementation, for example, has been linked to some 23,000 visits to U.S. emergency departments annually (Geller et al., 2015), various side-effects such as pancreatitis, liver disease (Bjelakovic et al., 2014), and even an increased risk of mortality compared to placebo (Bjelakovic et al., 2012).

Other underappreciated harms of alternative remedies arise from interactions with conventional medications (Byard and Musgrave,

* Corresponding author.M304, 35 Stirling Hwy, Perth, 6009, Australia.
E-mail address: douglas.macfarlane@research.uwa.edu.au (D. MacFarlane).

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2010) and opportunity costs from delaying or not seeking evidence-based treatment (Greenlee and Ernst, 2012), which is a particular concern in cancer patients (Citrin et al., 2012). Harm also arises through risk compensation (Bolton et al., 2006)—when health remedy messaging (e.g., "promotes natural immunity") undermines individual perceptions of the risk associated with a relevant risky behaviour (e.g., vaccine hesitancy; Attwell et al., 2018). Recent studies have also uncovered widespread ingredient substitution (e.g., with undeclared plant or animal taxa), toxic contamination (e.g., with heavy metals such as lead, cadmium, & arsenic), and high rates of adulteration with conventional pharmacological agents (e.g., warfarin & paracetamol; Coghlan et al., 2015; Rocha et al., 2016). Moreover, the demand for alternative remedies is also a major driver of the illicit trade in endangered animals, through traditional remedies that use animal body parts such as rhino horn, bear bile, and pangolin scales (Graham-Rowe, 2011).

Despite this mounting evidence of harms, alternative remedies are rarely held to the same rigorous standards of clinical evidence as conventional medicine. In the U.S., for example, manufacturers of dietary supplements and alternative health remedies are not required to provide demonstrations of safety or efficacy of products prior to marketing (Bellanger et al., 2017), nor does the U.S. Food & Drug Administration routinely perform pre-market safety analyses (Avigan et al., 2016). The fact that governments routinely fall short of protecting consumers means that health communicators should employ other avenues to provide consumers with the means to avoid the harms arising from fraudulent health remedies. To successfully protect consumers, health communicators need to identify the cognitive, social, and emotional biases that health fraudsters exploit to sell their products and then employ evidence-based interventions that provide consumers with strategies for detecting and reducing their susceptibility to health fraud. Accordingly, in the current article, we present a new taxonomy that synthesizes insights from psychology relevant to tackling this problem.

1.1. Research gap filled by the present taxonomy

Over the last decade, psychological research has provided a deeper understanding of our cognitive capacities and consumer biases when making judgements and decisions under uncertainty (Cialdini, 2009; Kahneman, 2012; Thaler and Sunstein, 2009). Yet, to the best of our knowledge, this research has not been compiled into a single framework that answers the following key questions: What are the major psychological drivers that make consumers susceptible to fraudulent health claims? How do fraudsters exploit consumers into buying fraudulent health remedies? How can consumers be protected from health fraud? The lack of a coherent framework presents three major obstacles to realizing effective interventions to protect consumers. First, it encourages ad-hoc intervention design, increasing the likelihood that a practitioner will overlook key psychological mechanisms. Second, it impedes theoretical progress, as there is no systematic plan to discern which psychological drivers make consumers most susceptible to health fraud. Third, it impedes applied progress, as there is no systematic plan to determine which interventions are most effective for protecting consumers.

To overcome these obstacles, we reviewed the literature and developed a new taxonomy (see Table 1) to integrate several key psychological insights relevant to consumer susceptibility to fraudulent health claims. This taxonomy is structured into five key psychological drivers that we hypothesise are the major contributors to consumer susceptibility to health fraud, namely visceral influence, affect, nescience, misinformation, and social norms. We provide a brief summary of each driver and outline how each contributes to consumer susceptibility to health fraud. As each psychological driver suggests a seemingly self-evident intervention, we then outline current research on related psychological barriers that may impede the effectiveness of potential interventions (for specific rationale, see the supplemental material 'Targeting the internal barriers impairing intervention effectiveness'). For each psychological driver and corresponding barrier, we also highlight tactics employed by advocates of alternative remedies to exploit consumer susceptibility to fraudulent health claims (for examples, see the supplemental material—Table S1). This framework of drivers, barriers, and strategies to manipulate consumers then forms the basis upon which we propose several hypotheses about specific measures—which we label as *treatments*—that could ensure that interventions help consumers overcome their psychological barriers and thus be more resilient to fraudulent health claims.

This new taxonomy presents a congruent and parsimonious framework for applying psychological theory in the design of interventions to protect consumers. The numerous predictions contained within the taxonomy thus form an extensive research agenda, whereby each hypothesised treatment should be experimentally tested, and effect sizes compared (for further details, see the supplemental material— "Testing the predictions of the taxonomy"). Furthermore, this taxonomy aims to fill a gap in the literature by providing a coherent framework for practitioners working to address the harms arising from fraudulent health claims (e.g., medical doctors, consumer advocates, and journalists), who may not have specific psychological expertise. Fig. 1 provides a step-by-step guide for practically applying the taxonomy. This overarching framework has been informed by existing behaviour-change frameworks (Kok et al., 2016; McKenzie-Mohr and Schultz, 2014) but tailored specifically for the context of combatting health fraud. For brevity, we provide detailed guidance on applying this overarching framework in the supplemental material (see section—"A detailed step-by-step guide to intervention design"). The taxonomy is now considered in greater detail in order of appearance of the five exploited psychological drivers of consumer susceptibility to fraudulent health claims: Visceral influence, Affect, Nescience, Misinformation, and Norms (VANMaN).

2. Five major psychological drivers that are exploited by fraudsters

2.1. Exploited psychological driver: Visceral influence

Visceral influences are motivational cues that can elicit strong psychological responses and thus impair cognitive abilities. Examples of visceral influences are pain avoidance, sensation seeking, financial stress, cravings associated with addiction, and biological needs such as hunger, thirst, and sexual desire. According to Loewenstein (1996), the more desirable the cue, the stronger the psychological reaction and the greater the impairment of cognitive ability. One common psychological response to a visceral influence is the narrowing of attention. For example, social drinkers with a high craving for alcohol experience greater attentional bias (reflected in faster response times to alcohol cues compared to control cues) and approach bias (indicated by faster categorization of alcohol-related behaviours compared to control behaviours) than those with a low craving (Field et al., 2005). Whilst a greater attentional bias will assist social drinkers to better locate and obtain alcohol, it also means that greater cognitive resources will be required to maintain self-control, should they wish to refrain from drinking. The effect of visceral influences may thus help explain much of the disjunction between people's behaviour and their self-interest (Loewenstein, 1996).

Another impact of visceral influences is that people tend not to think about the ramifications of their own behaviour beyond satisfying their immediate visceral needs. For example, in one experiment, participants presented with a sexually charged video (visceral cue) made significantly worse assessments of subsequent risks (i.e., expressed a greater likelihood of having unprotected sex in a hypothetical situation) compared to participants presented with only a written account of a sexual encounter (control). Another experiment found similar results when participants were presented with a cookie compared to a written

Table 1
The VANMaN Taxonomy of Psychological Drivers, Barriers, and Treatments for Protecting Consumers from Fraudulent Health Claims.

Drivers[a]	Interventions[b]	Barriers[c]	Treatments to overcome barriers[d]	Example treatment ~ Example application[e]
Visceral influence	Raise awareness	Illusion of attention	i) Provide pre-emptive cues about key information ii) Reduce cognitive load by reducing rule complexity	i) Inoculate ~ warn that remedy advocates employ fake groups of "experts" ii) Simplify rules to avoid fraud ~ 'don't buy remedies from the person diagnosing you'
		Motivational influences	i) Encourage consumers to avoid unsolicited favours ii) Highlight the concealment & intention behind 'gifts' iii) Encourage support from social networks iv) Inoculate against the threat of resource scarcity	i) Prevent reciprocal traps ~ remind consumers to avoid "free" offers ii) Provide warnings ~ "free" alternate health checks are often concealed scams iii) Prevent isolation ~ urge severely ill patients to consult support networks iv) Foster resistance ~ warn about the intent to manipulate using scarcity appeals
Affect	Counter irrational affect	Positive affect ~ unsupported remedy	i) Impede positive-affective branding ii) Fear appeals—Ensure coping efficacy is high iii) Fear appeals—Stress susceptibility of target group iv) Fear appeals—Depict relatively high risks	i) Advertising bans ~ legislate for plain packaging of cigarettes ii) Target non-addictive remedies ~ e.g., unsupported dietary supplements iii) ~ stress 'vitamin E supplements increase prostate cancer risks for men' iv) ~ warn that 'consuming primate meat can cause deadly simian immune viruses'
		Negative affect ~ effective medicine	i) Employ evidence-based debunking of myths ii) Provide comparative frame of risks vs benefits	i) Explain ~ bed rest was believed to … but exercise assists cancer patients by … ii) Compare unsupported remedy vs medicine ~ surgery vs exercise for lower back pain
Nescience	Provide information	Illusions of causality	i) Reduce frequency of action to uncouple 'causality' ii) Increase exposure to negative outcomes iii) Contingency tables and alternate explanations	i) Encourage less frequent use ~ 'don't take vitamin C after the onset of each cold' ii) Communicate side effects ~ stress that toxins are often infused with rhino horn iii) Explain lack of efficacy ~ 'supplements have no benefit over placebo because … '
		Illusion of confidence	i) Communicate overconfidence and lack of knowledge ii) Ensure health advice is confident (where appropriate)	i) Expose overconfidence ~ highlight several of Dr Oz's fraudulent health claims ii) Clearly state ~ best-evidence shows exercise is superior to surgery for back pain
		Illusion of knowledge	i) Provide training in science and reflective thinking ii) Provide images and reductive explanations iii) Define key vocabulary and major concepts iv) Provide access to detailed information	i) Educate & promote science skepticism ~ explain the importance of clinical evidence ii) Provide reductive information ~ use neuroscience & brain images to show impacts iii) Define ~ the nocebo effect is … and occurs when … iv) ~ direct consumers to research on adulteration rates in supplements
Misinformation	Refute misinformation	Continued influence effect	i) Pre-exposure warnings ii) Repetition iii) Visualise evidence iv) Fill the mental gap	i) Warn ~ 'the following story is misinformation' ii) Routinely repeat ~ homeopathy is not effective iii) Add images ~ use fMRI brain scans to explain treatment impacts iv) Provide alternative explanation ~ 'consumers experience health benefits because … '
		Motivated reasoning	i) Anticipate defensive responses ii) Utilise source credibility iii) Worldview framing iv) Moral framing	i) Bolster self-efficacy ~ provide support tools for smoking cessation ii) Employ influence ~ leading traditional remedy societies reject use of rhino horn … iii) Identify-congruent framing ~ employ gain-framed vaccine messaging for Liberals iv) Appeal to morality ~ use 'purity/sanctity' terms to foster Republican support
		Conspiratorial thinking	i) Apply guidelines for evaluating conspiracies ii) Inoculate the "fence sitters" iii) Target structural factors	i) Query mismatches ~ scope & villainy of alleged conspirators vs the risks & feasibility ii) Pre-empt tactics ~ "politically motivated groups use misleading tactics, such as …" iii) Reduce barriers (e.g., affordability) that increase appeal of conspiracy theories.
Norms	Employ desirable norm appeals	Misperceived norms	i) Avoid reciting adverse norms ii) Emphasise desirable descriptive norms iii) Combine descriptive norms with injunctive norms iv) Accommodate potential moderators of norms v) Ensure norm appeals are sufficiently public	i) Avoid stating ~ 'many people use homeopathy' ii) Affirm ~ 'only 14% of pharmacists believe homeopathy to be effective' iii) Highlight also ~ 'the Pharmaceutical Society disapproves of homeopathy' iv) Ensure norms relevant to target group ~ 'most pharmacists reject homeopathy' v) Appeal to many members, including from the wider community, simultaneously
		Logical fallacies	i) Debunk logical fallacies ii) Provide evidence diversity	i) & ii) Debunk the fallacy of ancient remedies and give culturally diverse evidence ~ to counter claims that a traditional remedy's long history makes it effective
		Resistant social structures	i) Cluster early adopters ii) Foster empathy through similar networks	i) Cluster multiple adopters in online forums ~ e.g., anti-vaxxer forums ii) Messengers should be similar, embedded, and provide social reinforcement

Note. The taxonomy guides intervention design by forcing practitioners to consider incorporating treatments to overcome the psychological barriers that can make consumers susceptible to fraudulent health claims. See text for further details.

[a] Five major psychological drivers exploited by fraudsters to manipulate consumers into buying fraudulent health remedies: Visceral influence, Affect, Nescience, Misinformation, and Norms (VANMaN).

[b] Five seemingly self-evident interventions to address the exploitation of each psychological driver.

[c] Key psychological barriers that may prevent successful application of interventions.

[d] Promising evidence-informed treatments that have the potential to help consumers overcome their psychological barriers (i.e., by being incorporated into interventions).

[e] Example applications of each treatment.

account of a cookie (Ditto et al., 2006). The effect sizes of visceral influence on cognitive capacity have been equated to the impairment caused by the loss of a full night's sleep or chronic alcoholism. In one study, researchers evoked financial concerns (using a hypothetical scenario involving an unexpected financial cost) before asking participants to complete a Raven's Progressive Matrices Test (Raven, 2000). In participants who did not have the capacity to deal with an unexpected financial loss, the impact of the visceral influence on measured fluid intelligence was a reduction of approximately 13 IQ points (i.e., almost a full standard deviation; Mani et al., 2013). Visceral influences are thought to create a short-term feeling of being 'out of control' (Langenderfer and Shimp, 2001). This attribute of induced short-term impulsiveness is well documented in the criminology literature regarding health fraud; two consistent elements of deceptive practices are the promises of large rewards and the manufactured urgency to act quickly (Lea et al., 2009; Wilson, 2014).

The cumulative impacts of visceral influences—increased focus, reduced perception of risk, reduced fluid intelligence, and increased impulsiveness—conspire to impair a consumer's cognitive ability to detect a fraud, and to consider the information necessary to objectively determine the safety and authenticity of a health remedy. It follows then that a promising approach to countering health fraud is to help consumers avoid visceral cues at times when they are likely to make complex health decisions. For example, vaccination needles present a strong visceral cue for individuals with high levels of needle sensitivity, inducing anxiety, discomfort, and in extreme cases panic, fainting, and even seizures (Wani et al., 2014). Under such strong visceral influence, consumers will tend to be more susceptible to misleading claims about vaccinations and/or alternative health remedies. Indeed, parents who are themselves fearful of needles are more likely to delay vaccination in their children (Callaghan et al., 2019). One way to protect consumers with high needle-sensitivity might therefore be to invest in needle-free methods of vaccination delivery (Giudice and Campbell, 2006). The dominant approach to protecting consumers is to pre-emptively raise awareness about the existence, and format, of recent health frauds, in the hope that people can actively detect and avoid misleading visceral influences. However, even where people are able to avoid visceral cues the effectiveness of awareness raising interventions is hampered by two key psychological barriers, namely the illusion of attention and emotional motivators.

2.1.1. One barrier to raising awareness: The illusion of attention

When people's attention is focused on an object or task, they often fail to perceive unexpected objects even when they are salient, potentially important, and appear right where they are looking (Chabris et al., 2011). This phenomenon, termed *inattentional blindness*, was made famous through an experiment where participants, tasked with counting the number of times a ball was passed between moving people, often failed to notice a person dressed in a gorilla suit walking casually through their field of vision (Simons and Chabris, 1999). Studies on inattentional blindness provide compelling evidence of the cognitive limits of our attentional capacities. Moreover, they have led to the discovery of a related phenomenon, termed *the illusion of attention*, which occurs when what people notice differs from what they think they notice (Levin and Angelone, 2008). For example, in one experiment, only 50% of participants noticed when a stranger they were having a conversation with was surreptitiously replaced by a different person (Simons and Levin, 1998). Yet, a later study found that 97% of participants estimated that they would have noticed such a change (Levin et al., 2000). This phenomenon provides an analogy for why someone, who is focused on finding a cure (i.e., a visceral cue), might consistently overestimate their ability to notice when they are being deceived (Lea et al., 2009).

Unfortunately, it may not be possible to train people to overcome inattentional blindness, as this phenomenon is a by-product of our limited-capacity attentional system (Begh et al., 2015). General skepticism of advertising claims also seems to provide insufficient protection from visceral influences and their associated effects, namely narrowing attention and inducing impulsiveness (Amos and Landreth Grau, 2015).

One robust treatment to attenuate inattentional blindness is to make important, but unattended, factors more salient (Gibbs et al., 2016). Doing so may be achieved by providing consumers with pre-emptive cues (i.e., just prior to making health decisions) that make important information more salient such as the outcomes of clinical trials and side effects. In practice, this would require forcing product packaging of alternative health remedies to provide key information (e.g., food labels have been shown to boost nutrition knowledge; Miller and Cassady, 2015). Another attribute of inattentional bias is that the greater the cognitive resources required to complete a task, the greater the bias' impact (Simons and Chabris, 1999). Thus, another treatment to reduce inattentional bias is to simplify tasks by providing simple rules for people to navigate otherwise complex tasks (Mata et al., 2010). For example, a simple rule for avoiding health fraud is "do not buy health remedies from the person who diagnosed you" because the seller is incentivised to invent a diagnosis, overstate the benefits of their remedy, and underreport the harms of that remedy (i.e., they have a conflict of interest).

2.1.2. Another barrier to raising awareness: Emotional motivators

Two key emotional motivators that augment the impact of visceral influences are reciprocity and scarcity. Reciprocity influences consumers when they receive a gift, favour, or invitation, which compels them to feel obliged to the giver (Cialdini, 2009). Reciprocity is a well-established element of health fraud, utilised by scammers who often provide small gifts, free consultations, free information, or appear to bend the rules in favour of the recipient in order to make them feel obligated (Lea et al., 2009). According to Cialdini (2009), perhaps the best way to overcome this barrier is to make receivers aware of the "norm of reciprocity" so that they can actively avoid situations where they might feel indebted. Other treatments to reduce the norm of reciprocity are to: encourage consumers to consider the exploitative intentions behind unsolicited favours (Cialdini, 2009), highlight that the giver is concealing their true intentions from the consumer (Friehe and Utikal, 2018), and help consumers find excuses not to reciprocate (Regner, 2016).

Scarcity appeals are manufactured sales tactics common to health fraud and include such cues as "only two products left!", which can make an offer seem more valuable (Aggarwal et al., 2011; it also encourages conformity by conveying that "many people" are purchasing a product; see later section on social norms), and urgency cues such as "sale ends today!", which can force consumers to make quick decisions whilst under a visceral influence (e.g., desiring a cure to an illness) when their capacity for risk assessment is poorest (Fischer et al., 2013). A recent review posited that scarcity appeals may operate through two distinct psychological mechanisms, namely a fear of missing out and a fear of a restriction of choice (Cannon et al., 2018).

One hypothesis posits that scarcity appeals operate via a desire to eliminate the anticipated risk that a resource may be unavailable in the future (i.e., fear of missing out). Under this availability-risk mechanism, scarcity operates as a visceral cue with several subsequent impacts on consumers including narrowed attention, heightened emotional arousal, and induced aggression through perceived competition (Kristofferson et al., 2017). One treatment to assist consumers to resist availability-risk scarcity appeals is to assist consumers to avoid making decisions under emotional pressure. One way to accomplish this is to encourage consumers to seek independent advice from their social networks, because others are unlikely to be under the same visceral influence (e.g., the desire to relieve pain) and are hence better able to provide rational advice. One limitation of this approach is that peoples' social networks may be homophilic—tailored in such a way to support alternative health views (see later section on resistant social

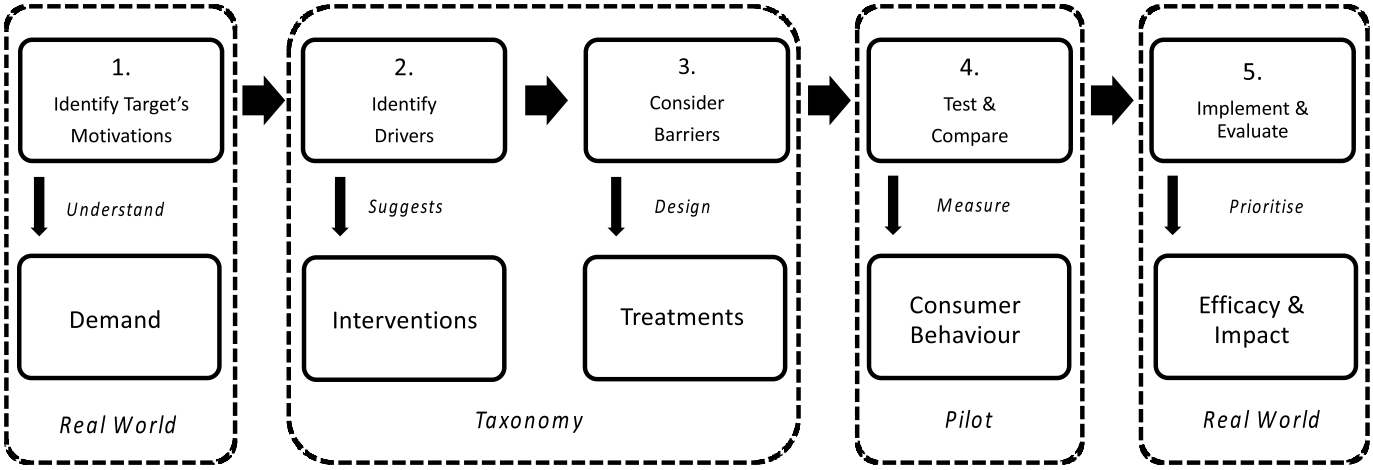

Fig. 1. A step-by-step guide for designing interventions using psychological insights.

structures")—and thus consumers should also seek advice from appropriately qualified medical practitioners.

The second hypothesis posits that scarcity appeals might also operate via a desire to eliminate an anticipated risk that certain choices may be restricted in the future. (e.g., loss of access to a previously available remedy). Under this mechanism, commonly termed *psychological reactance*, scarcity has been shown to operate through a combination of anger and negative cognitions (Dillard and Shen, 2005). Cialdini (2009) argued that psychological reactance may help explain why banning products can be ineffective or even drive a greater intention to consume. One treatment to assist consumers to resist urgency and scarcity appeals, which induce psychological reactance, is to forewarn consumers of a salesperson's persuasive intent—namely, that such appeals are manufactured sales tactics intended to manipulate consumers into making purchases. A meta-analysis by Wood and Quinn (2003) concluded that warnings about influence attempts can help "inoculate" people against psychological reactance by preparing them to resist subsequent persuasive appeals.

2.2. Exploited psychological driver: (Irrational) affect

Affect is the emotive quality of "goodness" or "badness" that becomes associated with an action or item (Slovic et al., 2007). Affective associations may be evolutionarily adaptive (e.g., bad smells can indicate infection) and are often culturally derived (e.g., taboos about physical contact with certain object; Huang et al., 2017; Rozin et al., 1986). Affective associations are often used heuristically to enable quick decisions. Indeed, adults unable to build affective associations (e.g., due to severe brain trauma) can develop deficits in decision making (Damasio et al., 1990). Irrational affective associations—that is, associations that are disproportionate or contrary to factual evidence—can also lead to irrational behaviours (Slovic et al., 2000; see also supplemental materials— "Irrational affective associations and magical thinking"). The theoretical distinction between visceral influences and affect is that the former serves to explain the influence of emotion on attentional processes and cognitive capacity, whereas the latter serves to explain how decisions are made based on positive or negative feelings.

Several attributes of affective decision making can be manipulated to make consumers susceptible to fraudulent health claims. One attribute is that affective evaluations of risks and benefits tend to be negatively correlated—even when the nature of the benefits is both distinctively and qualitatively different from the nature of the risks. For example, if antibiotics are portrayed as low in risk, it contributes to the perception that they are also high in benefit. In contrast, if smoking is portrayed as low in benefits, this contributes to the perception that it is also high in risk. (Alhakami and Slovic, 1994). Thus, evaluations of risks and benefits tend to be causally determined, meaning that the perception of one attribute can be influenced by manipulating information about the other (Finucane et al., 2000). For example, one study in the UK found that the most commonly cited justification for consuming homeopathic remedies was a perceived lack of side effects. Furthermore, the perceived efficacy of homeopathy was correlated with perceptions about risks of conventional medicine (Stoneman et al., 2013). Importantly, people's reliance on affective decision-making increases when under time pressure, because there is less opportunity for analytic deliberation. In one study, the strength of the inverse relationship between perceived risks and benefits for a range of items, such as cigarettes and pesticides, was greatly increased under time pressure (Finucane et al., 2000). Thus, consumers are more susceptible to fraudulent health claims when fraudsters artificially induce time constraints (see previous section on scarcity).

Another attribute of affect that can be manipulated to increase consumer susceptibility to fraudulent health claims is the evaluability principle—the idea that actions, or items, are not easily evaluable in isolation; instead their meaning is often, or more easily, evaluated through affective comparisons. For example, consider two products that are identical except for their quantity and labelling: Product (A) "250 mg of ingredient X"; and Product (B) "500 mg of ingredient X, may cause minor headaches". When consumers view only Product A in isolation, the quantity "250 mg of ingredient X" is only diffusely evaluable and thus carries minimal weight when making affective judgments. Consequently, consumers are more likely to perceive Product A to be of higher value, compared to consumers who only view Product B, because the value of the latter is reduced by the affective association with a potential side effect. However, when directly compared, it is obvious that Product B, which offers twice the amount of ingredient X, offers superior value to Product A, and is also more informative about the potential side effects. This example is based on experimental evidence demonstrating how the lack of comparative frames of reference serves to limit the capacity for rational judgements (Hsee, 1996). The evaluability principle may explain how evaluations of fraudulent health remedies, when consumers are isolated from scientific evidence, can be unduly influenced by affect-laden terms such as "natural", or "holistic", and not by factual comparisons.

The obvious intervention to overcome irrational affective associations is to counteract them with affective comparisons that accurately depict the known risks and benefits of the fraudulent health remedy compared to conventional medicine. However, considerable care should be taken to ensure messages are sufficiently targeted and do not backfire (Rossen et al., 2016; also see sections below on motivated reasoning and norms). Two barriers to such interventions are positive

affect associated with fraudulent health remedies, and negative affect associated with supported medicines.

2.2.1. One barrier to countering irrational affect: Positive affect

Much consumer demand for fraudulent health remedies is maintained through associations that carry positive affect. For example, the ubiquitous marketing of alternative remedies as "natural" is effectively a tactic to convey that a product is harmless, despite the fact that there are abundant natural poisons such as hemlock and strychnine (Hall, 2008). The impact of positive affect marketing was recently demonstrated through an experiment that found simply masking cigarette packaging (i.e., the brand marketing linking those cigarettes with positive associations such as fun or sophistication) significantly reduced the cigarettes' appeal to smokers on measures of taste, quality, enjoyment, and intent to purchase (Skaczkowski et al., 2018). To manufacture positive associations with fraudulent health remedies, advocates adopt real scientific terms such as "osmosis" or invent medical jargon such as "negative calories" (Lea et al., 2009). One treatment to counteract positive affect that has become associated with a fraudulent health remedy is to draw attention to its potential risks. Health interventions that depict the risks of a particular action are commonly termed *fear appeals*. A common example includes graphic images of smoking-related disease on cigarette packets.

The effectiveness of fear appeals in altering behaviour is the subject of some debate (Peters et al., 2018). Some have argued that fear appeals are only effective under specific circumstances—most notably, where there is high perceived efficacy (i.e., both (i) self-efficacy—the capacity to alter one's behaviour towards the recommended action [e.g., stop smoking]; and (ii) response efficacy—the belief that the recommended action will enable one to avoid the stated threat (Kok et al., 2018). Still, Tannenbaum et al.'s (2015) recent meta-analysis concluded that fear appeals were effective at altering attitudes, intentions, and behaviours; worked in all but few cases; and did not backfire under any identified circumstances (see Kok et al., 2018, for an alternate perspective).

In any case, there appears to be a consensus that when perceived efficacy is high, fear appeals are likely to be effective (Peters et al., 2018). The use of fear appeals for reducing demand for fraudulent health remedies is thus likely to be effective in most cases, because efficacy-related variables such as dependency, addiction, or lack of consumer alternatives are generally absent in this context. Tannenbaum et al. (2015) identified a number of factors that increase the effectiveness of fear appeals. Two key factors listed in our taxonomy are depicting a relatively high amount of risk and stressing the susceptibility of the target group.

2.2.2. Another barrier to countering irrational affect: Negative affect

Another psychological barrier arises when negative affect becomes associated with an evidence-based conventional medicine, such as chemotherapy or exercise. In a study of women diagnosed with breast cancer, key reasons for rejecting conventional medicine in favour of alternative remedies were the fear of side effects, negative experiences with conventional doctors, and a lack of perceived benefits of conventional medicine (Citrin et al., 2012). Negative affect can become associated with evidence-based medicine when new evidence overturns pre-existing beliefs about standard medical care. For example, bed rest was long prescribed as a key ingredient to illness recovery including recovery from cancer. However, compelling evidence now suggests that exercise is both effective and safe for counteracting many of the adverse physical and psychological effects of cancer and its treatments (Cormie et al., 2018). Further, exercise has proven effective for treating lower-back pain (whereas common standard approaches such as opioids, surgery, and spinal injections have been found relatively ineffective; Foster et al., 2018). To counteract negative affect surrounding an evidence-based medicine, interventions should seek to correct the myths using evidence-based debiasing techniques (see section on misinformation).

Negative affect can also contribute to a *nocebo effect*—where the expectation of harm increases the psychogenic experience of symptoms that are consistent with health concerns. For example, according to the best evidence, there are no negative health impacts of wind turbines (Tonin, 2018). Yet, negative affective commentary by anti-windfarm activists has, in some people, created the expectation that the infrasound produced by wind turbines can cause health harms, and this is thought to have caused some people to experience health symptoms. One treatment to counteract negative affect is to highlight the potential benefits of the target behaviour. To illustrate, Crichton and Petrie (2015) showed that associating infrasound with positive health effects caused a *placebo effect* that reversed the nocebo response and lessened psychogenic symptoms.

2.3. Exploited psychological driver: Nescience

Nescience is the absence of knowledge or awareness. Nescience makes consumers susceptible to health fraud because people intuitively generate, or uncritically accept, spurious causal associations between actions and outcomes (e.g., remedy X cured illness Y; i.e., illusory causation) without considering that such associations might be coincidental, meaning that evidence to determine causality is lacking (i.e., evidence that excludes other causal explanations for an outcome). Overcoming nescience is difficult because humans have evolved a strong bias for finding patterns in meaningless background noise (i.e., illusory correlation; Foster and Kokko, 2009). The problem is further compounded by a host of other psychological mechanisms (see Lilienfeld et al., 2014), such as the tendency to selectively recall only outcome variables of improvement or to overestimate our ability to influence events (the illusion of control; Langer, 1975). Such mechanisms conspire so that even clinicians and researchers are not immune to naïve realism—the pervasive assumption that cause and effect can be observed through intuitive observations (Lilienfeld et al., 2014). Scientific methods facilitate the assessment of causality by controlling for alternate explanations. However, in the absence of a scientific approach, illusory causal associations between health outcomes and possible remedies can be created through several common scenarios, such as inferring the effect of a health remedy following personal trial and error, exposure to highly confident personal narratives, or exposure to biased samples such as online forums where those who claim to have been "cured" are overrepresented compared to those who experienced no benefit or harmful side effects.

Intuitive causal associations can serendipitously lead to discoveries of real causal relationships, as when our ancestors noticed that the bark of the willow tree relieved pain, which eventually led to the discovery of aspirin (Hall, 2008). On many occasions, however, such causal associations are illusory, such as the use of rhino horn in traditional Chinese medicine as a cure for various ailments from cancer to hangovers. Rhino horn has no medicinal properties, yet its unabated consumption has contributed to several recent sub-species extinctions (Milliken, 2014).

The seemingly obvious intervention to overcome nescience is to provide information on what works and what does not. This so-called *information deficit model* (Bubela et al., 2009; Rossen et al., 2016) intuitively leads practitioners to launch awareness-raising campaigns. However, numerous studies have shown that awareness campaigns are generally ineffective at altering behaviour (Christiano and Neimand, 2017). Increases in scientific knowledge are, at best, moderately correlated with increased positive attitudes towards science (Allum et al., 2008) and, at worst, strongly correlated with increased polarisation on issues that are divided along political or cultural worldviews (Kahan, 2015; Kahan et al., 2012). One reason why awareness campaigns are generally ineffective is that they seldom target the specific psychological barriers (other than knowledge) preventing the uptake of the desired behaviour (McKenzie-Mohr, 2000). Three psychological barriers that specifically relate to nescience include the illusion of

causality, the illusion of confidence, and the illusion of knowledge.

2.3.1. One barrier to overcoming nescience: The illusion of causality

The illusion of causality occurs when an outcome, by mere coincidence, occurs in close temporal proximity to an action (Matute et al., 2015). Causal illusions are pervasive because people are generally only exposed to, and thus are more likely to remember, positive outcomes. A prime example is the unsubstantiated link between taking vitamin C at the onset of a cold (action) and a recovery from illness (outcome) (Hemila and Chalker, 2013). Belief in the efficacy of vitamin C is perpetuated by people more readily recalling instances when they took vitamin C and subsequently recovered from a cold, compared to instances when they did nothing and recovered all the same. This tendency is further compounded by reporting bias—when people tend to share positive treatment outcomes more than average outcomes—which distorts the information available to others (de Barra, 2017; see also Ioannidis, 2017). Another reason why causal illusions are persuasive is that people generally fail to take into account alternative explanations when considering what caused an outcome (e.g., that pain reduction was caused by a placebo effect; Hayes et al., 2016). Causal illusions are especially convincing for many alternative medicines because these are often perceived to have no side effects, which encourages frequent consumption, which in turn increases the probability that the outcome will occur in close proximity to the perceived cause (Matute et al., 2015).

Assisting people to overcome illusions of causality is a challenge. Research has shown that simply showing people the facts is not sufficient (Yarritu and Matute, 2015) and that higher intelligence does not provide protection (Wiseman and Watt, 2006). Nevertheless, several promising treatments are worth considering.

In instances where someone has control over the perceived cause, an effective treatment is to advise people to reduce the frequency of consuming the perceived health remedy (e.g., advise people to consume vitamin C only every other time they catch a cold). Reducing this frequency reduces the probability that the outcome will occur in close proximity to the perceived cause, and thus works to uncouple the illusory association (Blanco et al., 2011). One way to encourage less frequent consumption is to communicate the potential side effects of the remedy (see earlier section on positive affect and fear appeals).

Another treatment is to provide interactive training about the scientific concepts key to evaluating causality. Barberia et al. (2013) showed that a workshop teaching school students about experimental controls (to account for confounding factors) and contingency testing (comparing outcomes for both “cause-present” and “cause-absent” scenarios) reduced the students’ susceptibility to causal illusions.

Another promising treatment is to provide people access to the “full picture,” namely the evidence from all four outcomes of a standard randomized controlled trial, that is, the number of people who (i) took the product and experienced the benefit, (ii) took the product and experienced no benefit, (iii) did not take the product but still experienced the benefit, and (iv) did not take the product and experienced no benefit. Information from all four cells in a contingency matrix enables conclusions to be drawn about whether a benefit is caused by the product (a positive contingency), or whether there was some other causal factor (a null contingency). Unfortunately, simply providing people with a contingency table of the results of clinical trials may not assist them to make reliable causal judgments because people's interpretations can be faulty, especially when the data being conveyed are complex (Batanero et al., 2015) or when the interpretation challenges prior beliefs (Kahan et al., 2013). To overcome these psychological barriers, a promising treatment combines two strategies: (i) simplify and clearly convey complex clinical results—for example, by using frequency formats “4 in 5 people report a benefit” rather than absolute values, percentages, or probabilities—in order to minimise opportunities for participants to misinterpret results due to cognitive biases such as motivated reasoning, denominator neglect, or availability bias (Slovic et al., 2007); and (ii) provide an alternative explanation of what causes consumers to experience health benefits because this helps to fill the mental gap caused by refuting participants' pre-existing pseudoscientific beliefs (Lewandowsky et al., 2012). In a recent experiment, this treatment reduced participants' willingness to pay for a real multivitamin supplement (by 23%) compared to a common refutation used by health authorities (MacFarlane et al., 2018).

MacFarlane et al. (2020) follow-up experiment combined this treatment with a fear appeal (i.e., evidence that multivitamin supplements actually increase mortality risk compared to placebo). The results showed that the fear appeal in isolation reduced willingness to pay (by 32%) compared to control, but that a combined intervention (the simple interpretation of clinical results and alternative explanation of consumer experiences plus the fear appeal) reduced participants' willingness to pay for multivitamins further still (by 50%). These results provide preliminary evidence that interventions based on psychological insights can assist people to overcome psychological barriers linked with fraudulent health claims.

2.3.2. A second barrier to overcoming nescience: The illusion of confidence

The illusion of confidence refers to the robust finding that people tend to overestimate their own qualities (e.g., skill, ability, and character) compared to their peers (Kruger and Dunning, 1999). The tendency towards overconfidence extends across many domains, from eyewitness testimony (Sporer et al., 1995) to medical decision making (Croskerry and Norman, 2008). This illusion presents a key psychological barrier due to the *Dunning-Kruger effect*, which is the finding that people who are the least competent, and thus most in need of self-improvement, tend to be the most overconfident, the least open to new information, and the least likely to recognise the need for self-improvement (Kruger and Dunning, 1999). The Dunning-Kruger effect has been shown to explain public opposition to vaccination policies, genetically modified foods, and genetic engineering technology (Fernbach et al., 2019; Motta et al., 2018). Unfortunately, simply giving people feedback about their lack of skills relating to a particular task does not always reduce overconfidence or improve performance, but instead often reduces performance (Kluger and DeNisi, 1996). Increasing people's competence (e.g., through training programs) so that their ability catches up to their confidence, appears to be the most reliable way to reduce overconfidence. However, such instruction needs to be substantial, as insufficient training may actually increase overconfidence (Sanchez and Dunning, 2018).

An additional psychological barrier related to the illusion of confidence is the tendency to interpret confidence, or lack thereof, as a valid signal of another person's abilities and knowledge. One explanation for this tendency is that people prefer definitive predictions over uncertainty (Keren and Teigen, 2001). In support, one study found that patients were more satisfied with doctors who expressed diagnosis certainty compared to those who conveyed uncertainty or consulted reference books (Johnson et al., 1988). This tendency thus presents a psychological barrier for consumers, because it undermines their capacity to discern which experts are truly knowledgeable. Further, it helps to explain why the public is easily misled by the confident, yet often unfounded, claims of alternative remedy advocates and celebrity doctors such as Dr Oz (Tilburt et al., 2017).

Evidence suggests that overconfidence may be a stable personality trait across multiple cognitive domains (Blais et al., 2005). Thus, having greater familiarity with a person's confidence on other issues may provide a more accurate benchmark for assessing the nexus between that person's actual knowledge and their outward confidence. Thus, a plausible treatment to overcome this aspect of the illusion of confidence is to highlight other instances where an advocate is confident about other clearly disproven issues. This should help dispel illusions regarding the advocate's real knowledge (Chabris and Simons, 2010). For this treatment to be effective, practitioners should first establish that the target audience also accepts those issues as disproven, which may

prove difficult in some cases. For example, the small number of people with strong anti-vaccination beliefs tend to be far less receptive to communication interventions than the considerably larger group of vaccine-hesitant parents (hence, vaccine scholars have suggested focusing on the latter group; Betsch et al., 2015). Where possible, public health practitioners should also ensure that health promotion messages are delivered confidently so as not to undermine the implicit message that the advice being given is based on the best available evidence.

2.3.3. A third barrier to overcoming nescience: The illusion of knowledge

People often believe that they understand things at a deeper level than they really do. This finding, termed the *illusion of knowledge*, causes people to mistake feelings of familiarity (what happens) for genuine knowledge (why it happens) (Rozenblit, 2004). This psychological barrier facilitates mistaken explanations for complex health phenomena by preventing people from asking questions that are critical to distinguishing between which health remedies are evidence-based and which are unproven, disproven, or untenable.

The illusion of knowledge may stem from our tendency to use simple models to understand complex systems (Lombrozo, 2007), which enables us to function without being overwhelmed by complexity. However, problems arise because it is difficult to determine how well our models help us understand reality. Instead, we infer how well we understand reality using three easily determined factors: (i) our confidence in our understanding of the simple model; (ii) our familiarity with the surface elements, concepts, and vocabulary of the complex system; and (iii) the amount of information we are aware of, or have access to (Fisher et al., 2015), regarding the complex system (Chabris and Simons, 2010). This model of mental self-assessment is, however, deeply flawed as it encourages us to overestimate our real knowledge—this is because the three factors provide no meaningful assessment of how well we actually understand reality. Reliance on these heuristics becomes problematic when advocates manipulate them to strengthen an illusion of knowledge about an alternative health remedy.

To illustrate, one tactic employed by alternative-health advocates is to overwhelm consumers with biased information that appears extensive. For example, the website of the British Homeopathic Association directs consumers to The Faculty of Homeopathy's (2018) evidence summary, which claims that four of five "major comprehensive" systematic reviews "broadly favour" the use of homeopathy—but only after further investigation would consumers learn that all four reviews noted that overall study quality was poor and the evidence inconclusive. Another tactic is to bolster the explanation of a phenomenon with irrelevant reductive information (i.e., information regarding basic system features or processes that are unrelated to the claim being made). Such information may interfere with people's ability to critique the underlying logic of the offered explanation (Weisberg et al., 2008), which, in turn, causes them to overvalue their understanding of that simple model (Hopkins et al., 2016). Consequently, explanations of psychological phenomena (especially bad explanations) can be made to appear more satisfying by adding irrelevant information, such as longer descriptions (Heit and Rotello, 2012), brain images (McCabe and Castel, 2008), or neuroscientific information (Weisberg et al., 2015; see also Im et al., 2017; Tabacchi and Cardaci, 2016). Such information increases people's familiarity with the surface concepts and vocabulary used to explain complex scientific phenomena.

One treatment to help prevent people from succumbing to the illusion of knowledge is to deliver targeted training and education campaigns that promote general scientific knowledge and reflective thinking, which help people apply informed and reasoned scientific skepticism to assess explanation quality (Hopkins et al., 2016). An alternative approach to preventing people from falling for the illusion of knowledge is to accept that these barriers are a psychological reality and thus, at the very least, should be accounted for when designing communications about evidence-based-medicine (Rossen et al., 2016). Specifically, to ensure consumers' confidence in and satisfaction with explanations is based on best evidence, practitioners should provide: (i) simple explanations that include images and reductive information (even if not strictly necessary); (ii) definitions of key vocabulary and major concepts used to describe the complex phenomenon; and (iii) access to detailed information about the complex phenomena.

2.4. Exploited psychological driver: Misinformation

Misinformation makes it difficult to distinguish between evidence-based medicines and fraudulent remedies and thus can have dire consequences for public health. For example, the spread of misinformation about the false link between the measles-mumps-rubella (MMR) vaccine and autism (Poland and Spier, 2010) has been associated with localised reductions in paediatric MMR vaccination rates (Leask, 2011), resulting in several outbreaks of measles (BBC, 2018). Countering misinformation requires multiple solutions, which vary depending on modes of transmission, underlying intentions, and political contexts.

Aspects of the contemporary media landscape have facilitated the dissemination of misinformation. Social media are especially amenable to spreading misinformation because people are more likely to share stories that elicit emotional arousal (i.e., those that evoke fear, disgust, or happiness; Berger, 2011). Social media are also increasingly being used to spread *dis*information—misinformation disseminated with the intent to deceive, often for political or financial motives. Emerging evidence is also revealing the considerable extent that automated social-media "bots" are being used to spread and politicise disinformation, including about vaccination (Broniatowski et al., 2018). With the benefit of hindsight, it has become clear that disinformation campaigns can generate considerable public confusion. For example, in 2006, a U.S. Federal Court found cigarette manufacturers guilty of conspiring to deny, minimise, and distort the hazards of smoking. Those responsible were ordered to publish corrective statements in the media, a common legal remedy for such consumer deception (Smith et al., 2011).

Another aspect of the contemporary media landscape that contributes to the spread of misinformation is the information retrieval algorithms employed by search engines (e.g., Google or Yahoo). This is because the sorting and ranking criteria they use ignore information quality (Ludolph et al., 2016). Advocates of fraudulent health remedies can try to actively manipulate search results to enhance the visibility of misinformation. For example, a study by Kitchens et al. (2014) found that first page results from Google searches on health topics (well-being, food, and nutrition) returned mostly websites with low-quality information. Further, the results relating to complementary and alternative therapies returned the highest proportion (approximately 70%) of low-quality online information.

One increasingly common tool for combatting intentionally, or carelessly, spread misinformation is fact-checking, which can be generally effective for refuting false claims (Ecker et al., 2019; Hameleers and van der Meer, 2019). Indeed, efforts are underway to integrate fact-checking into social media platforms (see Lewandowsky et al., 2017). Combatting technologically derived sources of misinformation requires an understanding of search engine logic so that, for example, health authorities can optimise the visibility of quality information. Another promising solution is to prioritise applied research into developing superior search algorithms, so that consumers would be presented with search results that ultimately favour credible and high-quality information (Lewandowsky et al., 2017). Beyond these interventions, effectively informing consumers requires that practitioners adopt psychologically informed approaches to debunking misinformation. To this end, we now consider two notable psychological barriers that operate to impair efforts to refute misinformation, namely the continued influence effect and motivated reasoning.

2.4.1. One barrier to combatting misinformation: The continued influence effect

Efforts to retract misinformation tend to be of limited efficacy, meaning that misinformation often continues to influence reasoning

and decision making despite clear and credible retractions or corrections. This effect has been termed the *continued influence effect of misinformation* (Johnson and Seifert, 1994). A number of cognitive factors are responsible for this effect, such as inadequate resources for objective veracity evaluation, and imperfect memory updating and retrieval processes (Lewandowsky et al., 2012; Swire et al., 2017).

To design "science-based" refutations to effectively debunk misinformation, several factors must be considered (Paynter et al., 2019). Specifically, to overcome the barriers presented by the continued influence effect, refutations should: (i) warn recipients before confronting them with misinformation because warnings can boost strategic monitoring processes and prevent the initial acceptance of misinformation, thus reducing the need for subsequent revision (Ecker et al., 2010); (ii) repeat the facts, but avoid repeating the misinformation more than necessary (in order to refute it), as repetition enhances familiarity, which can foster false beliefs (Jacoby and Kelley, 1989); (iii) use graphical evidence, as visual representations help consumers comprehend data and make counter-arguing more difficult (Dixon et al., 2015); and (iv) provide an alternate explanation of the phenomenon to fill the mental "gap" left behind by retracting the misinformation. Ideally, this explanation should also address the motivation behind the initial source of misinformation. For example, it is useful to know that Andrew Wakefield, who initially suggested that autism was linked to the MMR vaccine, failed to disclose financial conflicts of interest that provided considerable incentive to falsify his results (Flaherty, 2011).

2.4.2. A second barrier to combatting misinformation: Motivated reasoning

Motivated reasoning refers to biased information processing in accordance with prevailing motivations and worldviews (Kunda, 1987). When processing misinformation and refutations, people may engage in motivated reasoning to defend their worldviews and social identities (Ecker and Ang, 2019) and reduce cognitive dissonance—the mental discomfort that arises whenever a person holds two inconsistent ideas, attitudes, beliefs, or opinions (e.g., "smoking kills" and "I am a smoker"; Festinger, 1962). Three pervasive biases in this context are (i) the *confirmation bias*—preferentially seeking out supportive evidence, whilst ignoring contrary evidence; (ii) the *disconfirmation bias*—counter-arguing contrary evidence and uncritically accepting supportive evidence; and (iii) *self-justification*—the post-hoc rationalising of one's beliefs (Tavris and Aronson, 2008). These mechanisms appear to be exhibited in a hierarchy of increasing cognitive demand, meaning that dissonant evidence is easiest to ignore, harder to counter-argue, and even harder to rationalise (Hughes and Zaki, 2015). Harder still is to change one's pre-existing worldviews.

Understanding how dissonant information is processed through a progression of stages can be useful for designing targeted interventions to overcome motivated reasoning. Common stages for reducing cognitive dissonance about bad health behaviours include avoiding dissonant information (easy), pointing to flaws in the health research (harder), or rationalising the bad behaviour (harder still). For example, graphic health warning labels on cigarette packages can increase feelings of dissonance for people with low self-efficacy (e.g., due to addiction or lack of support; Witte and Allen, 2000). Smokers avoid such dissonance by putting cigarettes into plain boxes to avoid seeing graphic health images (easy), seeking out, and uncritically accepting, criticism about cancer research (harder), and rationalising that smoking, on balance, is beneficial because it prevents weight gain (a common justification for smoking). By anticipating these types of defensive consumer responses, practitioners can design more effective warning messages that are less threatening and thus less likely to be avoided (Kok et al., 2018; Hall et al., 2018), provide tools for improving self-efficacy (e.g., nicotine gum; Hartmann-Boyce et al., 2018), and offer alternative means for appetite suppression (Seeley and Sandoval, 2011).

Perhaps the greatest source of dissonance is information that threatens pre-existing worldviews, especially when such worldviews operate to define affiliations with particular social groups, such as a political party or an ethnic community. One treatment for practitioners to reduce this dissonance is to employ a spokesperson from the target community. People are more likely to trust advice from experts that come from an ingroup, especially on polarising issues (Kahan, 2015; Berinsky, 2017). Another treatment to reduce dissonance is to frame messages so that they are congruent with the worldview of the target group. For example, political conservatives experience more fear of loss than political liberals experience, and thus should be more persuaded by loss-framed messages (negative consequences of not acting) than gain-framed messages (positive consequences of acting), and the reverse should be true for liberals. This has been supported by studies investigating policy support for mandatory vaccination (Nan and Madden, 2014) and reducing obesity (Lee and Kim, 2017).

A further source of dissonance may derive from people's sense of morality. For example, Feinberg and Willer (2013) found that lower pro-environmental attitudes amongst conservatives than liberals could be attenuated using pro-environmental rhetoric that was framed in terms of moral values endorsed by conservatives (concerns about the purity and sacredness of the environment), but not by using similar rhetoric framed in terms of liberal moral values (moral duty to protect the environment from harm). To the best of our knowledge, the impact of moral framing on health remedies has not yet been experimentally tested. However, several correlational studies have linked vaccine hesitancy to people's intuitions about different moral virtues (Graham et al., 2009). In a study of Australian parents, Rossen and colleagues (2019) found that vaccine rejecters were higher on the purity foundation compared to acceptors and fence-sitters. They also found that vaccine rejecters and fence-sitters had a higher moral preference for liberty (beliefs about the rights of the individual) compared to acceptors. In a study of American parents, Amin and colleagues (2017) found that parents with high vaccine hesitancy were twice as likely to emphasise liberty and purity compared to respondents with low vaccine hesitancy. In another study of American parents, Callaghan et al. (2019) found a correlation between an inclination towards delaying the HPV vaccination and a high moral preference for purity, which the authors suggested is additionally linked to conservative views about sexuality. Based on these correlational findings, researchers should experimentally test whether interventions to decrease vaccine hesitancy are made more effective by applying tailored moral frames to different populations.

2.4.3. A third barrier to combatting misinformation: Conspiratorial thinking

Conspiratorial thinking (also known as conspiratorial ideation) is the predisposition towards assuming that powerful groups are taking secretive action against the common good for their own benefit. Contemporary examples of health-related conspiracy theories include the notion that the Zika virus is spread by genetically modified mosquitoes (Klofstad et al., 2019), and that the causal link between childhood vaccination and autism is being suppressed by an unscrupulous medical industry (Goertzel, 2010). National surveys of the American public show that several medical conspiracy theories are widely known, broadly endorsed, and highly predictive of many common health behaviours, such as taking vitamin supplements, prioritising organic food consumption, and even using sunscreen (Oliver and Wood, 2014). Naturally, it is important to note in this context that conspiracy theories are not always immediately false, and that genuine health-related conspiracies do occur. However, unlike fringe conspiracy theories, which appear to persist in support of an ideological position despite the lack of positive evidence (Lewandowsky et al., 2013), verified health conspiracies typically involve commercial fraud (e.g., involving adulterating or counterfeiting pharmaceuticals or dismissing unfavourable clinical results; see; Davies, 2018; Eban, 2019; Greene, 2019; O'Steen & O'Steen, 2006).

Conspiracy theories can have broad negative consequences for society through the rejection of scientific evidence and the associated poor health choices (e.g., see van der Linden, 2015). However,

debunking conspiracy theories is difficult not least because conspiratorial thinking: (i) has a "self-sealing nature"—the tendency to reject contrary evidence or refutation attempts as confirmation of the existence of an alleged nefarious plot; and (ii) thrives on the abundance of disconfirming evidence and the lack confirming evidence, which is the inverse of rational thinking (Lewandowsky et al., 2013; Sunstein and Vermeule, 2009; Uscinski and Parent, 2014). Despite the challenges, the public-health implications of the current widespread belief in conspiracy theories mean that health authorities must nevertheless work to assist the public to distinguish between conspiracy theory and fact.

We recommend that practitioners familiarise themselves with the tools of scientific enquiry and consider the pros and cons of various conspiracy evaluation guidelines (Uscinski and Parent, 2014). One promising treatment to assist consumers to avoid fraudulent conspiratorial claims would thus be to provide consumers with the rational, methodical tools to evaluate the evidence of conspiracy theories (see Uscinski and Parent, 2014). Another approach would be to communicate the deceptive strategies employed by health-remedy marketers. Such an approach was demonstrated in recent studies that found that people could be "inoculated" against the adverse effects of misinformation by pre-emptively explaining the deceptive argumentation techniques employed by those spreading the misinformation (Cook et al., 2017; van der Linden et al., 2017). An alternative approach to might be to consider interventions other than directly debunking conspiracy theories. For example, health practitioners could structure the environment in such a way that makes it inconvenient to maintain disproven beliefs (e.g., by requiring a considerable administrative burden to opt-out of vaccination). Similarly, practitioners should also consider reducing the structural barriers (e.g., access to conventional healthcare) that contribute to people's willingness to accept conspiracy theories (e.g., real-world barriers that can inhibit parents from vaccinating, such as lack of transport or assistance with timely child support; Leask, 2011).

2.5. Exploited psychological driver: Norms

Social norms are rules or standards about how members of a community should behave. For rules to be considered social norms (hereafter referred to as norms), they must be supported and "enforced" by a sufficient portion of a community. Examples of norms range from explicit laws (e.g., pharmaceutical drugs must pass clinical testing) through to informal guidelines (e.g., a taboo about openly criticising another person's beliefs). Evolutionary psychology provides one useful framework for understanding how norms impact behaviour: As individuals we owe much of our success to the behaviour of other members of our community, and thus cooperation must be evolutionarily adaptive. Yet, for a community to cooperate effectively, individuals must reliably adhere to a set of behavioural norms. The benefits of ensuring cooperation help to explain why many human behaviours have evolved for norm detection and enforcement (Simler and Hanson, 2017). Game theory provides another useful framework for understanding norms. For example, one classic study showed that since enforcement can be costly for an individual (e.g., it can elicit retaliation from those being punished), norms are most effective when there are incentives for enforcement, termed *meta-norms* (e.g., a norm punishing those who do not punish others; Axelrod, 1986). Further, in order for a new norm to be established, individuals must have reason to believe that other members of the community are also aware, and might support, that new norm. This factor helps to explain why public communications about norms can have a considerable impact on individual behaviour.

Human impulses towards conformity and social inclusion are so fundamental that community norms can become an intrinsic part of our individual sense of identity. For example, adolescent binge drinking is predicted by perceived alcohol consumption norms from multiple sources (parents, friends, society; Kuntsche et al., 2017) and the extent to which alcohol is viewed as part of an individual's identity (Ridout et al., 2012). Conversely, Berger and Rand (2008) experimentally showed that when unhealthy behaviours (e.g., binge drinking and consuming fattening foods) were conspicuously linked to the identity of an undesirable social outgroup, individuals reported altering their behaviour (i.e., drinking less or consuming fewer fattening foods) to avoid signalling association with the undesired group.

One approach to changing a harmful behaviour is a norm appeal—a message that aims to change an undesirable behaviour by highlighting a behavioural norm. To design effective norm appeals, practitioners need to distinguish between (i) *injunctive norms*—what others approve or disapprove of doing; (ii) *descriptive norms*—what people typically do, and (iii) *perceived norms*—what individuals believe about the real descriptive and injunctive norms. Injunctive norms operate by signalling the likelihood of social approval or disapproval, and therefore the possible social consequences of one's behaviour. Descriptive norms operate by serving as an indicator of the injunctive norm (where there is uncertainty about the injunctive norm) and by serving as a heuristic for calculating the costs vs. benefits of compliance (Farrow et al., 2017). Failure to distinguish between different types of norms can result in campaigns that inadvertently strengthen undesirable norms. For instance, stating that flu vaccination rates are low may be accurate, but it also communicates a descriptive norm that few people get vaccinated and thus may encourage greater conformity in the wrong direction (Cialdini, 2003). In contrast, stating that vaccine approval rates are high may be equally accurate, but instead highlights an injunctive norm that most people approve of vaccines, and thus may encourage conformity in the desired direction. In support of this principle, a study on flu vaccination rates found that individuals who believed a majority of people around them approved of vaccination (injunctive norm) were much more likely to get vaccinated than those who believed that the majority disapproved of vaccination (Quinn et al., 2017). Three major barriers that prevent norm appeals from influencing behaviour are misperceived norms, logical fallacies, and resistant social structures.

2.5.1. One barrier to successful norm appeals: Misperceived norms

Misperceptions about norms (e.g., a belief that a behaviour occurs more, or less, frequently than it does in reality) can lead individuals to unwittingly behave in ways that are inconsistent with their social group, and thus can be harmful to health. For example, college students tend to view their own alcohol use as less problematic if they overestimate the use and approval of alcohol by their peers (Borsari and Carey, 2003). In theory, norm appeals can be used to counter such misperceptions, by conveying the true norms (descriptive, injunctive, or ideally both; Cialdini, 2003). However, evaluations of this approach have found mixed results (DeJong et al., 2009; Perkins and Craig, 2006; Wechsler et al., 2003). Wechsler et al. (2003) suggested one key reason why norm appeals may sometimes have been ineffective was that they targeted college campuses with diverse student populations, which were unlikely to contain a "typical student" or a single common set of norms.

In line with this explanation, a recent review of the norms literature (Farrow et al., 2017) suggested several factors that may moderate message acceptance, including characteristics of the implied reference group (e.g., its size), characteristics of the target individual (e.g., underlying motivations, risk tolerance, socio-demographics, attitude towards and social proximity to the reference group), the social context of the behaviour (e.g., anonymous or public), and the environmental context (e.g., visual cues indicating if others behave in accordance with the norm appeal). Obtaining knowledge about these factors before designing interventions will help practitioners develop an informed theory about the impact of a given norm appeal.

One fraudulent health behaviour that could lend itself to a norm appeal is pharmacists' sales of homeopathic remedies. For example, a 2013 Australian study found that 36% of pharmacists agreed that

homeopathic remedies had a place in pharmacies, yet only 14% believed homeopathic remedies were effective—suggesting some pharmacists were comfortable in knowingly selling ineffective products (Schultz et al., 2013). This behaviour may have been driven by a misperceived descriptive norm, namely that some pharmacists overestimated the extent to which their colleagues believed homeopathic remedies to be useful. Indeed, Schultz et al. (2013) found pharmacists were more likely to be comfortable selling homeopathic remedies if they believed that other pharmacists considered them to be useful. In contrast, pharmacists were less likely to be comfortable selling homeopathic remedies if they believed that respect from other health practitioners would be lost by stocking such remedies.

These results suggest that a promising treatment to discourage pharmacists from selling homeopathic remedies would be to combine a descriptive norm (most pharmacists believe homeopathy is ineffective) with an injunctive norm (stocking homeopathic remedies is a risk to reputation). A further injunctive norm could be added to stress that major medical representative bodies disapprove of homeopathy (Australian National Health & Medical Research Council [NHMRC], 2015; National Health Service [NHS] England, 2017). Yet another injunctive norm that could be leveraged is that communities generally disapprove of commercial transactions where the merchant knows (or ought to know) that the product does not work (Macdonald and Gavura, 2016). For these treatments to be effective, such norm appeals would need to be sufficiently public to create a credible threat of collective enforcement—pharmacists selling homeopathic remedies would need to believe that a sufficient proportion of other pharmacists, and the wider community, would also receive the norm appeal (Simler and Hanson, 2017). Incidentally, a similar norms approach could also be leveraged for other alternative health remedies, by highlighting that pharmacists generally lack the knowledge to provide advice about alternative remedies (Waddington et al., 2015) and major medical societies are increasingly opposed to alternative medicines (South West London Medicines Optimisation Group NHS, 2018; Pharmaceutical Society of Australia, 2015).

2.5.2. A second barrier to successful norm appeals: Logical fallacies

Advocates of fraudulent health remedies will routinely appeal to norms with the aim of manipulating consumers' receptivity to their claims. In a typical norm appeal, an advocate will espouse the vocabulary or ideology of a given community in order to enhance the appeal of a pseudoscientific claim. Almost invariably, such appeals rely on logical fallacies—invalid arguments or irrelevant points that lack evidence. A typical fallacious appeal is the appeal to duty, which advocates for consuming a particular health remedy out of a moral duty to protect one's family. For example, marketers continue to make claims that antibacterial soaps are superior to ordinary soaps for protecting families from germs and infection, despite no such evidence and even some studies suggesting they might be harmful (FDA, 2016). Debunking norm appeals that rely on logical fallacies requires two steps. First, highlight the errors in reasoning: Practitioners can become proficient at this step by acquiring familiarity with logical fallacies and the principles of reasoning (Cook et al., 2018). Second, provide persuasive counter-evidence: Cognitive research on inductive reasoning—making predictions about novel phenomena based on existing knowledge—suggests that a range of factors can increase perceptions of argument strength such as ensuring evidence diversity (Hayes and Heit, 2018). For example, providing evidence from two culturally dissimilar nations considerably increased support for scientific claims on public health issues, compared to evidence from two culturally similar nations (Kary et al., 2018).

The appeal to tradition is another logical fallacy routinely employed by advocates of alternative remedies. The essential form of this fallacy is that the longevity of a health approach (e.g., Traditional Chinese Medicine)—the fact that it has been practised for thousands of years—is evidence of its effectiveness. This argument is invalid because many health systems that have persisted for a long time are plainly false. Thus, an effective treatment to dispel this fallacy would be to point to culturally diverse evidence where long-held ancient health remedies are unequivocally false such as physiognomy and humoral biology (Novella, 2007).

The appeal to authority is another common logical fallacy. The essential form of this fallacy is that support for a claim (e.g., rhino horn cures cancer) from an authority (e.g., a respected medical doctor) is evidence that supports the claim. The argument is invalid because even medical professionals can provide advice that is counter to scientific consilience. In a typical example, an appeal to authority is made whenever a successful sportsperson endorses the use of an unsupported dietary supplement. For such appeals, an effective counter-strategy might be to provide diverse evidence of athletes who succeeded without using dietary supplements, or who only used, or endorsed, certain health remedies after they already achieved sporting success.

2.5.3. A third barrier to successful norm appeals: Resistant social structures

A common intuition about intervention messaging is that social networks with the most connections (e.g., public broadcasters or "social media influencers") will facilitate the greatest spread of behaviour change. This intuition relies on the underlying assumption that persuasive messages (e.g., catchy advertisements or informative documentaries) will efficiently diffuse the intended changes through social networks consisting of many weak connections (e.g., casual acquaintances), such that more connections will result in greater uptake (e.g., shared internet memes that "go viral"). However, research on the diffusion of complex behaviours suggests that the content of an intervention message may be less influential than the structure and relations of the network that the message is diffused through (Centola, 2011). In particular, this research suggests that the complexity of a particular behaviour will influence how effectively it diffuses through different structured networks.

For simple behaviours (e.g., sharing an amusing photo) the most efficient network structure requires many weak ties—casual acquaintances that are distal, dissimilar, and characterized by low-frequency contact—because the behaviour can easily diffuse between two distantly related contacts, helping it to spread quickly throughout the population. In contrast, for complex behaviours (e.g., deciding whether to vaccinate), the most efficient network structure may require relatively few strong ties—family, friends, and community members that tend to be proximate, similar, and characterized by high-frequency contact—because individuals are more likely to adopt new a social norm when they receive social reinforcement from multiple familiar sources. Indeed, the abundance of weak ties within a social network can even inhibit the adoption of complex behaviours in a population because highly-connected individuals will receive a greater proportion of countervailing signals from non-adaptors (Centola, 2010; Centola et al., 2007).

In support, Centola (2010) experimentally showed that the uptake of a health behaviour was greater when participants received social reinforcement from multiple neighbours in an online social network, compared to a more distally connected random network. In a follow-up study, Centola (2011) showed that the uptake of a health behaviour was significantly influenced by manipulating the level of homophily—the similarity of social contacts—in online social network structures. Specifically, they found that groups consisting of individuals with similar characteristics (gender, age, and body mass index) had greater diffusion of the health behaviour than individuals randomly assigned to networks.

To date, the impact of social network structure has only been experimentally tested with a few positive health interventions (e.g., increased physical activity) and none to our knowledge have aimed to counter health fraud. Nevertheless, both observational and modelling research into the diffusion of fraudulent health claims (such as anti-fluoride and anti-vaccine networks; Salathé and Bonhoeffer, 2008;

Seymour et al., 2015) supports the notion that strong ties in a community present a considerable barrier to the acceptance of outside expert opinion. Practitioners wishing to protect consumers from fraudulent health claims should thus compare the impact of engaging different network structures on the diffusion of various social norms. The emerging research into the diffusion of complex behaviours suggests several treatments for countering health fraud (Centola, 2018). One treatment is to create clusters of early adopters, as this may drive a robust process of social reinforcement, compared to diluting their influence amongst a population. Another promising treatment is to enhance the persuasiveness of intervention messaging by fostering empathy. Centola suggests that the right form of homophily (i.e., similarity in ways relevant to the behaviour) can foster empathy sufficient to drive effective diffusion.

3. Conclusions

The primary goal of the present taxonomy (Table 1) is to provide a framework to combat the weapons of persuasive influence that health fraudsters exploit, by considering the psychological mechanisms by which those weapons operate, and then using these insights to craft treatments to help consumers resist such exploitation. Our taxonomy draws on principles, insights, and experimental evidence from several psychological fields to make predictions about interventions. However, it is important to note that most of these predictions are yet to be empirically tested.

Although several randomized controlled trials have supported the proposed treatments for counteracting the illusion of causality (MacFarlane et al., 2018), more trials, and subsequent replications, are needed to test all of the predictions in the taxonomy. Thus, the taxonomy should also serve as a springboard for future applied research. Depending on the outcomes of this research, it is our hope that the taxonomy will serve as a robust guide for practitioners to design, implement, and evaluate psychologically-informed interventions. Care should also be taken to ensure that interventions are always implemented with due regard to ethical considerations, including taking steps to secure public acceptability (Reynolds et al., 2019).

We stress that the taxonomy is not exhaustive, nor does it examine the individual personality or cognitive traits that might make certain groups of people, such as the elderly, more susceptible to fraud than others (Kircanski et al., 2018). Instead, we have provided a selection of the major drivers of consumer susceptibility to health fraud, key psychological barriers to intervention effectiveness, and some promising psychologically-informed treatments.

This review has sought to make three key contributions. First, it has reviewed the major psychological insights that likely contribute to consumer susceptibility to health fraud. Second, it has presented a coherent framework for systematically testing which psychological drivers render consumers most susceptible to health fraud. Third, it has introduced a congruent and parsimonious taxonomy that enables practitioners to systematically design, test, and compare interventions to protect consumers from fraudulent health claims. Future research should test the numerous predictions made by the taxonomy to establish what combinations of treatments are most effective at protecting consumers from health fraud.

Declaration of competing interest

None.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.socscimed.2020.112790.

References

National Health Service [NHS] England, 2017. Prescription curbs to free up hundreds of millions of pounds for frontline care. [Press release]. Retreived from. https://www.england.nhs.uk/2017/11/.
Aggarwal, P., Jun, S.Y., Huh, J.H., 2011. Scarcity messages. J. Advert. 40, 19–30.
Alhakami, A.S., Slovic, P., 1994. A psychological study of the inverse relationship between perceived risk and perceived benefit. Risk Anal. 14, 1085–1096.
Allum, N., Sturgis, P., Tabourazi, D., Brunton-Smith, I., 2008. Science knowledge and attitudes across cultures: a meta-analysis. Public Underst. Sci. 17, 35–54.
Amos, C., Landreth Grau, S., 2015. Does consumer scepticism negate the effects of visceral cues in weight loss advertising? Int. J. Advert. 30, 693–719.
Attwell, K., Ward, P.R., Meyer, S.B., Rokkas, P.J., Leask, J., 2018. "Do-it-yourself": vaccine rejection and complementary and alternative medicine (CAM). Soc. Sci. Med. 196, 106–114.
Australian Government Department of Health, 2015. Review of the australian government rebate on natural therapies for private health insurance. Retrieved from. http://www.health.gov.au/internet/main/publishing.nsf/content/phi-natural-therapies.
Avigan, M.I., Mozersky, R.P., Seeff, L.B., 2016. Scientific and regulatory perspectives in herbal and dietary supplement associated hepatotoxicity in the United States. Int. J. Mol. Sci. 17, 331.
Axelrod, R., 1986. An evolutionary approach to norms. Am. Pol. Sci. Rev. 80, 1095–1111.
Barberia, I., Blanco, F., Cubillas, C.P., Matute, H., 2013. Implementation and assessment of an intervention to debias adolescents against causal illusions. PLoS One 8, e71303.
Batanero, C., Cañadas, G.R., Díaz, C., Gea, M.M., 2015. Judgment of association between potential factors and associated risk in 2 × 2 tables: a study with psychology students. Math. Enthus. 12, 347–363.
Begh, R., Munafo, M.R., Shiffman, S., Ferguson, S.G., Nichols, L., Mohammed, M.A., ... Aveyard, P., 2015. Lack of attentional retraining effects in cigarette smokers attempting cessation: a proof of concept double-blind randomised controlled trial. Drug Alcohol Depend. 149, 158–165.
Bellanger, R.A., Seeger, C.M., Smith, H.E., 2017. Safety of complementary and alternative medicine (CAM) treatments and practices. Side Eff. Drugs Annu. 39, 503–512.
Berger, J., 2011. Arousal increases social transmission of information. Psychol. Sci. 22, 891–893.
Berger, J., Rand, L., 2008. Shifting signals to help health: using identity signaling to reduce risky health behaviors. J. Consum. Res. 35, 509–518.
Berinsky, A.J., 2017. Rumors and health care reform: experiments in political misinformation. Br. J. Polit. Sci. 47, 241–262.
Betsch, C., Korn, L., Holtmann, C., 2015. Don't try to convert the antivaccinators, instead target the fence-sitters. Proc. Natl. Acad. Sci. 112, E6725–E6726 [10.1073/pnas.1516350112].
Bjelakovic, G., Nikolova, D., Gluud, L.L., Simonetti, R.G., Gluud, C., 2012. Antioxidant supplements for prevention of mortality in healthy participants and patients with various diseases. Cochrane Database Syst. Rev. (3), CD007176.
Bjelakovic, G., Gluud, L.L., Nikolova, D., Whitfield, K., Wetterslev, J., Simonetti, R.G., ... Gluud, C., 2014. Vitamin D supplementation for prevention of mortality in adults. Cochrane Database Syst. Rev. 1 (1), CD007470.
Blais, A.-R., Thompson, M.M., Baranski, J.V., 2005. Individual differences in decision processing and confidence judgments in comparative judgment tasks: the role of cognitive styles. Personal. Individ. Differ. 38, 1701–1713.
Blanco, F., Matute, H., Vadillo, M.A., 2011. Making the uncontrollable seem controllable: the role of action in the illusion of control. Q. J. Exp. Psychol. 64, 1290–1304.
Bolton, L.E., Cohen, J.B., Bloom, P.N., 2006. Does marketing products as remedies create "get out of jail free cards"? J. Consum. Res. 33, 71–81.
Borsari, B., Carey, K.B., 2003. Descriptive and injunctive norms in college drinking: a meta-analytic integration. J. Stud. Alcohol 64, 331–341.
Broniatowski, D.A., Jamison, A.M., Qi, S., AlKulaib, L., Chen, T., Benton, A., ... Dredze, M., 2018. Weaponized health communication: twitter bots and Russian trolls amplify the vaccine debate. Am. J. Public Health 108, 1378–1384.
Bubela, T., Nisbet, M.C., Borchelt, R., Brunger, F., Critchley, C., Einsiedel, E., ... Caulfield, T., 2009. Science communication reconsidered. Nat. Biotechnol. 27, 514–518.
Byard, R.W., Musgrave, I., 2010. Herbal medicines and forensic investigations. Forensic Sci. Med. Pathol. 6.
Callaghan, T., Motta, M., Sylvester, S., Lunz Trujillo, K., Blackburn, C.C., 2019. Parent psychology and the decision to delay childhood vaccination. Soc. Sci. Med. 238, 112407.
Cannon, C., Goldsmith, K., Roux, C., Kirmani, A., 2018. A self-regulatory model of resource scarcity. J. Consum. Psychol. 1–24 0.
Centola, D., 2010. The spread of behavior in an online social network experiment. Science 329, 1194.
Centola, D., 2011. An experimental study of homophily in the adoption of health behavior. Science 334, 1269–1272.
Centola, D., 2018. How Behavior Spreads: the Science of Complex Contagions. Princeton University Press.
Centola, D., Eguíluz, V.M., Macy, M.W., 2007. Cascade dynamics of complex propagation. Phys. A Stat. Mech. Appl. 374, 449–456.
Chabris, C.F., Simons, D., 2010. The Invisible gorilla: and Other Ways Our Intuitions

Deceive Us. Crown, New York.
Chabris, C.F., Weinberger, A., Fontaine, M., Simons, D.J., 2011. You do not talk about Fight Club if you do not notice Fight Club: inattentional blindness for a simulated real-world assault. I-perception 2, 150–153.
Christiano, A., Neimand, A., 2017. Stop Raising Awareness Already. *Stanford Social Innovation Review*. Retrieved , Accessed date: 20 February 2017.
Cialdini, R.B., 2003. Crafting normative messages to protect the environment. Curr. Dir. Psychol. Sci. 12, 105–109.
Cialdini, R.B., 2009. Influence: the Psychology of Persuasion. Harper Collins.
Citrin, D.L., Bloom, D.L., Grutsch, J.F., Mortensen, S.J., Lis, C.G., 2012. Beliefs and perceptions of women with newly diagnosed breast cancer who refused conventional treatment in favor of alternative therapies. The Oncologist 17, 607–612.
Coghlan, M.L., Maker, G., Crighton, E., Haile, J., Murray, D.C., White, N.E., ... Bunce, M., 2015. Combined DNA, toxicological and heavy metal analyses provides an auditing toolkit to improve pharmacovigilance of traditional Chinese medicine (TCM). Sci. Rep. 5, 17475.
Cook, J., Lewandowsky, S., Ecker, U.K.H., 2017. Neutralizing misinformation through inoculation: exposing misleading argumentation techniques reduces their influence. PLoS One 12, e0175799.
Cook, J., Ellerton, P., Kinkead, D., 2018. Deconstructing climate misinformation to identify reasoning errors. Environ. Res. Lett. 13, 024018.
Cormie, P., Atkinson, M., Bucci, L., Cust, A., Eakin, E., Hayes, S., ... Adams, D., 2018. Clinical Oncology Society of Australia position statement on exercise in cancer care. Med. J. Aust. 209, 184–187.
Crichton, F., Petrie, K.J., 2015. Accentuate the positive: counteracting psychogenic responses to media health messages in the age of the internet. J. Psychosom. Res. 79, 185–189.
Croskerry, P., Norman, G., 2008. Overconfidence in clinical decision making. Am. J. Med. 121, S24–S29.
Damasio, A.R., Tranel, D., Damasio, H., 1990. Individuals with sociopathic behavior caused by frontal damage fail to respond autonomically to social stimuli. Behav. Brain Res. 41, 81–94.
Davies, Dan, 2018. Lying for Money: How Legendary Frauds Reveal the Workings of Our World. Profile Books, London.
de Barra, M., 2017. Reporting bias inflates the reputation of medical treatments: a comparison of outcomes in clinical trials and online product reviews. Soc. Sci. Med. 177, 248–255.
DeJong, W., Schneider, S.K., Towvim, L.G., Murphy, M.J., Doerr, E.E., Simonsen, N.R., ... Scribner, R.A., 2009. A multisite randomized trial of social norms marketing campaigns to reduce college student drinking: a replication failure. Subst. Abus. 30, 127–140.
Dillard, J.P., Shen, L., 2005. On the nature of reactance and its role in persuasive health communication. Commun. Monogr. 72, 144–168.
Ditto, P.H., Pizarro, D.A., Epstein, E.B., Jacobson, J.A., MacDonald, T.K., 2006. Visceral influences on risk-taking behavior. J. Behav. Decis. Mak. 19, 99–113.
Dixon, G.N., McKeever, B.W., Holton, A.E., Clarke, C., Eosco, G., 2015. The power of a picture: overcoming scientific misinformation by communicating weight-of-evidence information with visual exemplars. J. Commun. 65, 639–659.
Eban, K., 2019. Bottle of Lies: the inside Story of the Generic Drug Boom. Harper Collins, New York, NY, USA.
Ecker, U.K.H., Ang, L.C., 2019. Political attitudes and the processing of misinformation corrections. Political Psychol. 40, 241–260.
Ecker, U.K.H., Lewandowsky, S., Tang, D.T., 2010. Explicit warnings reduce but do not eliminate the continued influence of misinformation. Mem. Cogn. 38, 1087–1100.
Ecker, U.K.H., O'Reilly, Z., Reid, J.S., Chang, E.P., 2019. The effectiveness of short-format refutational fact-checks. Br. J. Psychol. https://doi.org/10.1111/bjop.12383.
Farrow, K., Grolleau, G., Ibanez, L., 2017. Social norms and pro-environmental behavior: a review of the evidence. Ecol. Econ. 140, 1–13.
U.S. Food and Drug Administration [FDA], 2016. Antibacterial Soap? You Can Skip it, Use Plain Soap and Water. [Press Release] Retreived from. https://www.fda.gov/ForConsumers/ConsumerUpdates/ucm378393.htm.
U.S. Food & Drug Administration [FDA], 2019. Health Fraud Scams. Retrieved from. https://www.fda.gov/forconsumers/protectyourself/healthfraud/default.htm.
Feinberg, M., Willer, R., 2013. The moral roots of environmental attitudes. Psychol. Sci. 24, 56–62.
Fernbach, P.M., Light, N., Scott, S.E., Inbar, Y., Rozin, P., 2019. Extreme opponents of genetically modified foods know the least but think they know the most. Nat. Human Behav. 3, 251–256.
Festinger, L., 1962. A Theory of Cognitive Dissonance, vol. 2 Stanford University Press 1962.
Field, M., Mogg, K., Bradley, B.P., 2005. Craving and cognitive biases for alcohol cues in social drinkers. Alcohol Alcohol 40, 504–510.
Finucane, M.L., Alhakami, A., Slovic, P., Johnson, S.M., 2000. The affect heuristic in judgements of risks and benefits. J. Behav. Decis. Mak. 13, 1–17.
Fischer, P., Lea, S.E.G., Evans, K.M., 2013. Why do individuals respond to fraudulent scam communications and lose money? The psychological determinants of scam compliance. J. Appl. Soc. Psychol. 43, 2060–2072.
Fisher, M., Goddu, M.K., Keil, F.C., 2015. Searching for explanations: how the Internet inflates estimates of internal knowledge. J. Exp. Psychol. Gen. 144, 674.
Flaherty, D.K., 2011. The vaccine-autism connection: a public health crisis caused by unethical medical practices and fraudulent science. Ann. Pharmacother. 45, 1302–1304.
Foster, K.R., Kokko, H., 2009. The evolution of superstitious and superstition-like behaviour. Proc. R. Soc. Biol. Sci. 276, 31–37.
Foster, N.E., Anema, J.R., Cherkin, D., Chou, R., Cohen, S.P., Gross, D.P., ... Woolf, A., 2018. Prevention and treatment of low back pain: evidence, challenges, and promising directions. The Lancet 391, 2368–2383.
Friehe, T., Utikal, V., 2018. Intentions under cover – hiding intentions is considered unfair. J. Behav. Exp. Econ. 73, 11–21.
Geller, A.I., Shehab, N., Weidle, N.J., Lovegrove, M.C., Wolpert, B.J., Timbo, B.B., Budnitz, D.S., 2015. Emergency department visits for adverse events related to dietary supplements. N. Engl. J. Med. 373, 1531–1540.
Gibbs, R., Davies, G., Chou, S., 2016. A systematic review on factors affecting the likelihood of change blindness. Crime Psychol. Rev. 2, 1–21.
Giudice, E.L., Campbell, J.D., 2006. Needle-free vaccine delivery. Adv. Drug Deliv. Rev. 58 (1), 68–89.
Goertzel, T., 2010. Conspiracy theories in science. EMBO Rep. 11, 493–499.
Graham, J., Haidt, J., Nosek, B.A., 2009. Liberals and conservatives rely on different sets of moral foundations. J. Personal. Soc. Psychol. 96, 1029–1046.
Graham-Rowe, D., 2011. Biodiversity: endangered and in demand. Nature 480, S101–S103.
Greene, J.A., 2019. After a Scandal, a One-Sided Warning against Generic Drugs. The Washington Post.
Greenlee, H., Ernst, E., 2012. What can we learn from Steve Jobs about complementary and alternative therapies? Prev. Med. 54, 3–4.
Guallar, E., Stranges, S., Mulrow, C., Appel, L.J., Miller, E.R., 2013. Enough is enough: stop wasting money on vitamin and mineral supplements. Ann. Intern. Med. 159.
Hall, H., 2008. Popular medical fallacies: ancient wisdom* it works for me* natural is good. Skeptic 14, 8–10.
Hall, M.G., Mendel, J.R., Noar, S.M., Brewer, N.T., 2018. Why smokers avoid cigarette pack risk messages: two randomized clinical trials in the United States. Soc. Sci. Med. 213, 165–172.
Hameleers, M., van der Meer, T.G.L.A., 2019. Misinformation and Polarization in a High-Choice Media Environment: How Effective Are Political Fact-Checkers? Communication Research, 0093650218819671.
Hartmann-Boyce, J., Chepkin, S.C., Ye, W., Bullen, C., Lancaster, T., 2018. Nicotine replacement therapy versus control for smoking cessation. Cochrane Database Syst. Rev. 5 Art. No. Art. No. CD00014.
Hayes, B.K., Heit, E., 2018. Inductive Reasoning 2.0, vol. 9 Wiley Interdisciplinary Reviews: *Cognitive Science*.
Hayes, B.K., Hawkins, G.E., Newell, B.R., 2016. Consider the alternative: the effects of causal knowledge on representing and using alternative hypotheses in judgments under uncertainty. J. Exp. Psychol. Learn. Mem. Cogn. 42, 723–739.
Heit, E., Rotello, C.M., 2012. The pervasive effects of argument length on inductive reasoning. Think. Reason. 18, 244–277.
Hemila, H., Chalker, E., 2013. Vitamin C for preventing and treating the common cold. Cochrane Database Syst. Rev. 1 Art. No. CD000980.
Hopkins, E.J., Weisberg, D.S., Taylor, J.C.V., 2016. The seductive allure is a reductive allure: people prefer scientific explanations that contain logically irrelevant reductive information. Cognition 155, 67–76.
Hsee, C.K., 1996. The evaluability hypothesis: an explanation for preference reversals between joint and separate evaluations of alternatives. Organ. Behav. Hum. Decis. Process. 67, 247–257.
Huang, J.Y., Ackerman, J.M., Newman, G.E., 2017. Catching (up with) magical contagion: a review of contagion effects in consumer contexts. J. Assoc. Consumer Res. 2, 430–443.
Hughes, B.L., Zaki, J., 2015. The neuroscience of motivated cognition. Trends Cogn. Sci. 19, 62–64.
Im, S.h., Varma, K., Varma, S., 2017. Extending the seductive allure of neuroscience explanations effect to popular articles about educational topics. Br. J. Educ. Psychol. 87, 518–534.
Ioannidis, J.P.A., 2017. Does evidence-based hearsay determine the use of medical treatments? Soc. Sci. Med. 177, 256–258.
Jacoby, L.L., Kelley, C., 1989. Becoming famous overnight: limits on the ability to avoid unconscious influences of the past. J. Personal. Soc. Psychol. 56, 326–338.
Jenkins, D.J.A., Spence, J.D., Giovannucci, E.L., Kim, Y.I., Josse, R., Vieth, R., ... Sievenpiper, J.L., 2018. Supplemental vitamins and minerals for CVD prevention and treatment. J. Am. Coll. Cardiol. 71, 2570–2584.
Johnson, H.M., Seifert, C.M., 1994. Sources of the continued influence effect: when misinformation in memory affects later inferences. J. Exp. Psychol. Learn. Mem. Cogn. 20, 1420–1436.
Johnson, C.G., Levenkron, J.C., Suchman, A.L., Manchester, R., 1988. Does physician uncertainty affect patient satisfaction? J. Gen. Intern. Med. 3, 144–149.
Kahan, D.M., 2015. What is the "science of science communication"? J. Sci. Commun. 14 (3).
Kahan, D.M., Peters, E., Wittlin, M., Slovic, P., Ouellette, L.L., Braman, D., et al., 2012. The polarizing impact of science literacy and numeracy on perceived climate change risks. Nat. Clim. Chang. 2, 732–735.
Kahan, D.M., Peters, E., Dawson, E.C., Slovic, P., 2013. Motivated Numeracy and Enlightened Self-Government (Public Law Working Paper No. 307). Yale Law School.
Kahneman, D., 2012. Thinking, Fast and Slow. Penguin, London.
Kary, A., Newell, B.R., Hayes, B.K., 2018. What makes for compelling science? Evidential diversity in the evaluation of scientific arguments. Glob. Environ. Chang. 49, 186–196.
Keren, G., Teigen, K.H., 2001. Why is p = .90 better than p = .70? Preference for definitive predictions by lay consumers of probability judgments. Psychon. Bull. Rev. 8, 191–202.
Kircanski, K., Notthoff, N., DeLiema, M., Samanez-Larkin, G.R., Shadel, D., Mottola, G., ... Gotlib, I.H., 2018. Emotional arousal may increase susceptibility to fraud in older and younger adults. Psychol. Aging 33, 325.
Kitchens, B., Harle, C.A., Li, S., 2014. Quality of health-related online search results. Decis. Support Syst. 57, 454–462.

Klofstad, C.A., Uscinski, J.E., Connolly, J.M., West, J.P., 2019. What drives people to believe in Zika conspiracy theories? Palgrave Commun. 5, 1–8.
Kluger, A.N., DeNisi, A., 1996. The effects of feedback interventions on performance: a historical review, a meta-analysis, and a preliminary feedback intervention theory. Psychol. Bull. 119, 254–284.
Kok, G., Gottlieb, N.H., Peters, G.J., Mullen, P.D., Parcel, G.S., Ruiter, R.A., et al., 2016. A taxonomy of behaviour change methods: an Intervention Mapping approach. Health Psychol. Rev. 10, 297–312.
Kok, G., Peters, G.Y., Kessels, L.T.E., Ten Hoor, G.A., Ruiter, R.A.C., 2018. Ignoring theory and misinterpreting evidence: the false belief in fear appeals. Health Psychol. Rev. 12, 111–125.
Kristofferson, K., McFerran, B., Morales, A.C., Dahl, D.W., 2017. The dark side of scarcity promotions: how exposure to limited-quantity promotions can induce aggression. J. Consum. Res. 43, 683–706.
Kruger, J., Dunning, D., 1999. Unskilled and unaware of It: how difficulties in recognizing one's own incompetence lead to inflated self-assessments. J. Personal. Soc. Psychol. 77, 1121.
Kunda, Z., 1987. Motivated inference: self-serving generation and evaluation of causal theories. J. Personal. Soc. Psychol. 53, 636.
Kuntsche, E., Kuntsche, S., Thrul, J., Gmel, G., 2017. Binge drinking: health impact, prevalence, correlates and interventions. Psychol. Health 32, 976–1017.
Langenderfer, J., Shimp, T.A., 2001. Consumer vulnerability to scams, swindles, and fraud: a new theory of visceral influences on persuasion. Psychol. Mark. 18, 763–783.
Langer, E.J., 1975. The illusion of control. J. Personal. Soc. Psychol. 32, 311–328.
Lea, S., Fischer, P., Evans, K., 2009. The psychology of scams, provoking and committing errors of judgement: *prepared for the office of fair trading by the university of exeter school of psychology*. Retrieved from. https://ore.exeter.ac.uk/repository/handle/10871/20958.
Leask, J., 2011. Target the fence-sitters. Nature 473, 443.
Lee, T.K., Kim, H.K., 2017. Differential effects of message framing on obesity policy support between democrats and republicans. Health Commun. 32, 1481–1490.
Levin, D.T., Angelone, B.L., 2008. The visual metacognition questionnaire: a measure of intuitions about vision. Am. J. Psychol. 121, 451–472.
Levin, D.T., Momen, N., Drivdahl IV, S.B., Simons, D.J., 2000. Change blindness blindness: the metacognitive error of overestimating change-detection ability. Vis. Cogn. 7, 397–412.
Lewandowsky, S., Ecker, U.K., Seifert, C.M., Schwarz, N., Cook, J., 2012. Misinformation and its correction: continued influence and successful debiasing. Psychol. Sci. Public Interest 13, 106–131.
Lewandowsky, S., Oberauer, K., Gignac, G.E., 2013. NASA faked the moon landing—therefore,(climate) science is a hoax: an anatomy of the motivated rejection of science. Psychol. Sci. 24, 622–633.
Lewandowsky, S., Ecker, U.K.H., Cook, J., 2017. Beyond misinformation: understanding and coping with the "post-truth" era. J. Appl. Res. Mem. Cogn. 6, 353–369.
Lilienfeld, S.O., Ritschel, L.A., Lynn, S.J., Cautin, R.L., Latzman, R.D., 2014. Why ineffective psychotherapies appear to work: a taxonomy of causes of spurious therapeutic effectiveness. Perspect. Psychol. Sci. 9, 355–387.
Loewenstein, G., 1996. Out of control: visceral influences on behaviour. Organ. Behav. Hum. Decis. Process. 65, 272–292.
Lombrozo, T., 2007. Simplicity and probability in causal explanation. Cogn. Psychol. 55, 232–257.
Ludolph, R., Allam, A., Schulz, P.J., 2016. Manipulating Google's Knowledge Graph Box to counter biased information processing during an online search on vaccination: application of a technological debiasing strategy. J. Med. Internet Res. 18.
Macdonald, C., Gavura, S., 2016. Alternative medicine and the ethics of commerce. Bioethics 30, 77–84.
MacFarlane, D., Hurlstone, M.J., Ecker, U.K.H., 2018. Reducing demand for ineffective health remedies: overcoming the illusion of causality. Psychol. Health 33, 1472–1489.
MacFarlane, D., Hurlstone, M.J., Ecker, U.K.H., 2020. Countering Demand for Unsupported Health Remedies: Do Consumers Respond to Risks, Lack of Benefits, or Both? (Unpublished results). .
Mani, A., Mullainathan, S., Shafir, E., Zhao, J., 2013. Poverty impedes cognitive function. Science 341, 976–980.
Mata, J., Todd, P.M., Lippke, S., 2010. When weight management lasts. Lower perceived rule complexity increases adherence. Appetite 54, 37–43.
Matute, H., Blanco, F., Yarritu, I., Díaz-Lago, M., Vadillo, M.A., Barberia, I., 2015. Illusions of causality: how they bias our everyday thinking and how they could be reduced. Front. Psychol. 6, 1–14.
McCabe, D.P., Castel, A.D., 2008. Seeing is believing: the effect of brain images on judgments of scientific reasoning. Cognition 107, 343–352.
McKenzie-Mohr, D., 2000. Fostering sustainable behavior through community-based social marketing. Am. Psychol. 55, 531–537.
McKenzie-Mohr, D., Schultz, P.W., 2014. Choosing effective behavior change tools. Soc. Mark. Q. 20, 35–46.
BBC, 2018. Measles cases hit record high in Europe. August 20, Retrieved form. https://www.bbc.co.uk/news/health-45246049.
Australian Governmant National Health and Medical Research Council, 2015. NHMRC statement: statement on homeopathy. Retrieved from. https://www.nhmrc.gov.au/_files_ nhmrc/publications/attachments/cam02_nhmrc_statement_homeopathy.pdf.
South West London Medicines Optimisation Group, 2018. Position statement on the prescribing of complementary and alternative medicines. Retrieved from https://www.swlmcg.nhs.uk/Policies/Position%20Statements/ .
Miller, L.M.S., Cassady, D.L., 2015. The effects of nutrition knowledge on food label use: a review of the literature. Appetite 92, 207–216.
Milliken, T., 2014. Illegal Trade in Ivory and an Assessment Report to Improve Law Enforcement under the Wildlife TRAPS Project. USAID & Traffic International, Cambridge, UK, pp. 1–24.
Motta, M., Callaghan, T., Sylvester, S., 2018. Knowing less but presuming more: Dunning-Kruger effects and the endorsement of anti-vaccine policy attitudes. Soc. Sci. Med. 211, 274–281.
Nan, X., Madden, K., 2014. The role of cultural worldviews and message framing in shaping public opinions toward the human papillomavirus vaccination mandate. Hum. Commun. Res. 40, 30–53.
Novella, S., 2007. The Argument from Antiquity [Blog]. September 27. Retrieved from. https://theness.com/neurologicablog/index.php/the-argument-from-antiquity/.
O'Steen, J.V., O'Steen, V., 2006. The FDA defense: vioxx and the argument against federal preemption of state claims for injuries resulting from defective drugs. Ariz. Law Rev. 48, 67.
Oliver, J.E., Wood, T., 2014. Medical conspiracy theories and health behaviors in the United States. JAMA Int. Med. 174, 817–818.
Paynter, J., Luskin-Saxby, S., Keen, D., Fordyce, K., Frost, G., Imms, C., ... Ecker, U.K.H., 2019. Evaluation of a template for countering misinformation—real-world Autism treatment myth debunking. PLoS One 14, e0210746.
Perkins, H.W., Craig, D.W., 2006. A successful social norms campaign to reduce alcohol misuse among college student-athletes. J. Stud. Alcohol 67, 880–889.
Peters, G.-J.Y., Ruiter, R.A.C., Ten Hoor, G.A., Kessels, L.T.E., Kok, G., 2018. Towards consensus on fear appeals: a rejoinder to the commentaries on Kok, Peters, Kessels, ten Hoor, and Ruiter (2018). Health Psychol. Rev. 12, 151–156.
Pharmaceutical Society of Australia, 2015. PSA position statement on complementary medicines. Retreived from. http://www.auspharmacist.net.au/images/psacam15.pdf.
Poland, G.A., Spier, R., 2010. Fear, misinformation, and innumerates: how the Wakefield paper, the press, and advocacy groups damaged the public health. Vaccine 28, 2361–2362.
Quinn, S.C., Hilyard, K.M., Jamison, A.M., An, J., Hancock, G.R., Musa, D., Freimuth, V.S., 2017. The influence of social norms on flu vaccination among African American and White adults. Health Educ. Res. 32, 473–486.
Raven, J., 2000. The Raven's progressive matrices: change and stability over culture and time. Cogn. Psychol. 41, 1–48.
Regner, T., 2016. Reciprocity under moral wiggle room: is it a preference or a constraint? Exp. Econ. 1–14.
Reynolds, J.P., Archer, S., Pilling, M., Kenny, M., Hollands, G.J., Marteau, T.M., 2019. Public acceptability of nudging and taxing to reduce consumption of alcohol, tobacco, and food: a population-based survey experiment. Soc. Sci. Med. 236, 112395.
Ridout, B., Campbell, A., Ellis, L., 2012. 'Off your Face (book)': alcohol in online social identity construction and its relation to problem drinking in university students. Drug Alcohol Rev. 31, 20–26.
Rocha, T., Amaral, J.S., Oliveira, M.B.P.P., 2016. Adulteration of dietary supplements by the illegal addition of synthetic drugs: a review. Compr. Rev. Food Sci. Food Saf. 15, 43–62.
Rossen, I., Hurlstone, M.J., Lawrence, C., 2016. Going with the grain of cognition: applying insights from psychology to build support for childhood vaccination. Front. Psychol. 7, 1483.
Rozenblit, L.G., 2004. Systematic bias in Knowledge Assessment: An Illusion of Explanatory Depth. Doctoral dissertation. ProQuest Dissertations Publishing Retrieved from. http://search.proquest.com/docview/305287115/.
Rozin, P., Millman, L., Nemeroff, C., 1986. Operation of the laws of sympathetic magic in disgust and other domains. J. Personal. Soc. Psychol. 50, 703.
Salathé, M., Bonhoeffer, S., 2008. The effect of opinion clustering on disease outbreaks. J. R. Soc. Interface 5, 1505–1508.
Sanchez, C., Dunning, D., 2018. Overconfidence among beginners: is a little learning a dangerous thing? J. Personal. Soc. Psychol. 114, 10–28.
Schultz, S.J., Hotham, E.D., Evans, A.M., 2013. Australian pharmacists' uncertainty about homeopathic products in community pharmacy. Focus Altern. Complement. Ther. 19, 9–15.
Seeley, R.J., Sandoval, D.A., 2011. Neuroscience: weight loss through smoking. Nature 475, 176–177.
Seymour, B., Getman, R., Saraf, A., Zhang, L.H., Kalenderian, E., 2015. When advocacy obscures accuracy online: digital pandemics of public health misinformation through an antifluoride case study. Am. J. Public Health 105, 517–523.
Simler, K., Hanson, R., 2017. The Elephant in the Brain: Hidden Motives in Everyday Life. Oxford University Press.
Simons, D.J., Chabris, C.F., 1999. Gorillas in our midst: sustained inattentional blindness for dynamic events. Perception 28, 1059–1074.
Simons, D.J., Levin, D.T., 1998. Failure to detect changes to people during a real-world interaction. Psychon. Bull. Rev. 5, 644–649.
Skaczkowski, G., Durkin, S., Kashima, Y., Wakefield, M., 2018. Influence of premium vs masked cigarette brand names on the experienced taste of a cigarette after tobacco plain packaging in Australia: an experimental study. BMC Public Health 18, 295.
Slovic, P., Monahan, J., MacGregor, D.G., 2000. Violence risk assessment and risk communication: the effects of using actual cases, providing instruction, and employing probability versus frequency formats. Law Hum. Behav. 24 (3).
Slovic, P., Finucane, M.L., Peters, E., MacGregor, D.G., 2007. The affect heuristic. Eur. J. Oper. Res. 177, 1333–1352.
Smith, P., Bansal-Travers, M., O'Connor, R., Brown, A., Banthin, C., Guardino-Colket, S., Cummings, K.M., 2011. Correcting over 50 years of tobacco industry misinformation. Am. J. Prev. Med. 40, 690–698.
Sporer, S.L., Penrod, S., Read, D., Cutler, B., 1995. Choosing, confidence, and accuracy: a meta-analysis of the confidence-accuracy relation in eyewitness identification studies. Psychol. Bull. 118, 315.
Stoneman, P., Sturgis, P., Allum, N., 2013. Understanding support for complementary and

alternative medicine in general populations: use and perceived efficacy. Health (London) 17, 512–529.
Sunstein, C.R., Vermeule, A., 2009. Conspiracy theories: causes and cures. J. Political Philos. 17, 202–227.
Swire, B., Ecker, U.K.H., Lewandowsky, S., 2017. The role of familiarity in correcting inaccurate information. J. Exp. Psychol. Learn. Mem. Cogn. 43, 1948–1961.
Tabacchi, M.E., Cardaci, M., 2016. Preferential biases for texts that include neuroscientific jargon. Psychol. Rep. 118, 793–803.
Tannenbaum, M.B., Hepler, J., Zimmerman, R.S., Saul, L., Jacobs, S., Wilson, K., Albarracin, D., 2015. Appealing to fear: a meta-analysis of fear appeal effectiveness and theories. Psychol. Bull. 141, 1178–1204.
Tavris, C., Aronson, E., 2008. Mistakes Were Made (But Not by Me). Mariner Books.
Thaler, R.H., Sunstein, C.R., 2009. Nudge: Improving Decisions about Health, Wealth, and Happiness. Penguin Books, New York: New York.
The Faculty of Homeopathy, 2018. The research evidence base for homeopathy. [Web pdf]. Retrieved from. https://www.britishhomeopathic.org/wp-content/uploads/2018/04/2-page-evidence-summary-for-homeopathy-HRI.pdf.
Tilburt, J.C., Allyse, M., Hafferty, F.W., 2017. The case of Dr. Oz: ethics, evidence, and does professional self-regulation work? AMA J. Ethics 19, 199–206.
Tonin, R., 2018. A review of wind turbine-generated infrasound: source, measurement and effect on health. Acoust Aust. 46, 69–86.
U.S. National Institute of Health [NIH], 2016. Americans spent $30.2 billion out-of-pocket on complementary health approaches. June 22, [Press release]. Retrieved from. https://nccih.nih.gov/news/press/cost-spending-06222016.
Uscinski, J.E., Parent, J.M., 2014. American Conspiracy Theories. Oxford University Press.
van der Linden, S., 2015. The conspiracy-effect: exposure to conspiracy theories (about global warming) decreases pro-social behavior and science acceptance. Personal. Individ. Differ. 87, 171–173.
van der Linden, S., Leiserowitz, A., Rosenthal, S., Maibach, E., 2017. Inoculating the public against misinformation about climate change. Global Chall. 1, 1600008.
Waddington, F., Naunton, M., Kyle, G., Thomas, J., Cooper, G., Waddington, A., 2015. A systematic review of community pharmacist therapeutic knowledge of dietary supplements. Int. J. Clin. Pharm. 37, 439–446.
Wani, A.L., Ara, A., Bhat, S.A., 2014. Blood injury and injection phobia: the neglected one. Behav. Neurol. 2014, 71340.
Wechsler, H., Nelson, T.F., Lee, J.E., Seibring, M., Lewis, C., Keeling, R.P., 2003. Perception and reality: a national evaluation of social norms marketing interventions to reduce college students' heavy alcohol use. J. Stud. Alcohol 64, 484–494.
Weisberg, D.S., Keil, F.C., Goodstein, J., Rawson, E., Gray, J.R., 2008. The seductive allure of neuroscience explanations. J. Cogn. Neurosci. 20, 470–477.
Weisberg, D.S., Taylor, J.C.V., Hopkins, E.J., 2015. Deconstructing the seductive allure of neuroscience explanations. Judgm. Dec. Making 10, 429–441.
Wilson, P.R., 2014. The art of the con: How to think like a real hustler and avoid being scammed. Lyons Press.
Wiseman, R., Watt, C., 2006. Belief in psychic ability and the misattribution hypothesis: a qualitative review. Br. J. Psychol. 97, 323–338.
Witte, K., Allen, M., 2000. Meta-Analysis of fear appeals: implications for effective public health campaigns. Health Edu. Behav. 27, 591–615.
Wood, W., Quinn, J.M., 2003. Forewarned and forearmed? Two meta-analysis syntheses of forewarnings of influence appeals. Psychol. Bull. 129, 119.
Yarritu, I., Matute, H., 2015. Previous knowledge can induce an illusion of causality through actively biasing behavior. Front. Psychol. 6, 389.