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*Pete Lunn, Cameron Belton, Ciarán Lavin, Féidhlim McGowan, Shane Timmons and Deirdre Robertson*

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# Using Behavioural Science to Help Fight the Coronavirus

Pete Lunn, Cameron Belton, Ciarán Lavin, Féidhlim McGowan,  
Shane Timmons and Deirdre Robertson

Behavioural Research Unit, ESRI

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## Summary

This paper summarises useful evidence from behavioural science for fighting the COVID-19 outbreak. It is based on an extensive literature search of relevant behavioural interventions and studies of crises. The findings aim to be useful not only to government and public authorities, but to organisations, workplaces and households. Seven issues are covered:

(1) Evidence on **handwashing** shows that education and information are not enough. Placing hand sanitisers and colourful signage in central locations (e.g. directly beyond doors, canteen entrances, the middle of entrance halls and lift lobbies) increases use substantially. All organisations and public buildings could adopt this cheap and effective practice. (2) By contrast, we lack direct evidence on reducing **face touching**. Articulating new norms of acceptable behaviour (as for sneezing and coughing) and keeping tissues within arm's reach could help. (3) **Isolation** is likely to cause some distress and mental health problems, requiring additional services. Preparedness, through activating social networks, making concrete isolation plans, and becoming familiar with the process, helps. These supports are important, as some people may try to avoid necessary isolation. (4) **Public-spirited behaviour** is most likely when there is clear and frequent communication, strong group identity, and social disapproval for those who don't comply. This has implications for language, leadership and day-to-day social interaction. (5) Authorities often overestimate the risk of panic, but **undesirable behaviours** to watch out for are panic buying of key supplies and xenophobic responses. Communicating the social unacceptability of both could be part of a collective strategy. (6) Evidence links **crisis communication** to behaviour change. As well as speed, honesty and credibility, effective communication involves empathy and promoting useful individual actions and decisions. Using multiple platforms and tailoring message to subgroups are beneficial too. (7) **Risk perceptions** are easily biased. Highlighting single cases or using emotive language will increase bias. Risk is probably best communicated through numbers, with ranges to describe uncertainty, emphasising that numbers in the middle are more likely. Stating a maximum, e.g. "up to X thousand", will bias public perception.

A final section discusses possibilities for combining these insights, the need for simplicity, the role of the media, and possibilities for rapid pretesting.

## **Introduction**

There is great uncertainty about the scale of the epidemic due to transmission of the coronavirus that causes the disease COVID-19. We cannot know how many people will become infected and how many of them may die.<sup>1</sup> We do know that multiple measures can be taken that are likely to reduce transmission of the virus and ultimately, therefore, to save lives.<sup>2,3</sup> Many of these measures involve good organisation of health services – resources for contact tracing<sup>4,5</sup>, procedures for handling phone calls to GP practices, transportation for people who need to be tested, availability of isolation beds, etc.<sup>6</sup> Others are designed to change the decision making and behaviour of citizens – improving handwashing and hygiene<sup>7</sup>, etiquette for sneezes and coughs, knowing when and how to self-isolate, etc.<sup>8,9</sup>

The present paper concerns this second set of measures, those designed to affect decision making and behaviour. Recent decades have seen increases in the quantity and quality of research in behavioural science. In the last ten years, this science has been increasingly applied to policy problems by governments and international organisations around the world.<sup>10</sup> Consequently, there is a body of applied scientific knowledge and evidence that can be called upon in the fight against COVID-19. This paper reviews relevant evidence and some of the lessons therein.

The aim is to distil the evidence into a paper to inform those trying to fight the disease. Some of the evidence is relevant to mass communication of public health information from governments and authorities. Other evidence concerns the design of local behavioural interventions to reduce transmission of the disease. An important point is that useful behavioural interventions can be put in place not only by relevant national and local authorities, but by individual organisations, workplaces and even households. Our everyday lives are the context in which transmission of the virus takes place and much of behavioural science concerns how context affects our decision making and behaviour. Given the nonlinear dynamics of infection, reduced transmission can ultimately lower the overall number who contract the disease and the number of cases at the peak of the epidemic, when health services will be most stretched.<sup>11</sup>

Some caveats are necessary. The paper has been produced much more rapidly and at shorter notice than would be standard for research of this type. Obviously, this is because time matters in fighting the virus, but it means that the team have had to trade thoroughness off against speed, at least to some extent. In negotiating this trade-off, we have striven to

prioritise accuracy. The main issue is that there are likely to be some important studies or ideas that are missing.

The paper is organised into seven sections: (1) Hand Washing; (2) Face Touching; (3) Entering and Coping with Isolation; (4) Encouraging Collective Action; (5) Avoiding Undesirable Behaviour; (6) Crisis Communication; (7) Risk Perception. Each section describes available evidence, with a final paragraph that draws conclusions. The final section summarises these and highlights some more general implications also.

## **1. Handwashing**

Behaviour change interventions that target everyday activities must overcome a common and substantial barrier: habits. Habits are highly efficient, designed to free up our minds to concentrate on other matters. By definition, habits operate mostly outside conscious awareness and are hence hard to break through improved education and knowledge. For instance, even in acute healthcare environments, attempts to improve hand hygiene and other infection control behaviours through education and awareness have limited and short-term impacts.<sup>12,13</sup>

There is, however, a body of evidence about which interventions do work. On the downside, much of the research takes place in hospital and other healthcare settings, whereas the COVID-19 response requires behaviour change also in homes, workplaces, public buildings, etc. On the upside, evidence does suggest how to design good interventions.

A 2001 review of research in hospitals found that combining educational interventions with reminders and better facilities (e.g. automated sinks) can increase handwashing.<sup>14</sup> A 2012 follow-up also concluded that multiple behavioural levers are required, including social influence, convenience, prompts, and cues.<sup>15</sup> Later studies point to benefits from placing alcohol-based hand sanitiser (AHS) in highly visible locations.<sup>16,17</sup> Indeed, a crucial aspect of successful handwashing interventions is to capture attention. Placing an AHS stand in the middle (versus the side) of a hospital entrance lobby increased usage substantially.<sup>18</sup> More visible, proximate and convenient locations for AHS dispensers increases their use,<sup>19</sup> more so than increasing the number of dispensers.<sup>20</sup> Another study increased use by deploying flashing lights to draw attention to the AHS.<sup>21</sup>

While fewer interventions have been studied outside healthcare settings, some have been successful. A 2018 review of research in office workplaces found that simple provision of

hand hygiene products, accompanied by education on how to use them, usually resulted in significant improvements in hand hygiene compliance.<sup>22</sup> Modest increases in soap use in public toilets can be obtained via written signs.<sup>23</sup> Towel and soap dispensers that do not require user activation also help.<sup>24</sup> Messages linked to disgust tend to be effective,<sup>25,26,27,28,29</sup> while evidence does *not* support messages that communicate social norms (“4 out of 5 people wash their hands every time...”).<sup>30,31</sup>

Evidence from multiple studies points to useful conclusions. Education and information are not sufficient to change habits; interventions need to attract attention and make compliance convenient. Thus, AHS is an important tool. Evidence supports a policy in which organisations of all types placed colourful AHS stands directly in front of entrances and centrally in lobbies, lift areas, canteens.

## **2. Face Touching**

In contrast to handwashing, we can find no proper scientific studies that evaluate interventions designed to reduce the frequency with which people touch their face. Observational studies suggest that people touch their mouth, nose or eyes perhaps 10-20 times per hour.<sup>32,33</sup> Self-recording of face touching is not accurate<sup>34</sup> and sample sizes of studies are typically very small.

The issue of face touching raises the question of how to encourage a specific behaviour in the absence of direct evidence. Behavioural scientists have developed guides to behaviour change interventions that draw general lessons from across domains. The “Behaviour Change Wheel”<sup>35</sup> centres on a model of behaviour change consisting of three essential elements: capability, opportunity and motivation. Individuals have to be psychologically or physically able to undertake the behaviour, the environment that surrounds them needs to facilitate the behaviour, and their own mental processes need to energise and direct the behaviour. Authors of this approach have issued some material specific to the coronavirus.<sup>36</sup> The EAST framework<sup>37</sup> emphasises that behaviour change is more likely when the behaviour is made Easy, Attractive, Social and Timely.

What is common to these frameworks is recognition that education and information is not enough; we need to alter physical and social environments as well as understanding and mindset. With respect to face touching, a physical intervention might be to place tissues in prominent locations, e.g. immediately before the keyboard for office workers, on lunch and

coffee tables, so that people can use them and not their hands to scratch an itch. A social intervention might be for the public health authorities to encourage a specific change in social acceptability, perhaps that scratching with a sleeve is fine, just as it is now advised to sneeze or cough into the elbow or upper arm rather than the hand. The UK Behavioural Insights Team has made similar suggestions.<sup>38</sup>

### **3. Entering and Coping with Isolation**

Part of the necessary response to the COVID-19 outbreak is to limit social contact, particularly with those who display symptoms or are at increased risk of having contracted the virus. While self-isolation can help to contain and control the spread of infectious diseases,<sup>39</sup> isolation has important negative psychological effects, which we describe here. Awareness of these consequences is important to help people prepare and, where possible, prevent them. The behavioural science literature also suggests that anticipation of these effects could affect compliance with self-isolation.

It is well-established in the psychology and public health literature that social isolation has detrimental consequences for wellbeing, with effects comparable to other well-known risk factors such as smoking.<sup>40</sup> Loneliness is also associated with increased risk for mental health problems, including depression and anxiety.<sup>41,42</sup>

A recent review of 24 studies, in which individuals were quarantined for durations ranging from several days to several weeks, sheds light on possible consequences.<sup>43</sup> While distress and irritability from lack of social contact, loss of freedom and boredom *during* quarantine might be expected, some studies indicate long-term effects,<sup>44</sup> including depressive symptoms<sup>45</sup> and substance dependence<sup>46</sup> up to three years after quarantine has ended. The review highlighted specific implications for healthcare workers, who can become concerned about failing to support co-workers during the outbreak,<sup>47</sup> can be stigmatised following quarantine,<sup>48</sup> and sometimes self-isolate beyond the quarantine period.<sup>49</sup>

The duration of isolation is important. Longer periods are associated with poorer mental health outcomes<sup>50</sup> and increased anger.<sup>49</sup> Extending the isolation period beyond initial suggestions can demoralise people and increase non-compliance.<sup>51</sup> Thus, clarity and certainty about timelines are both important.

The mental health effects of loneliness during isolation can be exacerbated by loss of routine, which is linked to multiple negative mental health consequences.<sup>52</sup> Protective behaviours

such as sleep<sup>53</sup> and exercise<sup>54</sup> routines can be disrupted and hindered during isolation. Children may be especially susceptible to such changes in routine.<sup>55</sup>

Planning for the effects of social isolation can help individuals to cope. Plans may be put in place to remotely engage with social networks, via phone and video calls, or social media. Activating social networks may be particularly important for those living alone. People can maintain aspects of routine that remain possible during isolation, such as keeping alarms set to usual times, maintaining working hours, and planning home-based exercise (for those well enough). Plans are easier to follow if they are time-specific and intentional, rather than general aspirations.<sup>36,56</sup> Creating plans in advance of isolation, discussing plans with others and incorporating familiar routines may help people to overcome anxiety. Familiarity and repeated “mere” exposure to choices is established to reduce uncertainty and promote positivity towards those choices.<sup>57</sup>

A danger is that perceived negative consequences of isolation could hinder voluntary engagement. When deciding whether to engage with proposed health solutions, people consider not only their susceptibility to the threat and its severity, but how effective they perceive the solution to be and the nature of the required behaviour.<sup>58</sup> For instance, some people actively avoid receiving important medical information when it might lead to an undesirable action, such as learning that they might need surgery.<sup>59,60</sup> People express unwillingness to isolate themselves when they harbour doubts about the chances of infecting others, but report greater willingness when they consider the possible effect on the most vulnerable in society.<sup>61</sup> Thus, if people anticipate and fear negative consequences of self-isolation, or fail to reflect on spreading the virus to those most at risk, they may downplay or not acknowledge symptoms of COVID-19, to avoid the possibility of isolation.

Overall, evidence suggests negative mental health consequences from isolation. The implication is that authorities need to supply and advertise additional mental health services, including support lines and advice, for people who undergo isolation. Helping people to create plans is likely to help. This includes encouraging people to inform social media networks that they are isolated, encouraging messages and calls, and maintaining some routine. Familiarising people with the process and ways to cope with it is likely to increase compliance. Highlighting the altruistic rationale for isolation may reduce stigma and increase compliance, as considered further in the next section.



#### 4. Encouraging Collective Action

The behavioural response to COVID-19 is unavoidably collective. Each person's chance of contracting the virus depends not only on their own behaviour, but also on the behaviour of their fellow citizens. Initial data show that young people face a substantially lower risk of succumbing to COVID-19 than older people,<sup>62</sup> yet willingness to adapt their behaviour will, in turn, influence how many older people get the virus.<sup>63</sup>

Similar problems have been studied for many decades under multiple labels (“public good games”, “social dilemmas”, “collective action problems”, “common pool resource games”). Whatever label one chooses, there are replicable empirical results that suggest ways to increase the likelihood that people do the right thing by their fellow citizens.

It was demonstrated some time ago that many, though not all, individuals will override self-interest and act in the collective interest.<sup>64,65</sup> Perhaps a majority of the population are what are referred to as “conditional co-operators”,<sup>66,67</sup> who are willing to make sacrifices for the public good provided that others are too, but cease co-operation if too many other people don't bother. There is some evidence that such co-operative behaviour is more likely in response to emergencies.<sup>68,69</sup>

Large scientific literatures now reveal when public-spirited behaviour is more or less likely. We highlight three factors: communication, group identity and punishment. Importantly, while the relevant evidence was initially demonstrated in laboratory experiments, it has since been verified in multiple real-world applications.<sup>70</sup>

A consistent finding is that co-operation is improved, often substantially, by communication.<sup>71</sup> Co-operation is increased by clear statements, articulated by leaders and repeated by others, of a desired collective behaviour that is in the group interest. This can enhance trust, establish social norms and encourage individuals to commit to the behaviour.<sup>72</sup> Observation of effective communication when facing social dilemmas reveals that it is the articulation of how the behaviour is best for all, rather than persuasion to undertake the specific behaviour, that most supports co-operation.<sup>73</sup> This evidence, for instance, suggests that one of the most effective arguments to promote compliance with isolation is that self-isolation in response to symptoms is the best way for all of us to prevent infecting each other.

The more people feel part of a group or community response, the more likely they are to make a selfless contribution.<sup>70</sup> This finding is particularly true of responses to threats, which generate a stronger public response when framed in group rather than individual terms.<sup>74</sup>

Co-operation is more likely when there is transparency about individuals' contributions and punishment for those who do not pull their weight.<sup>75</sup> This punishment need not be material, but can simply consist of social disapproval,<sup>76</sup> although there is evidence that where punishment is itself unjust or antisocial, it can backfire.<sup>77,78</sup>

This evidence relating to collective action has implications for fighting COVID-19. Our situation is collective, not only at the international or national level, but within localities, workplaces and households. In each of these overlapping social groups, strong communication of a common strategy to fight the disease is likely to increase adherence to prescribed behaviours. Language and leadership matters. Where behaviour is about “we” and “us” rather than “I” or “you”, more public-spirited responses are likely. Media reporting matters too. Faithfully reporting that people are trying to follow advice, assuming that they are, is as important as highlighting failures to follow it. Conditional co-operators need to know that others are co-operating. Nevertheless, where behaviour falls short, a reasonable degree of disapproval is helpful; polite but clear interventions when official advice is not followed are likely to improve behaviour. We are in this together.

## **5. Avoiding Undesirable Behaviour**

Neglecting to wash hands, failing to cover coughs or sneezes, or avoiding self-isolation at the first genuine sign of symptoms, all constitute poor behaviour relative to ideal standards in response to the coronavirus epidemic. Nevertheless, these behaviours can be distinguished from more antisocial behaviours. Among such behaviours are panic responses, undue expressions of anger towards officials or health workers, xenophobic responses to people of a race or nationality perceived to be high-risk, or unsympathetic responses to those who contract the virus.

Encouragingly, studies suggest that mutual assistance is a more common response to a crisis than mass panic and social disorder.<sup>79,80</sup> The relative recent experience with swine flu (H1N1) is a case in point.<sup>81,82</sup> Nevertheless, severe social and economic disturbances can occur in response to disease outbreak.<sup>83</sup> Overreaction is not limited to the public, but can also affect professionals and workers in healthcare systems.<sup>84,85</sup>

Multiple studies have investigated responsible versus irresponsible media coverage, and its effects on public perceptions. The method is generally to analyse content for exaggeration or alarming language, or to relate media volume, content and tone to public opinion surveys. An initial analysis of the worldwide coverage of the coronavirus has raised concerns about unhelpful, alarming language, such as “killer virus”.<sup>86</sup> However, a recent review of research into swine flu coverage concluded that while there was some evidence of overdramatization, the bigger issue was the focus on reporting the threat (number of diagnoses, etc.) at the expense of communicating how best to fight the disease.<sup>87</sup>

We can find surprisingly little high-quality evidence on the drivers of panic buying and or efforts to prevent it. Despite its name, panic buying is not always driven by strong emotions, but can be a natural response of risk-averse individuals to a threat of future unavailability or lack of access (e.g. due to isolation).<sup>88</sup> Evidence from studies of financial behaviour suggests that it is more likely when individuals observe others stocking up.<sup>89</sup> In effect, stockpiling amounts to antisocial behaviour in a large-scale “common pool resource” problem. We have to rely on encouraging responsible behaviour, especially in relation to hand sanitisers and other medical supplies. In line with the previous section, this requires articulating a clear strategy and expectation of behaviour that we all need to comply with.

An important concern is the possibility that specific social groups perceived to be associated with the virus might face discrimination or ostracization.<sup>90</sup> For instance, Asian-Americans experienced discrimination during the SARS epidemic.<sup>91</sup> In general, people who feel more vulnerable to disease express more negative reactions to out-groups<sup>92</sup> and priming people to think about disease increases ethnocentrism.<sup>93</sup> To combat this, strong messages from leaders might stress both the social unacceptability of any xenophobic behaviour and the importance of understanding that different people face the same threat and share a common goal.<sup>94</sup>

In summary, there is evidence from past crises that public authorities can overestimate the likelihood of panic and public disorder, including the role of the media in propagating it. There are nevertheless known risks of panic buying and xenophobic behaviour. Evidence suggests that clear leadership and statements about the unacceptability of such behaviour are required, as part of our collective response as a society, coupled with visible use of available punishments for people who transgress.

## 6. Crisis Communication

A scientific literature covers how people respond to crisis communication and aims to identify the best ways to communicate in a crisis. Although many studies are specific to single countries or incidents, useful principles emerge. These may be helpful not only for national communication but across the public health system, to balance the need to inform and motivate against the danger of inciting unnecessary fear.<sup>95</sup>

The word “unnecessary” is important here, because fear is to some extent a legitimate force that can positively influence attitudes, intentions and behaviours.<sup>96</sup> There is evidence that communication of threat is particularly effective when combined with communication about how to respond. There is an ongoing scientific debate about whether ‘fear appeals’ generate long-term behaviour change. However, the consensus is that they are more effective when perceptions of self-efficacy (belief that one’s own actions make a difference) are high.<sup>97,98</sup>

Messages can be designed to elicit emotions other than fear. Evidence shows that ‘empathy appeals’ can have positive impacts on behaviour change.<sup>99</sup> In the context of smoking, social marketing that portrays realistic narratives involving loss or pain within personal relationships can be as or more persuasive than graphic ‘fear appeals’. Similar empathetic framing may strengthen belief that a community working together *can* do something to mitigate the effects of a crisis.<sup>100,101</sup>

Different subgroups can respond differently to communication during a crisis, which can be important for more vulnerable groups<sup>102</sup> but also helpful for good crisis communication. Making communication sensitive to the demographics of the intended recipient helps people to feel that society is more prepared.<sup>103</sup> Messages specific to ethnic groups can also improve engagement.<sup>104</sup> For example, African American women were more likely to test for HIV after viewing a video featuring a presenter matching their gender, and more likely still when the context of the messages were framed in a culturally relevant way.<sup>105</sup>

Marketing researchers have noted that public health campaigns are more effective when they apply principles that are successfully used by private companies – be distinctive, consistent, engaging and relevant. For example, catchy phrases or mnemonics help children and families to retain important public health information.<sup>106</sup> The Australian ‘Slip, Slop, Slap’ sun

protection campaign is a prime example of the widespread, lasting impact on behaviour that campaigns which incorporate these principles can achieve.<sup>107</sup>

Social media has opened new avenues for communication<sup>108</sup> and offers potential for rapid information dissemination.<sup>109</sup> It can be harnessed to promote altruistic behaviour. Messages that convey a moral imperative for people to act and messages that evoke strong emotional reactions are more likely to be shared.<sup>110</sup> Campaigns that invoke an internally sourced ‘intrinsic’ motivation to help others generally last longer than ones that leverage extrinsic incentives to do ‘good’.<sup>111</sup>

However, there is generally mixed evidence on the benefits of social media in crises. Following the 2015 MERS (Middle East Respiratory Syndrome) coronavirus outbreak in South Korea, those exposed to information on social media were more likely to experience fear and anger, but both emotions were positively associated with the extent of subsequent preventive behaviours.<sup>112</sup> In relation to the Zika and Ebola viruses, studies have suggested that use of social media messaging by authorities may not be beneficial for knowledge,<sup>113</sup> can reduce perceptions of credibility<sup>114</sup> and may increase focus on panic and uncertainty.<sup>115</sup>

The US federal agency, Centers for Disease Control and Prevention (CDC), has previously distilled evidence into six guiding principles for crisis communication.<sup>116</sup> These are: (1) Be first: provide information as soon as possible or, if not possible, explain how you are working to get it and when. (2) Be right: tell people what you know when you know it, tell them what you don't know, and tell them if you will know later. (3) Be credible: tell the truth. (4) Express empathy: acknowledge what people are feeling. (5) Promote action: give people relevant things to do. (6) Show respect: involve stakeholders in decision making processes and try to meet media deadlines.

Some messages pass through the media filter more easily than others. These principles closely map onto those tested in a content analysis of US media stories that concerned foodborne illnesses and natural disasters.<sup>117</sup> This found a strong tendency for news outlets to

focus on information and explanation, with little coverage of expressions of empathy, although the above evidence suggests empathy is important during crises.

The evidence provides some clear principles for communicating health crisis information. In addition to speed, honesty and credibility, it is important to stress the usefulness of individual actions and decisions. Empathy matters – people need reassurance that those in charge understand how they feel. Using multiple platforms and tailoring some key messages to subgroups is likely to be beneficial too, although social media has not generally proved effective for official communication during outbreaks.

## **7. Risk Perception**

A primary role of government and authorities during an epidemic is to inform citizens about risk. From a behavioural perspective, this is difficult territory. The evidence below demonstrates that risk perceptions are easily biased. Downplaying risk may undermine efforts to change behaviour, but overstating it could increase economic and social costs. Moreover, different people have different tolerance for risk; there is no “right” response to a given level of risk.

While not unchallengeable, the assumption we make here is that authorities (and others) should communicate the risks surrounding COVID-19 to the public as faithfully as possible. The rationale for this assumption is threefold. First, to do otherwise is antidemocratic. People must rely on the authorities to give them an accurate picture on which to base decisions. Second, trust is a vital ingredient of public-spirited behaviour. Exaggeration or downplaying risk could damage trust, which needs to be maintained over the course of an epidemic. Third, if government is seen to manipulate perceptions of risk, it gives others licence to do likewise, including businesses and the media, for whom risk perceptions may have commercial consequences, good or bad. In short, at times like this, truth is a public good.

The issue is important because there is good evidence from meta-analyses to suggest that risk perception does drive behavioural responses, both in general<sup>118</sup> and in relation to health behaviours such as vaccination.<sup>119</sup> Moreover, following a change in behaviour, people tend to adjust their perception of risk downwards.<sup>120</sup> However, individuals struggle to perceive risks accurately and distort probability when making decisions,<sup>121</sup> with substantial differences

between individuals.<sup>122</sup> Nevertheless, many effects are known and can be taken into consideration when trying to communicate risk faithfully.

People judge the likelihood of an outcome partly by how easily it springs to mind.<sup>123</sup> This “availability heuristic” biases perceptions of lethal risks, increasing the perceived likelihood of evocative outcomes and those emphasised by the media.<sup>124</sup> Perceptions of risk and protective behaviours tend to track the volume of coverage on traditional and social media.<sup>125</sup> Risks are judged to be greater when they have more emotional impact – the “affect heuristic”.<sup>126,127</sup> Fear tends to increase perception of risk, while anger can reduce it.<sup>128</sup> Availability and affect heuristics can operate together.<sup>129</sup> Overall, there is no established dynamic for how risks to the public are perceived over time; some provoke excessive response, others insufficient.<sup>130</sup>

A bias that may be particularly important for authorities during a crisis is “hindsight bias”. Information regarding the coronavirus is evolving all the time, leading to constant revisions of assessments. Compared to their assessment beforehand, people generally believe that an outcome was always more likely once they know that it happened.<sup>131,132</sup> Over months, or even weeks, this may lead to a perception that the authorities “should have known” where events were heading, when in reality uncertainty was great. Being clear about the extent of uncertainty and reminding people of that uncertainty may be important for credibility.

Knowing these biases, one might strive to communicate numeric estimates of risk. People trust numbers more and most (but not all) people prefer them.<sup>133,134</sup> However, even numbers can be framed in ways that make risks appear larger or smaller.<sup>135,136</sup> This includes positive and negative framing (e.g. 2% mortality versus 98% survival),<sup>137</sup> leading some to argue that both should be used.<sup>138</sup>

An important issue is how to communicate uncertainty. The impact of COVID-19 is, and will remain, hard to assess. Hindsight bias is likely as the situation becomes clearer. Stating a cautious range is one solution. However, a trade-off exists: ranges imply honesty, but can undermine the perceived expertise of decision-makers.<sup>139</sup> In addition, many people think of the distribution underlying a range as uniform, like drawing lottery balls, rather than understanding that numbers near the middle are more likely.<sup>140</sup>

Given the above, evidence does not provide an uncontested “best practice” for communicating public health risks,<sup>141,142</sup> but there are lessons. These include not using specific or extreme cases, avoiding emotive language (beyond expressing empathy), sticking dispassionately to numbers. Communicating uncertainty via ranges is honest, but it should be emphasised that the middle is most likely. Stating ranges as maximums (“anything up to X”) will exacerbate upward bias. While the aim here is primarily to inform authorities, these lessons apply equally to media reporting.

## **General Discussion**

The evidence described and interpreted in this paper has been rapidly assembled to address seven areas where behavioural science can make a constructive contribution to the fight against COVID-19. The evidence varies in volume and strength and, therefore, in the definitiveness with which conclusions can be drawn. For instance, findings on placement of hand sanitisers straightforwardly point to practices that, if made sufficiently widespread, will be likely to slow transmission. Implications in other areas, such as effective crisis communication, are more nuanced and reached on the balance of probabilities. It is important to note, however, that the results relating to highly specific and localised behaviours, such as increased handwashing, are not generally stronger or more reliable than those surrounding more general behaviours, such as public-spirited actions. In fact, the findings that collective action is more effective when there is communication, group identity and punishment, are some of the strongest and most replicable findings in behavioural science.

The final paragraph of each section presented conclusions in each of the seven areas, which are not repeated in this final section. Instead, this discussion pulls together some general lessons that arise when evidence is considered across the different areas. Four issues are considered: the combination of behavioural effects, the need for simplicity, the role of the media, and possibilities for deploying rapid pre-testing.

The opportunity for combining behavioural interventions can be illustrated by the experience of one of the authors when attending a Dublin hospital a few days after the first case of COVID-19 was confirmed in Ireland. Inside the main revolving door was a large, red “stop” sign, modelled on the equivalent road sign. It was unmissable and marked the hand sanitiser. At the reception desk, before saying anything else, the receptionist politely asked everyone “have you used the hand sanitiser?” Most people confidently replied “yes”, some hesitated



before unconvincingly forcing out a “yes”, a few apologised and went to use it. There were additional salient sanitisers placed in the most public spaces: by, and in, the lifts, and at entrances to each consultant clinic. This is how to use behavioural evidence to fight the virus. An intervention known to be effective was combined with a method to capture attention, enforcement of a social norm, and likely social disapproval for those who don’t co-operate because interventions were in the most public spaces in the building.

Organisations wishing to play their part in tackling COVID-19 can all do similarly. In addition, they can use language that stresses and reinforces the collective nature of action required from staff and visitors, communicate preparedness for the possibility of cases in their domain, provide tissues on workbenches and next to keyboards, and ensure continued communication with anyone unfortunate enough to face isolation. In combination, evidence implies that these behavioural interventions, and perhaps others, can substantially slow transmission.

There is one important additional behavioural principle to keep in mind. Across multiple areas of behavioural science, there are often benefits to be had from keeping things simple.<sup>143</sup> Even when strongly motivated, people cannot process and retain large volumes of information; mental bandwidth is limited. This is important for national communication, where a focus on just three or four crucial behaviours (hand washing, face touching, cough and sneeze etiquette, self-isolation) has probably been effective. The principle is inherent in the hospital intervention described above. Each intervention was simple and sequentially separated, likely to generate a result far more effective than a more complex poster or leaflet explaining the benefits of hand-washing.

Looking across the seven areas surveyed by this paper, the effectiveness of communication stands out as a crucial issue in generating desirable behaviour. Yet a large proportion of communication from public authorities, naturally, passes through the filter of the media. Several findings covered in the body of this paper apply. In particular, there is evidence that there is much more reporting on the latest levels of threat than on actions that people can and should take to reduce it, or on utterances of responsible individuals that may communicate empathy or credibility – factors that evidence suggests are important to subsequent behaviour. One can make a reasonable case that during a health crisis such as this, the role of the media should change somewhat, as it does during other periods, such as elections. There may be personal and societal benefits to giving more time than usual to advice, constructive

personal actions and direct communications between authorities and citizens. This can be done without affecting the ability of the media to fulfil its functions in faithfully reporting events and holding the powerful to account.

Finally, one growing and important aspect of the growth in applied behavioural science requires mention. A number of the studies cited here exemplify the possibilities for pre-testing behavioural interventions for effectiveness. Even when time is short and authorities are responding quickly, this may be possible.<sup>144</sup> Rapid online testing of comprehension and public responses to health materials can be undertaken to support the development of the best materials.

At the time of writing, unfortunately, it seems that this virus will afflict people around the world for the coming months and perhaps years. There will be multiple opportunities for behavioural science to contribute to the fight against it. We hope that this paper has made an initial contribution to that effort.

## References

- <sup>1</sup> Read, J. M., Bridgen, J. R., Cummings, D. A., Ho, A., & Jewell, C. P. (2020). Novel coronavirus 2019-nCoV: Early estimation of epidemiological parameters and epidemic predictions. [Preprint] medRxiv. <https://doi.org/10.1101/2020.01.23.20018549>
- <sup>2</sup> McCloskey, B., & Heymann, D. L. (2020). SARS to novel coronavirus – old lessons and new lessons. *Epidemiology and Infection*, 148, e22. <https://doi.org/10.1017/S0950268820000254>
- <sup>3</sup> Anderson, R. M., Heesterbeek, H., Klinkenberg, D., & Hollingsworth, T. D. (2020). How will country-based mitigation measures influence the course of the COVID-19 epidemic? *The Lancet*, Published online. [https://doi.org/10.1016/S0140-6736\(20\)30567-5](https://doi.org/10.1016/S0140-6736(20)30567-5)
- <sup>4</sup> Keeling, M. J., Hollingsworth, T. D., & Read, J. M. (2020). The Efficacy of Contact Tracing for the Containment of the 2019 Novel Coronavirus (COVID-19). [Preprint] medRxiv. <https://doi.org/10.1101/2020.02.14.20023036>
- <sup>5</sup> Hellewell, J., Abbott, S., Gimma, A., Bosse, N. I., Jarvis, C. I., Russell, T. W., Munday, J. D., Kucharski, A. J., Edmunds, W. J., Funk, S., Eggo, R. M., Sun, F., Flasche, S., Quilty, B. J., Davies, N., Liu, Y., Clifford, S., Klepac, P., Jit, M., ... van Zandvoort, K. (2020). Feasibility of controlling COVID-19 outbreaks by isolation of cases and contacts. *The Lancet Global Health*, S2214109X20300747. [https://doi.org/10.1016/S2214-109X\(20\)30074-7](https://doi.org/10.1016/S2214-109X(20)30074-7)
- <sup>6</sup> Hanefeld, J., Mayhew, S., Legido-Quigley, H., Martineau, F., Karanikolos, M., Blanchet, K., Liverani, M., Yei Mokuwa, E., McKay, G., & Balabanova, D. (2018). Towards an understanding of resilience: Responding to health systems shocks. *Health Policy and Planning*, 33, 355–367. <https://doi.org/10.1093/heapol/czx183>
- <sup>7</sup> Rabie, T., & Curtis, V. (2006). Handwashing and risk of respiratory infections: A quantitative systematic review. *Tropical Medicine & International Health*, 11(3), 258–267. <https://doi.org/10.1111/j.1365-3156.2006.01568.x>
- <sup>8</sup> Smith, R. D. (2006). Responding to global infectious disease outbreaks: Lessons from SARS on the role of risk perception, communication and management. *Social Science & Medicine*, 63, 3113–3123. <https://doi.org/10.1016/j.socscimed.2006.08.004>
- <sup>9</sup> Cheng, C., & Ng, A.-K. (2006). Psychosocial Factors Predicting SARS-Preventive Behaviors in Four Major SARS-Affected Regions. *Journal of Applied Social Psychology*, 36, 222–247. <https://doi.org/10.1111/j.0021-9029.2006.00059.x>
- <sup>10</sup> OECD (2017). *Behavioural insights and public policy: lessons from around the world*. OECD Publishing, Paris. <http://dx.doi.org/10.1787/9789264270480-en>
- <sup>11</sup> Haushofer, J. and Metcalf, J.C.E. (2020). *Combining behavioral economics and infectious disease epidemiology to mitigate the COVID-19 outbreak*. Working Paper, Princeton University.
- <sup>12</sup> Edwards, R., Charani, E., Sevdalis, N., Alexandrou, B., Sibley, E., Mullett, D., Loveday, H. P., Drumright, L. N., & Holmes, A. (2012). Optimisation of infection prevention and control in acute health care by use of behaviour change: A systematic review. *The Lancet Infectious Diseases*, 12, 318–329. [https://doi.org/10.1016/S1473-3099\(11\)70283-3](https://doi.org/10.1016/S1473-3099(11)70283-3)
- <sup>13</sup> Wilson, S., Jacob, C. J., & Powell, D. (2011). Behavior-change interventions to improve hand-hygiene practice: A review of alternatives to education. *Critical Public Health*, 21(1), 119–127. <https://doi.org/10.1080/09581591003786122>
- <sup>14</sup> Naikoba, S., & Hayward, A. (2001). The effectiveness of interventions aimed at increasing handwashing in healthcare workers—A systematic review. *Journal of Hospital Infection*, 47, 173–180. <https://doi.org/10.1053/jhin.2000.0882>
- <sup>15</sup> Huis, A., van Achtenberg, T., de Bruin, M., Grol, R., Schoonhoven, L., & Hulscher, M. (2012). A systematic review of hand hygiene improvement strategies: A behavioural approach. *Implementation Science*, 7, 92. <https://doi.org/10.1186/1748-5908-7-92>
- <sup>16</sup> Pittet, D., Hugonnet, S., Harbarth, S., Mourouga, P., Sauvan, V., Touveneau, S., & Perneger, T. V. (2000). Effectiveness of a hospital-wide programme to improve compliance with hand hygiene. *The Lancet*, 356(9238), 1307–1312. [https://doi.org/10.1016/S0140-6736\(00\)02814-2](https://doi.org/10.1016/S0140-6736(00)02814-2)
- <sup>17</sup> Gould, D. J., Moralejo, D., Drey, N., Chudleigh, J. H., & Taljaard, M. (2017). Interventions to improve hand hygiene compliance in patient care. *Cochrane Database of Systematic Reviews*. <https://doi.org/10.1002/14651858.CD005186.pub4>
- <sup>18</sup> Hobbs, M. A., Robinson, S., Neyens, D. M., & Steed, C. (2016). Visitor characteristics and alcohol-based hand sanitizer dispenser locations at the hospital entrance: Effect on visitor use rates. *American Journal of Infection Control*, 44(3), 258–262. <https://doi.org/10.1016/j.ajic.2015.10.041>
- <sup>19</sup> Cure, L., & Van Enk, R. (2015). Effect of hand sanitizer location on hand hygiene compliance. *American Journal of Infection Control*, 43, 917–921. <https://doi.org/10.1016/j.ajic.2015.05.013>

- <sup>20</sup> Chan, B. P., Homa, K., & Kirkland, K. B. (2013). Effect of Varying the Number and Location of Alcohol-Based Hand Rub Dispensers on Usage in a General Inpatient Medical Unit. *Infection Control & Hospital Epidemiology*, 34(9), 987–989. <https://doi.org/10.1086/671729>
- <sup>21</sup> Rashidi, B., Li, A., Patel, R., Harmsen, I. E., Sabri, E., Kyeremanteng, K., & D'Egidio, G. (2016). Effectiveness of an extended period of flashing lights and strategic signage to increase the salience of alcohol-gel dispensers for improving hand hygiene compliance. *American Journal of Infection Control*, 44, 782–785. <https://doi.org/10.1016/j.ajic.2016.01.002>
- <sup>22</sup> Zivich, P. N., Gancz, A. S., & Aiello, A. E. (2018). Effect of hand hygiene on infectious diseases in the office workplace: A systematic review. *American Journal of Infection Control*, 46(4), 448–455. <https://doi.org/10.1016/j.ajic.2017.10.006>
- <sup>23</sup> Judah, G., Aunger, R., Schmidt, W.-P., Michie, S., Granger, S., & Curtis, V. (2009). Experimental Pretesting of Hand-Washing Interventions in a Natural Setting. *American Journal of Public Health*, 99, S405–S411. <https://doi.org/10.2105/AJPH.2009.164160>
- <sup>24</sup> Ford, E. W., Boyer, B. T., Menachemi, N., & Huerta, T. R. (2014). Increasing Hand Washing Compliance With a Simple Visual Cue. *American Journal of Public Health*, 104, 1851–1856. <https://doi.org/10.2105/AJPH.2013.301477>
- <sup>25</sup> Botta, R. A., Dunker, K., Fenson-Hood, K., Maltarich, S., & McDonald, L. (2008). Using a relevant threat, EPPM and interpersonal communication to change hand-washing behaviours on campus. *Journal of Communication in Healthcare*, 1, 373–381. <https://doi.org/10.1179/cih.2008.1.4.373>
- <sup>26</sup> Porzig-Drummond, R., Stevenson, R., Case, T., & Oaten, M. (2009). Can the emotion of disgust be harnessed to promote hand hygiene? Experimental and field-based tests. *Social Science & Medicine*, 68, 1006–1012. <https://doi.org/10.1016/j.socscimed.2009.01.013>
- <sup>27</sup> Curtis, V. A., Danquah, L. O., & Aunger, R. V. (2009). Planned, motivated and habitual hygiene behaviour: An eleven country review. *Health Education Research*, 24, 655–673. <https://doi.org/10.1093/her/cyp002>
- <sup>28</sup> George, C. M., Biswas, S., Jung, D., Perin, J., Parvin, T., Monira, S., Saif-Ur-Rahman, K. M., Rashid, M., Bhuyian, S. I., Thomas, E. D., Dreibelbis, R., Begum, F., Zohura, F., Zhang, X., Sack, D. A., Alam, M., Sack, R. B., Leontsini, E., & Winch, P. J. (2017). Psychosocial Factors Mediating the Effect of the CHoBI7 Intervention on Handwashing With Soap: A Randomized Controlled Trial. *Health Education & Behavior*, 44(4), 613–625. <https://doi.org/10.1177/1090198116683141>
- <sup>29</sup> Inauen, J., Lilje, J., & Mosler, H.-J. (2020). Refining hand washing interventions by identifying active ingredients: A cluster-randomized controlled trial in rural Zimbabwe. *Social Science & Medicine*, 245, 112712. <https://doi.org/10.1016/j.socscimed.2019.112712>
- <sup>30</sup> Lapinski, M. K., Maloney, E. K., Braz, M., & Shulman, H. C. (2013). Testing the Effects of Social Norms and Behavioral Privacy on Hand Washing: A Field Experiment. *Human Communication Research*, 39, 21–46. <https://doi.org/10.1111/j.1468-2958.2012.01441.x>
- <sup>31</sup> Stella, S. A., Stace, R. J., Knepper, B. C., Reese, S. M., Keniston, A., Burden, M., & Young, H. L. (2019). The effect of eye images and a social norms message on healthcare provider hand hygiene adherence. *Infection Control & Hospital Epidemiology*, 40(7), 748–754. <https://doi.org/10.1017/ice.2019.103>
- <sup>32</sup> Nicas, M., & Best, D. (2008). A study quantifying the hand-to-face contact rate and its potential application to predicting respiratory tract infection. *Journal of Occupational and Environmental Hygiene*, 5, 347–352. <https://doi.org/10.1080/15459620802003896>
- <sup>33</sup> Kwok, Y. L. A., Gralton, J., & McLaws, M.-L. (2015). Face touching: A frequent habit that has implications for hand hygiene. *American Journal of Infection Control*, 43, 112–114. <https://doi.org/10.1016/j.ajic.2014.10.015>
- <sup>34</sup> Lipinski, D., & Nelson, R. (1974). The reactivity and unreliability of self-recording. *Journal of Consulting and Clinical Psychology*, 42, 118–123. <https://doi.org/10.1037/h0036059>
- <sup>35</sup> Michie, S., van Stralen, M. M., & West, R. (2011). The behaviour change wheel: A new method for characterising and designing behaviour change interventions. *Implementation Science*, 6, 42. <https://doi.org/10.1186/1748-5908-6-42>
- <sup>36</sup> <https://blogs.bmj.com/bmj/2020/03/03/behavioural-strategies-for-reducing-covid-19-transmission-in-the-general-population/> [accessed 11/03/2020]
- <sup>37</sup> Behavioural Insights Team. (2014). EAST: Four simple ways to apply behavioural insights. London: Behavioural Insights. <https://www.bi.team/blogs/how-to-stop-touching-our-faces-in-the-wake-of-the-coronavirus/> [Accessed 11/03/20].
- <sup>38</sup> Day, T., Park, A., Madras, N., Gumel, A., & Wu, J. (2006). When is quarantine a useful control strategy for emerging infectious diseases?. *American Journal of Epidemiology*, 163(5), 479–485. <https://doi.org/10.1093/aje/kwj056>

- 
- <sup>40</sup> Holt-Lunstad, J., Smith, T. B., Baker, M., Harris, T., & Stephenson, D. (2015). Loneliness and Social Isolation as Risk Factors for Mortality. *Perspectives on Psychological Science*, 10(2), 227–237. <https://doi.org/10.1177/1745691614568352>
- <sup>41</sup> Cacioppo, J. T., Hughes, M. E., Waite, L. J., Hawkley, L. C., & Thisted, R. A. (2006). Loneliness as a specific risk factor for depressive symptoms: cross-sectional and longitudinal analyses. *Psychology and Aging*, 21(1), 140. <https://doi.org/10.1037/0882-7974.21.1.140>
- <sup>42</sup> Cacioppo, S., Capitanio, J. P., & Cacioppo, J. T. (2014). Toward a neurology of loneliness. *Psychological bulletin*, 140(6), 1464. <https://doi.org/10.1037/0882-7974.21.1.140>
- <sup>43</sup> Brooks, S. K., Webster, R. K., Smith, L. E., Woodland, L., Wessely, S., Greenberg, N., & Rubin, G. J. (2020). The psychological impact of quarantine and how to reduce it: rapid review of the evidence. *The Lancet*. [https://doi.org/10.1016/S0140-6736\(20\)30460-8](https://doi.org/10.1016/S0140-6736(20)30460-8)
- <sup>44</sup> Cava, M. A., Fay, K. E., Beanlands, H. J., McCay, E. A., & Wignall, R. (2005). Risk perception and compliance with quarantine during the SARS outbreak. *Journal of Nursing Scholarship*, 37(4), 343-347. <https://doi.org/10.1111/j.1547-5069.2005.00059.x>
- <sup>45</sup> Liu, X., Kakade, M., Fuller, C. J., Fan, B., Fang, Y., Kong, J., ... & Wu, P. (2012). Depression after exposure to stressful events: lessons learned from the severe acute respiratory syndrome epidemic. *Comprehensive psychiatry*, 53(1), 15-23. <https://doi.org/10.1016/j.comppsy.2011.02.003>
- <sup>46</sup> Wu, P., Liu, X., Fang, Y., Fan, B., Fuller, C. J., Guan, Z., ... & Litvak, I. J. (2008). Alcohol abuse/dependence symptoms among hospital employees exposed to a SARS outbreak. *Alcohol & Alcoholism*, 43(6), 706-712. <https://doi.org/10.1093/alcalc/agn073>
- <sup>47</sup> Maunder, R., Hunter, J., Vincent, L., Bennett, J., Peladeau, N., Leszcz, M., ... & Mazzulli, T. (2003). The immediate psychological and occupational impact of the 2003 SARS outbreak in a teaching hospital. *Cmaj*, 168(10), 1245-1251. <https://www.ncbi.nlm.nih.gov/pubmed/12743065>
- <sup>48</sup> Lee, S., Chan, L. Y., Chau, A. M., Kwok, K. P., & Kleinman, A. (2005). The experience of SARS-related stigma at Amoy Gardens. *Social science & medicine*, 61(9), 2038-2046. <https://doi.org/10.1016/j.socscimed.2005.04.010>
- <sup>49</sup> Marjanovic, Z., Greenglass, E. R., & Coffey, S. (2007). The relevance of psychosocial variables and working conditions in predicting nurses' coping strategies during the SARS crisis: an online questionnaire survey. *International journal of nursing studies*, 44(6), 991-998. <https://doi.org/10.1016/j.ijnurstu.2006.02.012>
- <sup>50</sup> Hawryluck, L., Gold, W. L., Robinson, S., Pogorski, S., Galea, S., & Styra, R. (2004). SARS control and psychological effects of quarantine, Toronto, Canada. *Emerging Infectious Diseases*, 10(7), 1206. <https://doi.org/10.3201/eid1007.030703>
- <sup>51</sup> Rona, R. J., Fear, N. T., Hull, L., Greenberg, N., Earnshaw, M., Hotopf, M., & Wessely, S. (2007). Mental health consequences of overstretch in the UK armed forces: first phase of a cohort study. *Bmj*, 335(7620), 603. <https://doi.org/10.1136/bmj.39274.585752.BE>
- <sup>52</sup> Fiese, B. H., Tomcho, T. J., Douglas, M., Josephs, K., Poltrock, S., & Baker, T. (2002). A review of 50 years of research on naturally occurring family routines and rituals: Cause for celebration?. *Journal of family psychology*, 16(4), 381. <https://doi.org/10.1037//0893-3200.16.4.381>
- <sup>53</sup> Irish, L. A., Kline, C. E., Gunn, H. E., Buysse, D. J., & Hall, M. H. (2015). The role of sleep hygiene in promoting public health: A review of empirical evidence. *Sleep medicine reviews*, 22, 23-36. <https://doi.org/10.1016/j.smr.2014.10.001>
- <sup>54</sup> Chekroud, S. R., Gueorguieva, R., Zheutlin, A. B., Paulus, M., Krumholz, H. M., Krystal, J. H., & Chekroud, A. M. (2018). Association between physical exercise and mental health in 1·2 million individuals in the USA between 2011 and 2015: a cross-sectional study. *The Lancet Psychiatry*, 5(9), 739-746. [https://doi.org/10.1016/S2215-0366\(18\)30227-X](https://doi.org/10.1016/S2215-0366(18)30227-X)
- <sup>55</sup> Wang, C. G., Zhang, Y., Zhao, J., Zhang, J., & Jiang, F. (2020). Mitigate the effects of home confinement on children during the COVID-19 outbreak. *The Lancet*. [https://doi.org/10.1016/S0140-6736\(20\)30547-X](https://doi.org/10.1016/S0140-6736(20)30547-X)
- <sup>56</sup> Gollwitzer, P. M. (1999). Implementation intentions: strong effects of simple plans. *American psychologist*, 54(7), 493. <https://doi.org/10.1037/0003-066X.54.7.493>
- <sup>57</sup> Lee, A. Y. (2001). The mere exposure effect: An uncertainty reduction explanation revisited. *Personality and Social Psychology Bulletin*, 27(10), 1255-1266. <https://doi.org/10.1177/01461672012710002>
- <sup>58</sup> Popova, L. (2012). The extended parallel process model: Illuminating the gaps in research. *Health Education & Behavior*, 39(4), 455-473. <https://doi.org/10.1177/1090198111418108>
- <sup>59</sup> Sweeny, K., Melnyk, D., Miller, W., & Shepperd, J. A. (2010). Information avoidance: Who, what, when, and why. *Review of general psychology*, 14(4), 340. <https://doi.org/10.1037/a0021288>
- <sup>60</sup> Aiken, L., West, S., Woodward, C., & Reno, R. (1994). Health beliefs and compliance with mammography-screening recommendations in asymptomatic women. *Health Psychology*, 13, 122–129. <https://doi.org/10.1037/0278-6133.13.2.122>

- <sup>61</sup> Kappes, A., Nussberger, A. M., Faber, N. S., Kahane, G., Savulescu, J., & Crockett, M. J. (2018). Uncertainty about the impact of social decisions increases prosocial behaviour. *Nature human behaviour*, 2(8), 573-580. <https://doi.org/10.1038/s41562-018-0372-x>
- <sup>62</sup> Sohrabi, C., Alsafi, Z., O'Neill, N., Khan, M., Kerwan, A., Al-Jabir, A., ... & Agha, R. (2020). World Health Organization declares Global Emergency: A review of the 2019 Novel Coronavirus (COVID-19). *International Journal of Surgery*, published online. <https://doi.org/10.1016/j.ijssu.2020.02.034>
- <sup>63</sup> <https://blogs.bmj.com/bmj/2020/03/04/abraar-karan-control-covid19-outbreak-young-healthy-patients-should-avoid-emergency-room/> [Accessed 11/03/20]
- <sup>64</sup> Ostrom, E., Walker, J., & Gardner, R. (1992). Covenants with and without a sword: Self-governance is possible. *American Political Science Review*, 86(2), 404-417. <https://doi.org/10.2307/1964229>
- <sup>65</sup> Ledyard, O. (1995). Public goods: some experimental results. In J. Kagel & A. Roth (Eds.), *Handbook of experimental economics*. Princeton: Princeton University Press (Chap. 2).
- <sup>66</sup> Chaudhuri, A. (2011). Sustaining cooperation in laboratory public goods experiments: a selective survey of the literature. *Experimental Economics*, 14, 47-83. <https://doi.org/10.1007/s10683-010-9257-1>
- <sup>67</sup> Thöni, C., & Volk, S. (2018). Conditional cooperation: Review and refinement. *Economics Letters*, 171, 37-40. <https://doi.org/10.1016/j.econlet.2018.06.022>
- <sup>68</sup> Moussaïd, M., & Trauernicht, M. (2016). Patterns of cooperation during collective emergencies in the help-or-escape social dilemma. *Scientific Reports*, 6, 33417. <https://doi.org/10.1038/srep33417>
- <sup>69</sup> Drury, J., Carter, H., Cocking, C., Ntontis, E., Tekin Guven, S., & Amlôt, R. (2019). Facilitating collective resilience in the public in emergencies: Twelve recommendations based on the social identity approach. *Frontiers in Public Health*, 7, 141. <https://doi.org/10.3389/fpubh.2019.00141>
- <sup>70</sup> Fehr, E., & Schurtenberger, I. (2018). Normative foundations of human cooperation. *Nature Human Behaviour*, 2, 458-468. <https://doi.org/10.1038/s41562-018-0385-5>
- <sup>71</sup> Zelmer, J. (2003). Linear public goods experiments: A meta-analysis. *Experimental Economics*, 6, 299-310.. <https://doi.org/10.1023/A:1026277420119>
- <sup>72</sup> Bornstein, G. (1992). Group decision and individual choice in intergroup competition for public goods. In W. Leibrand, D. Messick, & H. Wilke (Eds.), *Social dilemmas: Theoretical issues and research findings* (pp. 247-263). Oxford, UK: Pergamon Press.
- <sup>73</sup> Pavitt, C. (2018). The Path to Cooperative Action during Group Social Dilemmas: A Literature Review, Set of Propositions, and Model Describing How the Opportunity to Communicate Encourages Cooperation. *Review of Communication Research*, 6, 54-83. <https://doi.org/10.12840/issn.2255-4165.2018.06.01.016>
- <sup>74</sup> Carter, H., Drury, J., Rubin, G., Williams, R. and Amlôt, R. (2013). The effect of communication during mass decontamination. *Disaster Prevention and Management*, 22, 132-147. <https://doi.org/10.1108/09653561311325280>
- <sup>75</sup> Fehr, E., & Gächter, S. (2000). Cooperation and punishment in public goods experiments. *American Economic Review*, 90, 980-994. <https://doi.org/10.1257/aer.90.4.980>
- <sup>76</sup> Masclet, D., Noussair, C., Tucker, S., & Villeval, M. C. (2003). Monetary and nonmonetary punishment in the voluntary contributions mechanism. *American Economic Review*, 93, 366-380. <https://doi.org/10.1257/000282803321455359>
- <sup>77</sup> Fehr, E. & Rockenbach, B. (2003). Detrimental effects of sanctions on human altruism. *Nature*, 422, 137-140.
- <sup>78</sup> Herrmann, B., Thöni, C. & Gächter, S. (2008). Antisocial punishment across societies. *Science*, 319, 1362-1367. <https://doi.org/10.1038/nature01474>
- <sup>79</sup> Mawson, A. R. (2005). Understanding mass panic and other collective responses to threat and disaster. *Psychiatry: Interpersonal and Biological Processes*, 68, 95-113. <https://doi.org/10.1521/psyc.2005.68.2.95>
- <sup>80</sup> Glass, T. A., & Schoch-Spana, M. (2002). Bioterrorism and the people: how to vaccinate a city against panic. *Clinical Infectious Diseases*, 34, 217-223. <https://doi.org/10.1086/338711>
- <sup>81</sup> Rubin, G., Potts, H., & Michie, S. (2010). The impact of communications about swine flu (influenza A H1N1v) on public responses to the outbreak: results from 36 national telephone surveys in the UK. *Health Technology Assessment*, 14, 183-266. <https://doi.org/10.3310/hta14340-03>
- <sup>82</sup> Sherlaw, W., & Raude, J. (2013). Why the French did not choose to panic: a dynamic analysis of the public response to the influenza pandemic. *Sociology of Health & Illness*, 35, 332-344. <https://doi.org/10.1111/j.1467-9566.2012.01525.x>
- <sup>83</sup> Evans, J., Fast, S., & Markuzon, N. (2013, April). Modeling the social response to a disease outbreak. In *International Conference on Social Computing, Behavioral-Cultural Modeling, and Prediction* (pp. 154-163). Springer, Berlin, Heidelberg. [https://doi.org/10.1007/978-3-642-37210-0\\_17](https://doi.org/10.1007/978-3-642-37210-0_17)
- <sup>84</sup> Van Damme, W., & Van Lerberghe, W. (2000). Editorial: Epidemics and fear. *Tropical Medicine and International Health*, 5, 511-514.
- <sup>85</sup> Bonneux, L., & Van Damme, W. (2006). An iatrogenic pandemic of panic. *British Medical Journal*, 332(7544), 786-788. <https://doi.org/10.1136/bmj.332.7544.786>

- <sup>86</sup> Wahl-Jorgensen, K. (2020). Coronavirus: how media coverage of epidemics often stokes fear and panic. Available at: <https://theconversation.com/coronavirus-how-media-coverage-of-epidemics-often-stokes-fear-and-panic-131844> [Accessed: 09/03/2020].
- <sup>87</sup> Klemm, C., Das, E., & Hartmann, T. (2016). Swine flu and hype: a systematic review of media dramatization of the H1N1 influenza pandemic. *Journal of Risk Research*, 19, 1-20. <https://doi.org/10.1080/13669877.2014.923029>
- <sup>88</sup> Savage, D. A., & Torgler, B. (2020). Stocking up to prepare for a crisis isn't 'panic buying'. It's actually a pretty rational choice. Available at: <https://theconversation.com/stocking-up-to-prepare-for-a-crisis-isnt-panic-buying-its-actually-a-pretty-rational-choice-132437> [Accessed 09/03/2020].
- <sup>89</sup> Moosa, I. A., & Ramiah, V. (2017). Other Biases in the Behavioural Finance Literature. In *The Financial Consequences of Behavioural Biases* (pp. 93–124), Palgrave Macmillan. [https://doi.org/10.1007/978-3-319-69389-7\\_5](https://doi.org/10.1007/978-3-319-69389-7_5)
- <sup>90</sup> Parmet, W. E., & Sinha, M. S. (2017). A panic foretold: Ebola in the United States. *Critical Public Health*, 27(1), 148-155. <https://doi.org/10.1080/09581596.2016.1159285>
- <sup>91</sup> Person, B., Sy, F., Holton, K., Govert, B., & Liang, A. (2004). Fear and stigma: The epidemic within the SARS outbreak. *Emerging Infectious Diseases*, 10, 358–363. <https://doi.org/10.3201/eid1002.030750>
- <sup>92</sup> Faulkner, J., Schaller, M., Park, J. H., & Duncan, L. A. (2004). Evolved disease-avoidance mechanisms and contemporary xenophobic attitudes. *Group Processes & Intergroup Relations*, 7, 333-353. <https://doi.org/10.1177/1368430204046142>
- <sup>93</sup> Navarrete, C. D., & Fessler, D. M. (2006). Disease avoidance and ethnocentrism: The effects of disease vulnerability and disgust sensitivity on intergroup attitudes. *Evolution and Human Behavior*, 27, 270-282. <https://doi.org/10.1016/j.evolhumbehav.2005.12.001>
- <sup>94</sup> Böhm, R., Rusch, H., & Baron, J. (2018). The psychology of intergroup conflict: a review of theories and measures. *Journal of Economic Behavior & Organization*. <https://doi.org/10.1016/j.jebo.2018.01.020>
- <sup>95</sup> Jin, Y., Austin, L., Vijaykumar, S., Jun, H., & Nowak, G. (2019). Communicating about infectious disease threats: Insights from public health information officers. *Public Relations Review*, 45, 167-177. <https://doi.org/10.1016/j.pubrev.2018.12.003>
- <sup>96</sup> Tannenbaum, M. B., Hepler, J., Zimmerman, R. S., Saul, L., Jacobs, S., Wilson, K., & Albarracín, D. (2015). Appealing to fear: A meta-analysis of fear appeal effectiveness and theories. *Psychological Bulletin*, 141(6), 1178. <https://doi.org/10.1037/a0039729>
- <sup>97</sup> Kok, G., Peters, G.-J. 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 Psychology Review*, 12(2), 111–125. <https://doi.org/10.1080/17437199.2017.1415767>
- <sup>98</sup> Peters, G. J. Y., Ruiter, R. A., Ten Hoor, G. A., Kessels, L. T., & Kok, G. (2018). Towards consensus on fear appeals: a rejoinder to the commentaries on Kok, Peters, Kessels, ten Hoor, and Ruiter (2018). *Health Psychology Review*, 12(2), 151-156. <https://doi.org/10.1080/17437199.2018.1454846>
- <sup>99</sup> Shen, L. (2015). Targeting smokers with empathy appeal antismoking public service announcements: A field experiment. *Journal of Health Communication*, 20, 573-580. <https://doi.org/10.1080/10810730.2015.1012236>
- <sup>100</sup> Bakker, M. H., van Bommel, M., Kerstholt, J. H., & Giebels, E. (2018). The influence of accountability for the crisis and type of crisis communication on people's behavior, feelings and relationship with the government. *Public Relations Review*, 44, 277-286. <https://doi.org/10.1016/j.pubrev.2018.02.004>
- <sup>101</sup> Shen, L. (2010). Mitigating psychological reactance: The role of message-induced empathy in persuasion. *Human Communication Research*, 36, 397-422. <https://doi.org/10.1111/j.1468-2958.2010.01381.x>
- <sup>102</sup> Vaughan, E., & Tinker, T. (2009). Influenza preparedness and response for vulnerable populations. *American Journal of Public Health*, 99, 324-332. <https://doi.org/10.2105/AJPH.2009.162537>
- <sup>103</sup> Heath, R. L., Lee, J., & Ni, L. (2009). *Crisis and Risk Approaches to Emergency Management Planning and Communication: The Role of Similarity and Sensitivity*. *Journal of Public Relations Research*, 21(2), 123–141. <https://doi.org/10.1080/10627260802557415>
- <sup>104</sup> Kreuter, M. W., & McClure, S. M. (2004). The Role of Culture in Health Communication. *Annual Review of Public Health*, 25(1), 439–455. <https://doi.org/10.1146/annurev.publhealth.25.101802.123000>
- <sup>105</sup> Kalichman, S. C., & Coley, B. (1995). Context framing to enhance HIV-antibody-testing messages targeted to African American women. *Health Psychology*, 14(3), 247–254. <https://doi.org/10.1037/0278-6133.14.3.247>
- <sup>106</sup> Paul, C., Tzelepis, F., Girgis, A., & Parfitt, N. (2003). The Slip Slop Slap years: Have they had a lasting impact on today's adolescents?. *Health Promotion Journal of Australia*, 14(3), 219-221. <https://doi.org/10.1071/HE03219>
- <sup>107</sup> Montague, M., Borland, R., & Sinclair, C. (2001). Slip! Slop! Slap! and SunSmart, 1980-2000: Skin cancer control and 20 years of population-based campaigning. *Health Education & Behavior*, 28, 290-305. <https://doi.org/10.1177/109019810102800304>

- <sup>108</sup> Toppenberg-Pejcic, D., Noyes, J., Allen, T., Alexander, N., Vanderford, M., & Gamhewage, G. (2018). Emergency Risk Communication: Lessons Learned from a Rapid Review of Recent Gray Literature on Ebola, Zika, and Yellow Fever. *Health Communication*, 1–19. <https://doi.org/10.1080/10410236.2017.1405488>
- <sup>109</sup> Kass-Hout, T. A., & Alhinnawi, H. (2013). Social media in public health. *British Medical Bulletin*, 108(1), 5–24. <https://doi.org/10.1093/bmb/ldt028>
- <sup>110</sup> Van Der Linden, S. (2017). The nature of viral altruism and how to make it stick. *Nature Human Behaviour*, 1(3), 1–4. <https://doi.org/10.1038/s41562-016-0041>
- <sup>111</sup> Van Der Linden, S. (2015). Intrinsic motivation and pro-environmental behaviour. *Nature Climate Change*, 5(7), 612–613. <https://doi.org/10.1038/nclimate2669>
- <sup>112</sup> Oh, S. H., Lee, S. Y., & Han, C. (2020). The Effects of Social Media Use on Preventive Behaviors during Infectious Disease Outbreaks: The Mediating Role of Self-relevant Emotions and Public Risk Perception. *Health Communication*, published online. <https://doi.org/10.1080/10410236.2020.1724639>
- <sup>113</sup> Abramson, D., & Piltch-Loeb, R. (2016). U.S. Public’s perception of Zika risk: Awareness, knowledge, and receptivity to public health interventions. *New York University Briefing Report*. Available at: [https://www.nyu.edu/content/dam/nyu/publicAffairs/documents/PDF/research/PiR2\\_Zika\\_Report\\_rf.pdf](https://www.nyu.edu/content/dam/nyu/publicAffairs/documents/PDF/research/PiR2_Zika_Report_rf.pdf) [Last accessed: 11/03/2020]
- <sup>114</sup> University of Chicago National Research Center, & The March of Dimes. (2016). The Zika virus: Gaps in Americans’ knowledge and support for government action. *NORC Issue Brief*. Available at: [https://www.norc.org/pdfs/marchofdimes/report\\_march\\_of\\_dimes\\_norc\\_zika\\_poll\\_090616.pdf](https://www.norc.org/pdfs/marchofdimes/report_march_of_dimes_norc_zika_poll_090616.pdf) [Last accessed: 11/03/2020]
- <sup>115</sup> Kilgo, D. K., Yoo, J., & Johnson, T. J. (2018). Spreading Ebola Panic: Newspaper and Social Media Coverage of the 2014 Ebola Health Crisis. *Health Communication*, 1–7. <https://doi.org/10.1080/10410236.2018.1437524>
- <sup>116</sup> Reynolds, B. J. (2011). When the facts are just not enough: credibly communicating about risk is riskier when emotions run high and time is short. *Toxicology and Applied Pharmacology*, 254(2), 206–214. <https://doi.org/10.1016/j.taap.2010.10.023>
- <sup>117</sup> Parmer, J., Baur, C., Eroglu, D., Lubell, K., Prue, C., Reynolds, B., & Weaver, J. (2016). Crisis and emergency risk messaging in mass media news stories: is the public getting the information they need to protect their health? *Health Communication*, 31, 1215–1222. <https://doi.org/10.1080/10410236.2015.1049728>
- <sup>118</sup> Sheeran, P., Harris, P. R., & Epton, T. (2014). Does heightening risk appraisals change people’s intentions and behavior? A meta-analysis of experimental studies. *Psychological Bulletin*, 140, 511–543. <https://doi.org/10.1037/a0033065>
- <sup>119</sup> Brewer, N. T., Chapman, G. B., Gibbons, F. X., Gerrard, M., McCaul, K. D., & Weinstein, N. D. (2007). Meta-analysis of the relationship between risk perception and health behaviour: The example of vaccination. *Health Psychology*, 26, 136–145. <https://doi.org/10.1037/0278-6133.26.2.136>
- <sup>120</sup> Brewer, N. T., Weinstein, N. D., Cuite, C. L., & Herrington, J. E. (2004). Risk perceptions and their relation to risk behavior. *Annals of Behavioral Medicine*, 27, 125–130. [https://doi.org/10.1207/s15324796abm2702\\_7](https://doi.org/10.1207/s15324796abm2702_7)
- <sup>121</sup> Kahneman, D. and Tversky, A. (2000). Choices, values and frames. Cambridge: CUP.
- <sup>122</sup> Fehr-Duda, H. and Epper, T. (2012). Probability and risk: foundations and economic implications of probability-dependent risk preferences. *Annual Review of Economics*, 4, 567–93. <https://doi.org/10.1146/annurev-economics-080511-110950>
- <sup>123</sup> Kahneman, D. and Tversky, A. (1973). Availability: A heuristic for judging frequency and probability. *Cognitive Psychology*, 5, 207–232. [https://doi.org/10.1016/0010-0285\(73\)90033-9](https://doi.org/10.1016/0010-0285(73)90033-9)
- <sup>124</sup> Lichtenstein, S., Slovic, P., Fischhoff, B., Layman, M., & Combs, B. (1978). Judged frequency of lethal events. *Journal of Experimental Psychology: Human Learning and Memory*, 4, 551. <https://doi.org/10.1037/0278-7393.4.6.551>
- <sup>125</sup> Chan, M. P. S., Winneg, K., Hawkins, L., Farhadloo, M., Jamieson, K. H., & Albarracín, D. (2018). Legacy and social media respectively influence risk perceptions and protective behaviors during emerging health threats: A multi-wave analysis of communications on Zika virus cases. *Social Science & Medicine*, 212, 50–59. <https://doi.org/10.1016/j.socscimed.2018.07.007>
- <sup>126</sup> Zajonc, R. B. (1980). Feeling and thinking: Preferences need no inferences. *American Psychologist*, 35, 151–175. <https://doi.org/10.1037/0003-066X.35.2.151>
- <sup>127</sup> Finucane, M. L., Alhakami, A., Slovic, P., & Johnson, S. M. (2000). The affect heuristic in judgments of risks and benefits. *Journal of Behavioral Decision Making*, 13, 1–17. [https://doi.org/10.1002/\(SICI\)1099-0771\(200001/03\)13:1<1::AID-BDM333>3.0.CO;2-S](https://doi.org/10.1002/(SICI)1099-0771(200001/03)13:1<1::AID-BDM333>3.0.CO;2-S)
- <sup>128</sup> Lerner, J. S., Gonzalez, R. M., Small, D. A., & Fischhoff, B. (2003). Effects of fear and anger on perceived risks of terrorism: A national field experiment. *Psychological Science*, 14, 144–150. <https://doi.org/10.1111/1467-9280.01433>
- <sup>129</sup> Pachur, T., Hertwig, R., & Steinmann, F. (2012). How do people judge risks: availability heuristic, affect heuristic, or both? *Journal of Experimental Psychology: Applied*, 18, 314. <https://doi.org/10.1037/a0028279>



- 
- <sup>130</sup> Loewenstein, G., & Mather, J. (1990). Dynamic processes in risk perception. *Journal of Risk and Uncertainty*, 3, 155-175. <https://doi.org/10.1007/BF00056370>
- <sup>131</sup> Fischhoff, B. (1975). Hindsight ≠ foresight: The effects of outcome knowledge on judgment under uncertainty. *Journal of Experimental Psychology; Human Perception and Performance*, 1, 188-299. <http://dx.doi.org/10.1136/qhc.12.4.304>
- <sup>132</sup> Agans, R. P., & Shaffer, L. S. (1994). The hindsight bias: The role of the availability heuristic and perceived risk. *Basic and Applied Social Psychology*, 15, 439-449. [https://doi.org/10.1207/s15324834basp1504\\_3](https://doi.org/10.1207/s15324834basp1504_3)
- <sup>133</sup> Visschers, V. H., Meertens, R. M., Passchier, W. W., & De Vries, N. N. (2009). Probability information in risk communication: a review of the research literature. *Risk Analysis*, 29, 267-287. <https://doi.org/10.1111/j.1539-6924.2008.01137.x>
- <sup>134</sup> Trevena, L. J., BPsych, H. M. D., Barratt, A., Butow, P., & Caldwell, P. (2006). A systematic review on communicating with patients about evidence. *Journal of Evaluation in Clinical Practice*, 12, 13-23. <https://doi.org/10.1111/j.1365-2753.2005.00596.x>
- <sup>135</sup> Akl, E. A., Oxman, A. D., Herrin, J., Vist, G. E., Terrenato, I., Sperati, F., ... and Schünemann, H. (2011). Using alternative statistical formats for presenting risks and risk reductions. *Cochrane Database of Systematic Reviews*, 3. <https://doi.org/10.1002/14651858.CD006776.pub2>
- <sup>136</sup> Yamagishi, K. (1997). When a 12.86% mortality is more dangerous than 24.14%: Implications for risk communication. *Applied Cognitive Psychology*, 11, 495-506. [https://doi.org/10.1002/\(SICI\)1099-0720\(199712\)11:6<495::AID-ACP481>3.0.CO;2-J](https://doi.org/10.1002/(SICI)1099-0720(199712)11:6<495::AID-ACP481>3.0.CO;2-J)
- <sup>137</sup> Peters, E., Hart, P. S., & Fraenkel, L. (2011). Informing patients: the influence of numeracy, framing, and format of side effect information on risk perceptions. *Medical Decision Making*, 31, 432-436. <https://doi.org/10.1177/0272989X10391672>
- <sup>138</sup> Gigerenzer, G. (2014). Should patients listen to how doctors frame messages?. *BMJ*, 349, g7091. <https://doi.org/10.1136/bmj.g7091>
- <sup>139</sup> Johnson, B. B., & Slovic, P. (1995). Presenting uncertainty in health risk assessment: initial studies of its effects on risk perception and trust. *Risk Analysis*, 15, 485-494. <https://doi.org/10.1111/j.1539-6924.1995.tb00341.x>
- <sup>140</sup> Dieckmann, N. F., Peters, E., & Gregory, R. (2015). At home on the range? Lay interpretations of numerical uncertainty ranges. *Risk Analysis*, 35, 1281-1295. <https://doi.org/10.1111/risa.12358>
- <sup>141</sup> Spiegelhalter, D. (2017). Risk and Uncertainty Communication. *Annual Review of Statistics and Its Applications*, 4, 31-60. <https://doi.org/10.1146/annurev-statistics-010814-020148>
- <sup>142</sup> Zipkin, D. A., Umscheid, C. A., Keating, N. L., Allen, E., Aung, K., Beyth, R., ... & Schardt, C. (2014). Evidence-based risk communication: a systematic review. *Annals of Internal Medicine*, 161, 270-280. <https://doi.org/10.7326/M14-0295>
- <sup>143</sup> Sunstein, C. R. (2013). *Simpler: The future of government*. Simon and Schuster.
- <sup>144</sup> Hallsworth, M. (2020, Mar 4). Handwashing Can Stop a Virus—So Why Don't We Do It?. Retrieved from: <https://behavioralscientist.org/handwashing-can-stop-a-virus-so-why-dont-we-do-it-coronavirus-covid-19/>