Short communication

Dual-process theories to counter the anti-vaccination movement

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ABSTRACT

Vaccine hesitancy is a problem attracting growing attention and concern. In this paper, we discuss why anti-vaccination messages are influential and which pro-vaccine messages can be effective to address vaccine hesitancy from the perspective of dual-process theories of cognitive functioning. The functioning of the human brain can be characterized by two different types of cognitive functioning: intuitive System 1, which is evolutionarily old, fast, and automatic; and analytical System 2, which is evolutionarily recent, slow, and deliberative. Anti-vaccination messages that inspire fear activate System 1, and vaccine recommendation messages that use statistics activate System 2. System 1 has a greater influence on judgment than System 2. The processing of System 1 is called "trajectory." Even if adequate knowledge about the effectiveness and safety of vaccination is input to System 2, vaccine hesitancy cannot be easily erased once it is generated by System 1. We suggest that vaccine recommendation messages should target System 1 in addition to System 2, to counter anti-vaccination messages and address vaccine hesitancy.

1. Introduction

Vaccinations are a significant public health achievement. However, physicians and researchers believe that anti-vaccination movements, both online and offline, contribute to low vaccination rates, which are less than optimal. Timely vaccination is challenged by the negative influence of vaccine controversies reported in the media, and particularly the wide diffusion of anti-vaccination messages on the internet and social media. Vaccine hesitancy, defined as a "delay in acceptance or refusal of vaccines despite the availability of vaccination services", has been identified by the World Health Organization as one of the top 10 global health threats of 2019 (World Health Organization, 2019). Although the influence of anti-vaccination messages has been studied quantitatively (Betsch et al., 2010) and qualitatively (Grant et al., 2015), discussion of this in terms of dual-process theories is scarce in the published literature. Dual-process theories of cognitive functioning are the leading theories in cognitive science. Theorists within a diverse set of specialty areas including cognitive psychology, social psychology, neuropsychology, and decision theory, have proposed dual-process theories (Evans and Stanovich, 2013). Discussing the influence of anti-vaccination messages in terms of dual-process theories has implications for future research and practice, to address vaccine hesitancy. In this paper, we discuss why anti-vaccination messages are influential and which pro-vaccine messages can be effective to address vaccine hesitancy from the perspective of dual-process theories of cognitive functioning.

2. Dual-process theories

According to dual-process theories, the functioning of the human brain can be characterized by two different types of cognitive functioning that have different functions as well as different strengths and weaknesses (Evans and Stanovich, 2013). System 1 consists of modules that are characterized as evolutionarily old and are shared with other animals, automatic, fast, heuristic-based, and undemanding of computational capacity. System 2 consists of modules that are characterized as evolutionarily recent and distinctively human, analytic, slow, rule-based, often language-based, and computationally expensive. Human cognitive functioning has been designed to maximize survival and reproductive success (i.e., fitness in evolutionary biology) (Cosmides and Tooby, 1994; Kenrick et al., 2010). System 1 responds automatically and rapidly to stimuli so as to maximize survival and reproductive success, and individual differences in these responses are small. System 2 represents the characteristics that psychologists have viewed as controlled processing. System 2 can examine and override inappropriately overgeneralized and biased responses generated by System 1. However, System 2 is associated with individual differences, constrained by working memory capacity and correlated with measures

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of general intelligence (Evans and Stanovich, 2013).

3. System 1's influence on judgment

System 1 has a greater influence on judgment than System 2 (Stanovich, 2005a; Kenrick and Griskevicius, 2013). Stanovich (2005b) gives several examples referring to previous research. One example is that of a previous study on support for rape victims. Although the husband of a rape victim is aware that he should support his wife psychologically, he may react inappropriately, perhaps by blaming his wife (Rodkin et al., 1982). Another example is a study investigating disgust. A participant eats a piece of fudge and expresses a desire to eat another. However, the second piece of fudge served to the participant is in the shape of dog feces. Although the individual understands that it is fudge, they no longer want to eat it (Rozin et al., 1986). As these examples show, intuitive System 1 operates preferentially and makes a wrong judgment, even though analytical System 2 could override it.

Social psychology studies using implicit association tests–which are considered to measure unconscious attitudes–also show the difficulty in System 2 correcting the prejudice generated from System 1. In one study, even those who answered that they were egalitarian about race in a self-reported questionnaire showed implicit prejudice in linking evil with blacks more often than with whites (Lai et al., 2014). Although many methods for reducing implicit prejudice have been identified, interventions are mostly ineffective (Lai et al., 2014). Thus, System 1s influence on judgment is greater than that of System 2.

4. Anti-vaccination messages target System 1

A content analysis of anti-vaccination messages online showed that anti-vaccination messages mainly convey the danger of vaccine toxicity and side effects using photos and stories (Kata, 2010). Additionally, another content analysis showed that messages against human papillomavirus vaccination assert that the vaccine raises the risk of infertility owing to vaccine additives (Okuhara et al., 2018a). It is assumed that those anti-vaccination messages directly stimulate and threaten recipients' drive for survival and reproduction. Further, anti-vaccination conspiracy theories are plausible stories and appeal to emotions, which are characteristics that encourage processing by System 1 (Stanovich, 2005b). In addition, System 1 has the tendency to see a deliberate design and pattern (Stanovich, 2005a), which is a characteristic of anti-vaccination conspiracy theories. Therefore, anti-vaccination conspiracy theories are considered to stimulate System 1. Thus, anti-vaccination messages are considered to have sufficient influence to forcibly activate the modules of System 1. However, a content analysis showed that messages recommending vaccination, including discourses by authorities, mainly explain the effectiveness and safety of vaccines using statistical data (Okuhara et al., 2018a, 2018b). Statistical information, such as probability, is a recently emerged expression in the evolutionary history of humans (Cosmides and Tooby, 1996) and therefore is considered to be analytically processed in System 2. However, as mentioned earlier, the processing of System 2 depends on individual capacities such as working memory and general intelligence (Evans and Stanovich, 2013). Therefore, it is assumed that not everyone processes pro-vaccination messages that use statistics to explain the efficacy, safety, and importance of vaccination.

The processing of System 1 is called "trajectory" and keeps activating after being triggered (Stanovich, 2005b). For example, a person can swallow their own saliva in their mouth; however, they will hesitate to swallow their own saliva from a cup (Dennett, 1993). Even if System 2 tries to control the repellent response of System 1 with thoughts like "It's okay. It's my saliva", the hesitancy persists. Similar to this example, even if adequate knowledge about the effectiveness and safety of vaccination is input to System 2, it is assumed that vaccine hesitancy cannot be easily erased once it is generated by System 1.

5. How to counter anti-vaccination messages

Considering vaccine hesitancy, vaccine recommendation messages should provide statistical data about the safety and effectiveness of vaccination. However, as proposed earlier, it is not sufficient to input adequate knowledge to System 2 to change vaccine hesitancy. Vaccine recommendation messages should target System 1, in addition to System 2. As one method, pro-vaccine messages can use narratives such as stories of patients with infectious diseases, as System 1 tends to respond to such narratives (Stanovich, 2003). In fact, recent studies show that narrative messages about experiences of infectious disease increase the audience's risk perception of developing the disease and their vaccination intention to prevent the disease to a greater degree than do didactic messages using statistics (De Wit et al., 2008; Nan et al., 2015; Okuhara et al., 2018c). A recent systematic review concluded that storytelling materials were found to be effective in increasing vaccination coverage (Nour, 2019). Several models such as the transportation-imagery model (Green and Brock, 2000) have been proposed to explain the influence of narratives. The influence of narratives on vaccination decisions can be explained using dual-process theories, as follows. System 1 responds to narratives about disease (Stanovich, 2003), and System 2 processes didactic messages using statistics (Cosmides and Tooby, 1996). As mentioned earlier, System 1 has a greater influence on decision-making than System 2 (Stanovich, 2005a, 2005b; Kenrick and Griskevicius, 2013). Thus, narratives are considered to be more influential than didactic messages using statistics, from the perspective of dual-process theories.

Additionally, System 1 responds to stimuli possessing cognitive ease such as perceptual, linguistic, and imagery ease (Kahneman, 2011). Therefore, if vaccine recommendation messages use fonts and type sizes that make materials easy to read for perceptual ease, plain language (i.e., common and familiar words, short sentences, explicit sentence constructions) for linguistic ease, and pictures for imagery ease, such pro-vaccination messages may be able to activate System 1 (Okuhara et al., 2017). Studies have shown that a message with high cognitive ease significantly increased self-efficacy (Okuhara et al., 2020), behavioral intention (Song and Schwarz, 2008), and actual behavior (Okuhara et al., 2018d) in comparison with a message with low cognitive ease. A recent systematic review found that visually enhanced and easily processed educational materials are more effective in increasing vaccination coverage (Nour, 2019).

Furthermore, general heuristic rules such as social norms–if many others are doing it, it must be good (e.g., 4 out of 5 people are vaccinated)–can also be used to activate System 1 in pro-vaccination messages (MacFerran, 2015), as the heuristic rule of social norms is the self-protection system acquired by human throughout evolutionary history (Griskevicius et al., 2009). Studies have shown that social norms influence individuals' judgement and behaviors (Shah, 2005; Fiske, 2010). A recent systematic review reported that a social norm is a facilitator of parental attitudes and beliefs toward childhood vaccination (Kang et al., 2017).

6. Conclusions

Based on dual-process theories, the influence of anti-vaccination messages may be increasing via the targeting of System 1. The influence of pro-vaccination messages may be able to be enhanced by targeting System 1 in addition to System 2. Although there is substantial research regarding dual-process theories, many fundamental questions remain unanswered in vaccine communication using those theories. For example, what message content will activate System 1 and System 2 in vaccine communication? Will pro-vaccination messages that activate System 1 really improve vaccination intention and behavior among vaccine-hesitant individuals? Future studies are expected to use dual-process theories to improve vaccine communication, counter anti-vaccination messages, and address vaccine hesitancy.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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