Task 1 Report:
Narrative Summary of a Literature Review About Belief Change

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U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

September 2021

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1. INTRODUCTION

Many of us -- as traffic safety stakeholders -- have the goal to reduce the number of traffic fatalities and serious injuries to zero. Because road user behavior is a common factor in traffic crashes, we must explore ways to encourage safer behaviors. Traffic safety culture recognizes that intentional behavior is influenced by the values, beliefs, and attitudes shared among a group of people. Therefore, to change behavior within a group, it is necessary to change beliefs. However, changing beliefs is difficult. To be successful, we need a better understanding of how beliefs are formed and changed so that we can develop more effective traffic safety culture strategies.

By better understanding the processes and conditions that form and change beliefs, traffic safety stakeholders can become more effective in developing and implementing strategies to change traffic safety culture. Growing traffic safety culture is necessary to achieve and sustain a vision of zero traffic fatalities and serious injuries.

The aims of this project are to:

1. Understand the processes and conditions that influence belief formation and change.
2. Guide traffic safety stakeholders in the design of effective strategies to change traffic safety culture.

In this report (Task 1), we provide a narrative summary of the main conclusions supported by this literature review process. This narrative is organized around the key questions that this process suggested were relevant to understanding how to change beliefs. The next task will distill recommendations and guidance for designing effective belief change strategies based on this literature review.

2. BACKGROUND

As shown in Figure 1, the Pooled Fund to date has focused on defining traffic safety culture – "the shared belief system of a group of people, which influences road user behaviors and stakeholder actions that impact traffic safety" (Ward et al., 2019) – including its measurement and relationship to road user behavior. In the next cycle of the Pooled Fund, it is necessary to shift to the next phase of the work, which focuses on growing a positive traffic safety culture.

Figure 1. Phases of work to understand and apply traffic safety culture.

To grow a positive traffic safety culture, we first need a better understanding of the cognitive processes that form and change beliefs – along with the factors that influence these processes. Gathering and synthesizing this information are critical for informing the design and implementation of effective traffic safety culture strategies. By reviewing the relevant research from social sciences, we can better understand how beliefs are formed and identify conditions and processes that encourage belief change.

3. MATERIALS AND METHODS

A literature review was conducted to provide a narrative synthesis (Juntunen & Lehenkari, 2021) of relevant information that answered several fundamental questions:

1. What are beliefs?
2. How are beliefs formed?
3. How do beliefs influence behavior?
4. Why do we change our beliefs?
5. How can we support belief change in others?

The review was based on publicly available and peer-reviewed literature published in English after 2006. For efficiency, an emphasis was placed on published literature reviews that included meta-analyses.

After exploring available search engines, we chose to use Research Rabbit, which is a new search platform with smart functions to construct, apply, and organize literature services. For example, this platform automatically sends email updates about new literature that has been published on specific topics of interest.

Research Rabbit uses Microsoft Academic as its primary search engine, which is a new tool for conducting literature reviews that uses algorithms based on artificial intelligence. As an example, its searches are based on the semantic meaning of chosen keywords rather than just the specific words used.

The review of literature was based on a choice of relevant keywords for each question this project tried to answer. The initial set of keywords included: “what are beliefs” and “how do beliefs change.” The initial set of keywords was then adjusted and expanded in an iterative process based on relevant keywords listed in the identified literature.

The final search focused on processes and conditions that govern the formation and change of beliefs that influence intentional behaviors. In this report (Task 1), we provide a narrative summary of the main conclusions supported by this literature review process. This narrative is organized around the key questions that this process suggested were relevant to understanding how to change beliefs.

4. RESULTS

4.1 Introduction

Beliefs and believing have been prominent topics for discussion and debate in psychology, philosophy, and religious studies (Boden et al., 2016). Beliefs are important because they influence our behavior (Castelfranchi & Paglieri, 2007). By understanding how beliefs form and later change, we can be more effective in developing strategies to change behaviors.

> Believing is arguably one of the most important things we do. Our beliefs are a core aspect of our identity, they define and shape our relationships with others, and enhance our ability to survive by making the world more predictable. (Boden et al., 2016, p. 399)

Before delving into beliefs, it is important to explore how we think. Humans process information from the environment using two distinct modes of thinking– sometimes referred to as "fast" and "slow" thinking (Grayot, 2020). These two modes differ in the amount of mental effort used and level of scrutiny applied to the processed information (Kahneman, 2011).

Fast thinking is characterized as "reactive, automatic, intuitive, heuristic, associative, and preconscious" (Grayot, 2020, p. 112). Fast thinking is fast because it uses little or no mental effort to quickly (milliseconds) provide just an impression of the information. In some cases, this impression is based on the emotional content of the information or familiarity based on past experiences.

In contrast, slow thinking is characterized as "controlled, reflective, serial, rule-based, and conscious" (Grayot, 2020, p. 112). Slow thinking is slow because processing requires greater mental effort to provide a more detailed analysis of the information, which requires significantly more time than fast thinking.

Humans try to avoid mental effort. If possible, we most often rely on fast thinking, which may provide sufficiently accurate beliefs that are also emotionally satisfying (Grayot, 2020; Kahneman, 2011).

However, because of the low effort and superficial analysis of fast thinking, we can be misled or make mistakes (Boden et al., 2016; Cooper, 2019). For example, in fast thinking, we use mental shortcuts ("heuristics") such as estimating the likelihood of an outcome based on how easily it is to remember similar events in the past (Tversky & Kahneman, 1973). As a result, if there is a highly publicized and traumatic event published in the newspaper (such as a fatal plane crash), we will mistakenly believe that plane crashes are more common than they truly are.

When mistaken fast thinking leads to unexpected or adverse outcomes, our awareness may shift us to slow thinking to review and revise our beliefs, so they more accurately and reliably represent reality (Grayot, 2020; Harmon-Jones et al., 2015).

With this brief background on thinking, the next sections explore what beliefs are, how beliefs are formed, how beliefs influence behavior, and how beliefs are changed.

4.2 What are beliefs?

Beliefs support our inherent need to understand our physical and social environment because such understanding is necessary for our survival (Boden et al., 2016; Nilsson, 2014). Our minds function as "belief engines" that automatically seek meaning from our environments (Alcock, 1995; Grayling, 2011). Beliefs represent the lessons learned from our interactions within these environments.

Beliefs are mental representations of meaningful information embedded in the environment. They result from "reaching out into the world to pick out, name, designate, apply to, or denote different things" (Britanica, 2017). They allow us to make meaning of signals in the environment and assess their personal relevance, which can trigger associated emotions (Angel et al., 2017; Connors & Halligan, 2015; Seitz & Angel, 2020).

Beliefs provide understanding of past behaviors and expectations of future behaviors (Seitz & Angel, 2020). They allow us to describe what is salient in the environment, justify our behaviors, and predict the outcomes. Eventually, the integration of these beliefs form our internalized model of reality (Nilsson, 2014). "Our beliefs play important roles in perceiving a current situation, in identifying appropriate actions, and in predicting the effects of these actions" (Nilsson, 2014, pp 15).

Importantly, beliefs support higher-order cognitive functions such as planning and decision making. Without beliefs, we would not be able to set goals, avoid threats, or regulate our behavior.

Beliefs also provide a framework with which to explain other beliefs, reconcile inconsistencies among beliefs, and form new beliefs by integrating new experiences. This ability allows us to understand our changing environment. It also allows us to maintain a sense of continuity in our beliefs – and therefore ourselves – over time.

Finally, beliefs that are shared among a group of people serve several social functions. In addition to defining our social identity and group culture (Walton & Cohen, 2007), the sharing of beliefs provides common understanding about shared environments (Boden et al., 2016; Seitz et al., 2018). This is necessary for effective collaboration and social governance in a challenging and changing environment (Castelfranchi & Paglieri, 2007; Nilsson, 2014; Seitz et al., 2018).

Psychologists have identified several characteristics of beliefs (Boden et al., 2016; Castelfranchi & Paglieri, 2007; Connors & Halligan, 2015):

- Beliefs themselves can be structured as propositions (i.e., statements) about the world (Schwitzgebel, 2019). The essence of any belief can be distilled into a sentence that references some characteristic of the world (Boden et al., 2016). For example, the perception that "Everyone I know drives above the speed limit" could be distilled into the sentence "Most people speed." Indeed, researchers and philosophers have suggested that beliefs exist in our minds as sentences or some other language-based format (Nilsson, 2014; Schwitzgebel, 2019).[1]

[1] The neurological basis of our beliefs probably resides in the parietal cortex region of the brain near the are responsible for high level cognitive functioning such as planning and decision making (Seitz & Angel, 2020).

- Beliefs can vary in scope (Connors & Halligan, 2015). Beliefs can represent propositions about specific events or general classes of events.
- Beliefs are "infinitely variable" (Boden et al., 2016). Because of variability in environments and experiences of them, the number and variety of beliefs that can be formed by a person or group of people is unlimited.
- Beliefs are held with varying degrees of "conviction." Conviction refers to the perceived (subjective) probability the proposition conveyed by the belief is accurate (i.e., correctly reflects the actual environment). Without some degree of conviction, a belief does not exist.[2]
- Beliefs are not static (Boden et al., 2016). After forming, belief content and conviction can change based on new experiences, reinterpretation of past experiences, and modifications to address inconsistencies among beliefs.
- Beliefs are not always conscious (Boden et al., 2016). Beliefs may be held unconsciously and not come into awareness until a relevant goal becomes salient and brings attention to it (Boden et al., 2016; Castelfranchi & Paglieri, 2007).
- Beliefs vary in terms of shared adoption (Connors & Halligan, 2015). Beliefs can be formed by an individual based on a unique experience or shared among a group of people.
- Group beliefs are formed and maintained through communication and culturally relevant activities such as storytelling (Bietti et al., 2019). Shared beliefs among group members may arise from shared experiences (i.e., group members are participating in the same experience). Communication (e.g., storytelling) can also produce shared beliefs based on the experiences of one or a few, which are then shared with other group members. This form of sharing is particularly adaptive for survival relevant information and beliefs. Conversely, isolated experiences without shared, effective communication tend to produce idiosyncratic beliefs held by individuals.

4.3 How are beliefs formed?

Humans have an inherent need and the innate ability to form beliefs based on their sensory information from the environment (Nilsson, 2014).[3] The beliefs we form can be considered personal theories (hypotheses) about the environment (Nilsson, 2014; Seitz et al., 2018). Together, these beliefs represent a mental model of our environment (Nilsson, 2014). Later experiences can serve to bolster or reject the beliefs embodied by this model. However, we generally only seek evidence to evaluate accuracy of our beliefs when needed (e.g., provoked by

[2] Without any conviction, we may hold a different form of mental representation other than a "belief" such as an idea or hypothesis (Boden et al., 2016).

[3] Much research on child development has focused on specific cognitive and belief abilities at different ages and the nuances the affect children's mental representations. Despite disagreement about the exact age at which children's belief formation processes match adults', there is general consensus that it occurs by age 6 and that from then on, children can separate their own mental representations from reality and from the mental representations of others (Keysar et al., 2003). Therefore, this review is focused on belief formation and change without specifically differentiating between children and adults.

unexpected or negative outcomes from our behaviors). Moreover, in these instances, we are biased to find only evidence that confirms our original beliefs (Boden et al., 2016).

The formation of beliefs depends on our ability to accurately perceive (comprehend) the meaning of sensory information and our capacity to derive emotional value (meaning) from those perceptions (Seitz et al., 2018; Seitz & Angel, 2020). This sensory information comes from our experiences. Experiences that give rise to beliefs can result from direct interaction with the external environment or indirectly by seeing others interacting within that environment (Bandura, 2001).

Our experiences can also include internal deliberation about our existing beliefs or external communication about beliefs shared with others. For example, participation in conversations or other forms of communication (e.g., social media, books, etc.) often reference our existing and shared beliefs. In this context, the ability to effectively communicate beliefs has an important personal and social function (Connors & Halligan, 2015). Some experiences are designed to convey and reinforce specific beliefs, for example, during socialization and indoctrination practices such as rituals (Boden et al., 2016; Seitz et al., 2018).

We do not always recall the original source of our beliefs. A belief created through personal experience and one adopted after communicating with someone else can be experienced and function the same way (Boden et al., 2016; Nilsson, 2014).

Beliefs are formed through a process called "believing" (Seitz et al., 2018). As shown in Figure 2, the believing process can be described as a multi-stage model (Connors and Halligan, 2015).

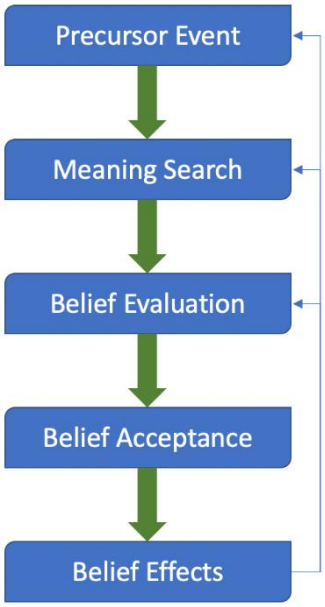

Figure 2**. Multi-stage model of believing process (based on Connors & Halligan, 2015)**

According to this model, the formation of a belief begins with a Precursor Event that we perceive as a perturbance in our perception of the world. Examples of such perturbances include the perception of information that (1) conveys novel information not currently represented by existing beliefs, (2) contradicts expectations derived from an existing belief, or (3) represents emotionally salient information that is self-relevant. Such events may (but not always) shift us

into the slow mode of thinking to analyze the situation more deeply to better understand the available information in the environment.

In the next stage of believing (Meaning Search), we try to understand the meaning of this event, which means to explain its occurrence. However, our ability to find meaning in an event is constrained by our existing beliefs and the specific context of the experience. As a result, our search for meaning of the precursor event may be personal and vary across circumstances.

From this search for meaning, we may generate plausible explanations of the event. Initially, these are considered "proto-beliefs" (or precursors to beliefs) because they are hypothetical explanations without knowing their representational accuracy.

It is not until the next stage (Belief Evaluation) that we actually evaluate our proto-beliefs in terms of their explanatory accuracy. We also evaluate these proto-beliefs in terms of their internal consistency with other existing beliefs.[4]

Proto-beliefs that survive the scrutiny of this evaluation stage become accepted beliefs. Our conviction in an accepted belief may depend not only on its accuracy in explaining the event and its alignment with other beliefs but also its role in regulating our emotional state.

In the last stage (Belief Effects), future events that violate expectations based on the new belief will be perceived as perturbances, thereby triggering the belief formation process again (see Figure 2). Moreover, the new belief will influence the search for meaning in future precursor events and contribute to the evaluation of other proto-beliefs.

To demonstrate this model, consider this example:

- **Precursor Event:** Despite sleeping well, a driver is surprised by his difficulty staying awake during his morning drive to work.
- **Meaning Search (proto-beliefs):** The driver considers all the possible reasons for his fatigue. For example, was the unusual fatigue the result of (1) him skipping his morning coffee routine; (2) his new anxiety medication; or (3) the large meal he had for breakfast.
- **Belief Evaluation:** The driver explores the plausibility of each of these possible explanations: (1) he has skipped coffee before without any fatigue effects; (2) the drug bottle does warn of fatigue symptoms; and (3) he has had larger meals and still felt alert.
- **Belief Acceptance:** The most plausible explanation is the new anxiety drug, so the driver accepts this is the reason for his unusual fatigue. The driver now believes that drugs such as this can cause him to feel extremely fatigued.
- **Belief Effects:** As a result of this belief, the driver may decide to take his medication in the evening rather than the morning. Or he may request a change in

[4] Because we are motivated to avoid contradictory beliefs, we are biased to accept proto-beliefs that are internally consistent (coherent) more than we are motivated to ensure proto-beliefs are necessarily accurate. In such situations, the desire to avoid uncomfortable emotions associated with being internally inconsistent is more salient that the need to represent the environment accurately.

medication from his doctor. In the future, he may also be more cautious about the effects of medications.

It is important to note that we may not be aware of these processes (i.e., they may be unconscious). The process may involve only fast thinking. Awareness of a belief may only be evident when events make us reflect on the belief and shift to slow thinking.

As mentioned previously, beliefs and emotions are connected. The American Psychological Association defines emotions as "a complex reaction pattern, involving experiential, behavioral and physiological elements." Therefore, beliefs are not just "cold" representations of reality – they are also "hot" sources of emotion (Rao et al., 2009).

Just as beliefs can be evaluated in terms of their accuracy compared to the observed world, beliefs also can be evaluated in terms of the positive or negative emotions they evoke (see **Error! Reference source not found.**). Therefore, beliefs can serve two functions: to help us u nderstand the world (representational accuracy) and to influence how we feel (emotional control).

Some beliefs may support one function more strongly than the other. Belief acceptance may depend on which functional goal – being accurate or feeling good – is most important in a particular context (Boden et al., 2016).

Sometimes, a belief can satisfy both functions (complementary). For example, the belief that "I failed my driver's license test because I did not practice enough" may accurately represent the reason the person failed and help the individual avoid despair by not accepting they may just be a bad driver.

However, in some cases, adopting a belief that aligns with one function may undermine the other function. For example, a driver who believes "I drive better after smoking cannabis" may feel better about their decision to drive after using cannabis (DUIC) but is also denying the reality that cannabis increases the risk of causing a fatal crash (Drummer, 2009).

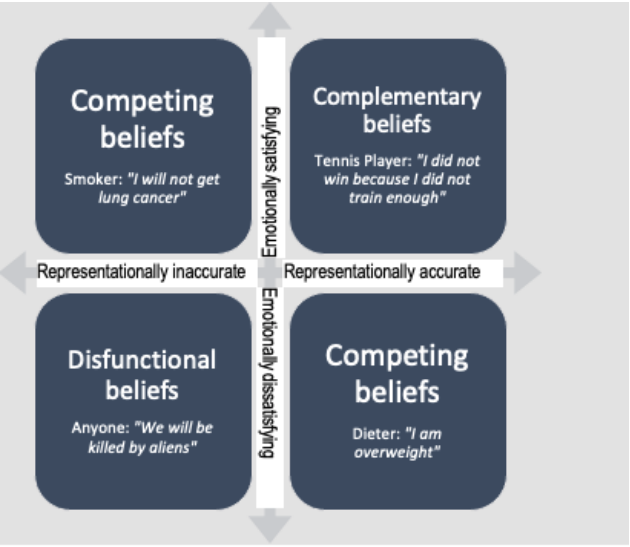

Figure 3. Illustration of representational and emotional functions that beliefs may fulfill (based on Boden et al., 2016).

The notion that beliefs have two primary functions may explain the wide variation in beliefs among people and over time (Boden et al., 2016). First, beliefs are evaluated differently by people depending on which function is most salient to them in a particular situation. Second, people with different functional goals may adopt different beliefs about the same experience. Third, the emotional benefit of some beliefs may explain why they persist without supporting evidence (or with contradicting evidence) about their representational accuracy.

In summary:

- We may form a new belief when we perceive an event (i.e., a precursor event) that we cannot explain. These types of events tend to be unexpected because we do not yet have any beliefs that enable us to predict them. In this instance, our goal is to form a belief that accurately represents the event.
- We may form a belief because it makes us feel good (i.e., the belief generates a positive emotion). This also includes forming a belief that removes an existing negative emotion. In this instance, our goal is to regulate our emotions.

4.4 How do beliefs influence behavior?

It is almost unanimously agreed that beliefs deeply affect our actions.

(Castelfranchi & Paglieri, 2007, p. 237)

Various models have been developed that represent the predicted relationship between beliefs and deliberate behaviors. Deliberate behaviors are different from reflexive behaviors (like a startle response to a loud noise), which involve much less cognitive processing. Figure 4 represents a model relating beliefs to behaviors based on the theory of reasoned action (Fishbein & Ajzen, 2010), the prototype willingness model (Gerrard et al., 2008), and the role of values (Oreg & Katz-Gerro, 2006). Table 1 summarizes the definitions of the components in the behavioral model.

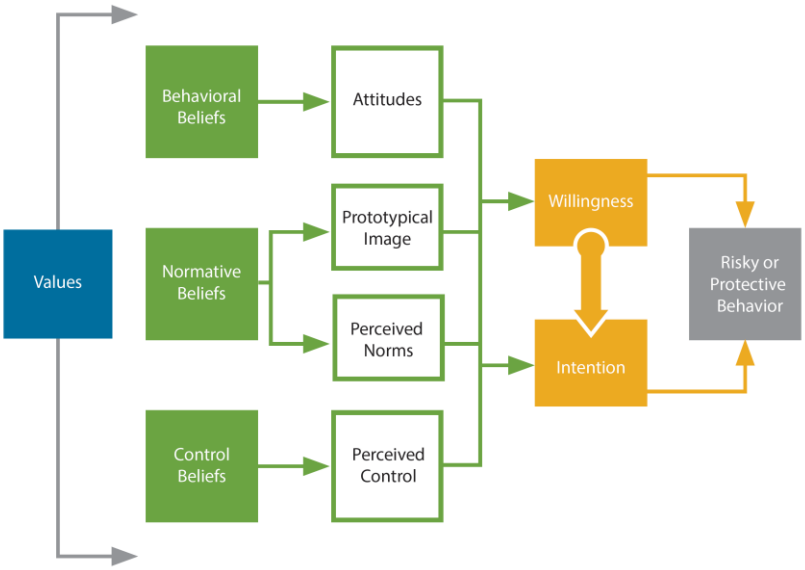

Figure 4. Behavioral Model

Researchers have used controlled experiments (many with random assignment) to change beliefs and then assessed subsequent changes in behaviors. It is beyond the scope of this project to review all these studies. Nonetheless, there is experimental evidence supporting the causal relationship between these beliefs and behaviors.

For example, extensive studies have explored the relationship between perceived norms and behavior. People typically want to behave in ways that are considered normal and acceptable (Rhodes et al., 2020); however, people often misperceive the norms of their peers, and these misperceptions can lead people to align their behaviors with the misperceived norms (Amialchuk et al., 2019). Research suggests social norms interventions seeking to change normative beliefs are effective (Miller & Prentice, 2016; Rhodes et al., 2020).

Strategies that seek to modify people's beliefs and behaviors by correcting misperceptions are known as social norms interventions (Lewis & Neighbors, 2006; Miller & Prentice, 2016). Social

norms interventions are divided into two groups: social norms marketing and personalized normative feedback (Lewis & Neighbors, 2006; Miller & Prentice, 2016).

Social norms marketing involves providing actual norms of the behavior by disseminating the information widely usually through media, posters, and other large channels of dissemination. Personalized normative feedback is more individualized and seeks to change normative misperceptions by creating discrepancies among a person's behavior, the perceived typical behavior of their peers, and the actual typical behavior of their peers (Lewis & Neighbors, 2006).

Table 1. Definitions of Components Used in Behavioral Model

Values	Ideals to which we aspire that define the goals for our behavioral choices and direct the formation of our belief systems (e.g., "I must protect my family," "I desire a life without stress").
Behavioral Beliefs	Expectations about the physical and social consequences of a behavior (e.g., "If I speed, I will likely get an expensive fine," "If I drink and drive, my friends will exclude me").
Attitudes	Subjective evaluation of an object or behavior in terms of emotional reaction (e.g., "Speeding is exciting") and perceived utility (e.g., "Seat belts are useless").
Normative Beliefs	Beliefs about what behaviors are most common in a group (e.g., "All my friends speed") and what important people in that group expect (e.g., "My parents expect me to wear a seat belt").
Perceived Norms	The behavior believed to be common and expected in a given context (e.g., wearing a seat belt when driving with parents).
Prototypical Image	The stereotype of people perceived to typically engage (or not engage) in the behavior (e.g., "People who speed are cool").
Control Beliefs	Beliefs about an individual's ability to engage or not engage in the behavior based on factors that are either internal or external to oneself (e.g., "Crashes are determined by fate," "I am comfortable not speeding even if everyone around me is").
Perceived Control	Perception of our ability to determine our own behaviors (e.g., "I can choose my own speed in traffic").
Intention	The deliberate decision to commit a behavior in an anticipated situation (e.g., "I intend to wear my seat belt every time I am in a vehicle").
Willingness	The predisposition to commit a behavior if an unexpected situation arises (e.g., "I am more willing to speed if everyone else around me is speeding").

4.5 Why do we change our beliefs?

> *One of the most important things to say about beliefs is that they are (or at least should be) tentative and changeable.*
>
> (Nilsson, 2014, p. 4)

We are most likely to change an existing belief when doing so improves the perceived accuracy of our beliefs (representational function) or helps regulate our emotions (emotional function). However, it is easier to change beliefs that do not strongly serve either function because a belief without a purpose is less resistant to change (Boden et al., 2016).

We may change a belief to regulate our emotional state. This is more likely to happen in ambiguous situations to reduce feelings of uncertainty or confusion (Boden et al., 2016). In such cases, we are motivated to revise beliefs to experience more pleasant emotions. For example, we may accept a belief that makes us feel better or reject a belief that would make us uncomfortable. In this section, we discuss "cognitive dissonance" as a special case of changing beliefs to reduce the emotional discomfort.

Often what leads to changing our beliefs is cognitive dissonance. Cognitive dissonance is a state of emotional discomfort resulting from our awareness that we have a belief that is inconsistent with other beliefs important to us or the behaviors we exhibit (Cooper, 2019; Harmon-Jones et al., 2015). Our awareness of this inconsistency may come as a result of an adverse outcome of a (freely chosen) behavior that was based on the belief. For example, a driver who values safety and believes they can drive safely while texting is involved in a crash while texting. They are upset because their belief that they can drive safely while texting is inconsistent with the experience of being in a crash. In such cases, we are motivated to change one or more beliefs to remove the perceived contradiction.

Inconsistency among beliefs that influence behavior may interfere with our perceptions of behavioral control, which will result in cognitive dissonance.[5] This dissonance motivates us to adjust our beliefs to become more internally consistent, especially in relation to control of behavior. We can do this by changing the inconsistent belief (in the previous example, the driver now believes texting while driving may be dangerous) or by adopting a belief that explains away the apparent contradiction.

For example, consider a person who has decided that it is dangerous to drive under the influence of alcohol (DUIA). Now imagine this person is in a situation where they had to make the short drive home after drinking at a restaurant. In this case, the belief that it is dangerous to drive under the influence of alcohol is inconsistent with the behavior of driving after drinking.[6] The behavior cannot be changed after the fact, so to reduce the apparent inconsistency, the person can change contradicting beliefs ("A small amount of alcohol is not enough to impair me") or adopt

[5] This presumes that the person has not chosen or been forced to behave inconsistently (Cooper, 2019).

[6] The behavior of driving home after drinking implies the belief that alcohol does not impair driving, which contradicts the belief the person already holds that DUIA is dangerous.

new beliefs to reduce the contradiction ("There is very little danger from driving such a short distance on a route I know very well").

Another way to explain away the apparent contradiction between our beliefs and outcome is to change relevant beliefs about our responsibility for an outcome and the nature of that outcome (in the previous example, the driver does not believe it was the texting that caused the crash but rather the poor driving of the other driver) (Harmon-Jones et al., 2015).

Especially when our responsibility is ambiguous, we are motivated to change our beliefs to portray others as being responsible for our behavior and convince ourselves the adverse outcome was unforeseeable (Cooper, 2019). Here, the motivation for changing beliefs is to reconceptualize the behavior and outcome as non-aversive – even desirable (Cooper, 2019).

The fundamental attribution error (also called correspondence bias) is another mental shortcut that humans often unconsciously make when assigning responsibility for adverse outcomes (Hooper et al., 2015; Ross, 1977). When bad things happen to other people, we tend to assign responsibility to the individual or their character. However, when we experience adverse outcomes ourselves, we assign responsibility to the situation or circumstance. For example, we see a crash involving other drivers, and we attribute the crash to their poor driving. However, when we are involved in a crash, we blame the road design, the weather, or the other driver. In this way, the fundamental attribution error serves a self-protective function and reduces the likelihood that we easily or willingly attribute responsibility for adverse outcomes to ourselves.

Cognitive dissonance can also be experienced vicariously. We can learn about the experience of someone from a social group we identify with behaving in ways that contradict our own beliefs, and this other person's experience can lead us to change our beliefs (Cooper, 2019). Humans are social beings, which means belonging to social groups is an important part of our identity (Abrams & Hogg, 1990; Brown, 2000; Chen & Li, 2009). Indeed, forming a social identity by belonging to groups is an important determinant of our health and emotional wellbeing (Steffens et al., 2021; Walton & Cohen, 2007).

The process of "belonging" to a group involves sharing the beliefs that define the culture of the group (Weller & Baer, 2002; Zou et al., 2009). When we identify with a group and espouse "our" shared culture, we may experience cognitive dissonance when we see a group member contradict those beliefs and look to resolve that dissonance in ourselves.

For example, in a study by Norton et al. (2003), a student (actually, a confederate in this experiment) who belonged to a group that shared the belief that university fees should not be raised followed the request to write a strongly worded statement in support of raising fees. It was evident that this statement might be used by the university to support their proposal to raise fees. The point of this experiment was to examine how the other students reacted to the observation of one of their fellow students writing the statement that contradicted the group's beliefs. In this case, the observing students also changed their beliefs to be more favorable toward the statement to reduce their own vicarious dissonance with the confederate's behavior. Moreover, the stronger the identification with the group, the greater the change in beliefs.

Cognitive dissonance occurs when we experience (directly or vicariously) a contradiction between our beliefs and our experience. We may feel uncomfortable because greater representational accuracy of our beliefs allows us to be more effective – with fewer adverse outcomes – during our interactions within our environment (Harmon-Jones et al., 2015).

Deciding the accuracy of our representational beliefs requires that we shift into our "slow" analytical mode of thinking (Nilsson, 2014). Slow thinking may prompt us to understand and revise our beliefs as we seek to achieve the accuracy necessary to reliably choose actions that produce intended outcomes.

Slow thinking may also help us better understand (i.e., form new beliefs) about the larger environment. We can only form beliefs about the environment we know. The explanations we form and the consequences we expect are limited to that known environment (see **Error! Reference source not found.**). However, when we are made aware of the larger environment, we may recognize there is more complexity to explain and learn that the consequences of our actions affect other parts of the environment (Stroth, 2015). Such experiences show us that our beliefs need to expand to account for our interactions within this larger system. For example, we may have beliefs about not speeding in our own neighborhood but frequently speed in areas outside our neighborhood. But when we realize that our speeding in these areas increases the risk of a fatal crash to the residents of those neighborhoods, we may change our beliefs about speeding across the transportation system.

4.6 How can we facilitate belief change in others?

Efforts to change beliefs in others often involve presenting information to the person to substantiate the change (e.g., facilitating cognitive dissonance). This information could be presented by an individual (e.g., a friend, family member, healthcare provider, counselor, etc.) or be provided in a message (e.g., a public service announcement, a booklet, information on the internet, etc.). The Elaboration Likelihood Model describes two pathways for processing this information that can lead to belief change depending on the motivation and ability of the individual (Petty & Cacioppo, 1986).

As summarized in Figure 5, if the individual is motivated and able to attend to the information, they may engage in slow thinking to analyze information and elaborate by recalling or generating related information (e.g., consider the quality of the arguments presented). If the elaboration leads to thoughts favorable toward the conveyed information, sustainable belief change may happen that reliably influences future behavior.

However, without sufficient motivation or ability, the person will instead use a peripheral pathway based on their fast mode of thinking that only recognizes superficial aspects of the information such as only the number of arguments in the information. In this case, belief change will likely be temporary and unlikely to influence future behavior.

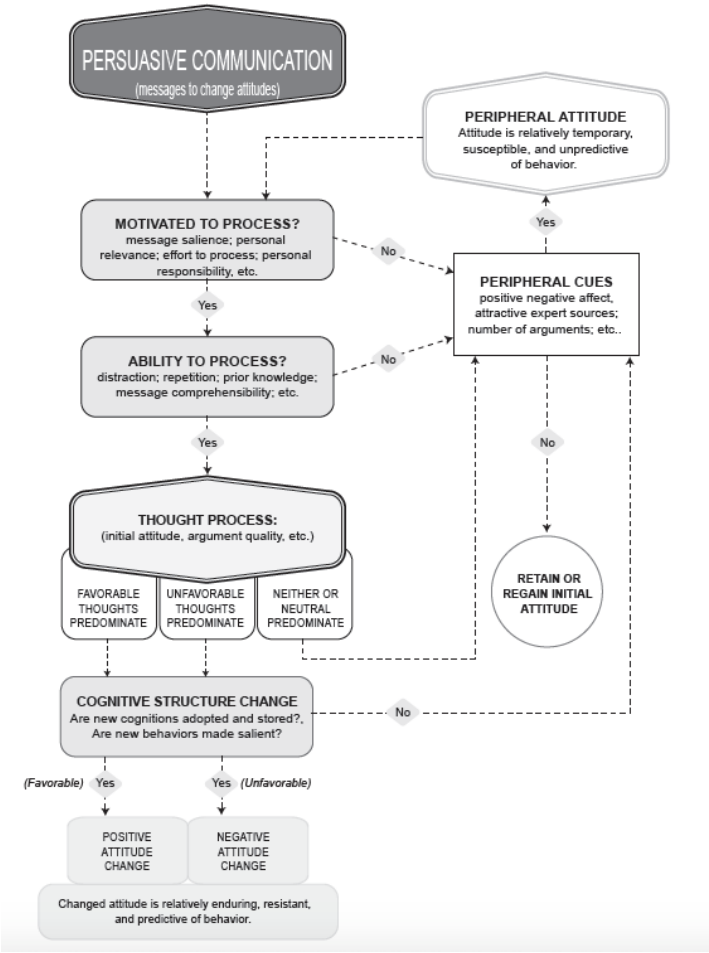

Figure 5. Elaboration Likelihood Model (ELM) describing two cognitive pathways for belief change (adapted from (Petty & Cacioppo, 1986)).

The Elaboration Likelihood Model implies that both motivation (e.g., personal relevance) and ability (e.g., focused attention) are necessary preconditions for information to change a person's beliefs and future behavior. There are internal and external factors that research has shown can facilitate belief change and the adoption of behavior influenced by that belief. Internal factors include emotions, perceived self-efficacy, and locus of control. External factors include framing, narratives, vividness, and credibility. This section concludes with factors that may inhibit belief change.

4.6.1 Emotions

The emotional state of the person receiving the information intended to change beliefs can influence how that information is processed (Petty & Briñol, 2015). Emotions vary by the pleasantness or unpleasantness of their experience, which is referred to as "emotion valance." For example, happiness is a pleasant and desirable emotion, while fear can be unpleasant and undesirable. However, the effect of the emotion depends on which pathway the person is using to process the message (see Figure 5). If the person is using the peripheral pathway, the valence of their emotion can be misattributed to the information and influence its interpretation and later

acceptance. For example, a person who is currently fearful may automatically dislike the information and reject it.

Fear is a specific emotion with a negative valence. A common strategy in messaging to change beliefs that influence behavior is to evoke fear by portraying the negative consequences of the behavior. The earlier discussion suggests that this approach would only be effective if the peripheral pathway for processing these messages can be avoided.

Indeed, there is evidence that fear-based messages can be effective, but only under certain conditions. For example, (Tannenbaum et al., 2015) concluded that fear-based messages can be effective, but only when they (1) advocate for one-time behaviors (rather than ongoing behaviors), (2) convey high susceptibility to severe outcomes, (3) prove the efficacy of the desired copying behaviors to reduce susceptibility and outcome severity, and (4) communicate to an audience with a substantial percentage of women.

In the context of traffic safety, these conditions associated with the apparent effectiveness of fear-based messages has led other researchers to conclude: "While fear arousal appears important for attracting attention, its contribution to behavior change appears less critical than other factors, such as perceptions of vulnerability and effective coping strategies" (Lewis et al., 2007a). Indeed, the influence fear-based messages have on belief change is usually "relatively weak" (Witte & Allen, 2000). Moreover, fear-based messages can have several undesired effects as well, including denial of the issue communicated by the message (Simpson, 2017). Thus, it is important to also explore the use of positive valence emotions in messaging strategies to change beliefs including hope and joy (Lewis et al., 2007b).

There is also evidence that the emotional state of a person can influence which pathway they use to process information (Petty & Briñol, 2015). Specifically, the emotional contentment resulting from feeling happy can dissuade people from investing the effort to analyze and elaborate information compared to more neutral emotions (fast thinking). In contrast, negative emotions such as sadness may imply problems in the environment that motivate efforts to analyze and elaborate information to improve the current situation (slow thinking).

However, the influence of emotions is different when people are motivated and able to consciously analyze and elaborate information using slow thinking:

- If a goal of the information is to instill an emotion, then it will be evaluated as more effective if the person is already experiencing that emotion. The current emotional state of the person is interpreted as evidence that the presented information is valid. For example, a seat belt message framed to be sad may be evaluated as more effective by people who themselves feel sad than by those feeling happy. This effect is opposite from what would be expected if these people were using the peripheral pathway shown in Figure 6 to process the message.
- The emotional state of the recipient can bias the elaboration process. Our emotional state biases the information we recall from memory. We are more likely to recall information that shares an association with our current emotion. This process influences the information we recall when analyzing and elaborating the information conveyed by a message. Specifically, if a person is happy, they will be biased toward evaluating the message more favorably because they are inclined to elaborate the message based on happy (positive) recalled information.

4.6.2 Perceived Self-Efficacy

Perceived self-efficacy includes people's beliefs about their skills, abilities, and capabilities to perform in specific situations. Research on self-efficacy suggests that what we think we can do in each situation, not what we can do, has important implications and influence on a wide range of behaviors (Bandura, 1982; Bauman et al., 2012; Gwaltney et al., 2009; Miao et al., 2017; Taubman – Ben-Ari, 2016). Our decisions about what actions to take are influenced by our evaluation of self-efficacy (Bandura, 1982, 1993). For example, if a person judges themself to be competent to intervene as a bystander, they are more likely to intervene than if they judge their skills to be inadequate.

Information that strengthens an individual's perception of self-efficacy can influence behavior change (Bandura, 1982). For example, messages that show people how to do a behavior through seeing others and modeling can increase beliefs of efficacy (Bandura, 1982). Similarly, messages that are encouraging (i.e., "You can do it," "I believe you are capable," "You're going to do great.") can bolster beliefs of efficacy to engage in a behavior (Bandura, 1982, 1993).

4.6.3 Locus of Control

Locus of control refers to people's beliefs about how much control they have over the outcomes they experience. Locus of control is considered a cognitive disposition (Ajzen, 2002), and is a key predictor of a variety of behavioral outcomes (Galvin et al., 2018). Perceptions that one's own behavior and personal attributes drive outcomes are referred to as an internal locus of control, while perceptions that external conditions outside of oneself drive outcomes are referred to as an external locus of control (Galvin et al., 2018). External locus of control beliefs often attribute outcomes to luck or powerful others (Jang & Baek, 2018). Locus of control is correlated with attitudes, motivation, and a variety of other outcomes related to performance (Ng et al., 2006).

Locus of control is often viewed in the literature as a trait, but researchers have also suggested that locus of control is changeable (Galvin et al., 2018; Kong & Shen, 2011) and should be considered when designing information or messages to influence beliefs related to behavior (Kong & Shen, 2011). Information can be tailored to locus of control beliefs (Jang & Baek, 2018). Information that provides specific skills and knowledge may enhance internal locus of control (Jang & Baek, 2018), which can mitigate the fundamental attribution error and increase an individual's sense of responsibility. Likewise, messages emphasizing individual autonomy and individual responsibility ("It's up to you.") may result in more favorable attitudes toward the messages among those with an internal locus of control (Jang & Baek, 2018; Kong & Shen, 2011; Williams-Piehota et al., 2007).

As a result, traffic safety messages that emphasize personal autonomy and bolster skills about how engaging in a specific traffic safety behavior may be more suited to those with an internal locus of control. Messages that offer advice, make recommendations, or encourage a specific behavior from well-known messengers may influence those with a more external locus of control (Jang & Baek, 2018; Williams-Piehota et al., 2007). Further, messages that are designed with a social-responsibility frame may produce more favorable attitudes among individuals with an external locus of control beliefs (Kong & Shen, 2011). For example, messages that use a

prosocial frame that emphasizes engaging in a specific traffic safety behavior for important others may be advantageous for those with an external locus of control.

4.6.4 Framing

Strategies to change beliefs related to behaviors can focus on what is gained or lost by engaging in that behavior. This focus on gain or loss is referred to as framing. A gain frame focuses on obtaining something desired or removing something undesired. For example, a message to influence beliefs associated with voting could be phrased as "Get higher wages – Vote for Smith" or "Lower your taxes – Vote for Smith."

Similarly, a loss frame focuses on obtaining something undesired or removing something desired. For example, a message to change teen driver beliefs could be phrased as "If you speed, you will be grounded" or "If you speed, you cannot use the car." In this context, evidence suggests that gain-framed messages are more effective in changing beliefs and associated behaviors than loss-framed message (O'Keefe & Jensen, 2007).

However, the impact of the message frame on effectiveness is small and has been proven only in a small number of public health domains (O'Keefe & Jensen, 2007). Moreover, the apparent effect of message framing is more evident on behavior than associated beliefs, which has most often been limited to studying attitude change (Gallagher & Updegraff, 2012). This suggests the need to understand the effect of message framing on more types of beliefs including perceived norms and perceived control.

4.6.5 Narratives

Whereas information may include factual information or rhetorical arguments that support belief change, a narrative is a form of story that immerses us in an experience that gives context to belief change (Shen et al., 2015). Examples of narratives include personal stories, anecdotes, testimonials, and contextual accounts of events. Narratives are a typical form of communication among people in groups and may therefore feel natural to both the teller and the listener. The use of narratives as part of public health strategies to change beliefs and associated behaviors has been found to have a "small but significant effect" (Shen et al., 2015). The effectiveness of narratives is greater when delivered by audio or video compared to text, as these communication channels are more likely to elicit emotions connected to the narrative. Moreover, narratives are more effective for increasing preventative behaviors than reducing harmful behaviors.

4.6.6 Vividness

Vividness has been defined as a quality of communicated information that attracts our intention, evokes emotions, and provokes imagination. Strategies to change beliefs need to attract attention and provoke imagination so that we are motivated to analyze and elaborate messages (i.e., shift us to slow thinking). Increasing the vividness of communication strategies can increase effectiveness in changing beliefs (Blondé & Girandola, 2016). Specifically, vividness increases the recall of memories that can elaborate a message but only when the form of vividness creates positive emotions that elicit positive thoughts. For example, a narrative based on a "concrete" testimonial is more vivid than an "abstract" story (Blondé & Girandola, 2016).

4.6.7 Credibility

Perceptions of the credibility of information have important implications for changing beliefs and influencing behavior (Ismagilova et al., 2020). Factors associated with the source of the information and the information itself influence credibility (Metzger et al., 2003). Credibility is influenced by the trustworthiness of the source, the perceived expertise (in the topic area) of the source, and whether the source is viewed as similar to the audience (i.e., shares attitudes, values, preferences, and demographic characteristics) (Ismagilova et al., 2020; Metzger et al., 2003).

Attention to the source is an important element of creating messages that influence beliefs and behaviors. Sources considered highly credible are likely to be more persuasive than sources that are perceived to be of low credibility (Pornpitakpan, 2004). In an online format, it has been suggested that making information about the source readily available to the audience, updating profile pages to include details that would support trustworthiness, showcasing the expertise of the staff, and finding ways to build a positive online community that highlights social similarities can provide evidence of credibility (Ismagilova et al., 2020).

Credibility is also influenced by factors associated with the information itself. The structure, content, and delivery of the information influence perceptions of credibility (Metzger et al., 2003). For example, how information is structured, organized, and whether it flows logically affect perceptions of credibility (Metzger et al., 2003). Further, the content of the information, how interesting it is to the audience, and its perceived validity are associated with credibility (Metzger et al., 2003). Using opinionated language decreases credibility compared to information that uses less intense language (Metzger et al., 2003). Information that is familiar, closely aligned, or that supports the views of the audience is viewed as more credible than information that has discrepancies (Metzger et al., 2003). Finally, the way in which information is delivered, including how hesitant or assertive the communication style, influences perceptions of credibility (Metzger et al., 2003).

4.6.8 Factors That May Inhibit Belief Change

Some factors can inhibit belief change. When we engage in fast thinking (which we unconsciously do most of the time), we are less aware (concerned) about the accuracy of our beliefs (i.e., how well our beliefs actually represent the world around us). Indeed, we are biased to create justifications after an experience to confirm our beliefs. If information presented to an individual is only processed using fast thinking, it is less likely to be analyzed deeply enough (with slow thinking) to affect belief change.

Recall that beliefs can have two functions: to enable us to function in the observed world and to regulate emotions. If a person holds a belief because of emotional benefits, efforts to change that belief based on challenging the representational accuracy of the belief may not be effective. Additionally, people are unlikely to know or acknowledge why they hold certain beliefs and may not recognize the emotional benefits of certain beliefs, making those beliefs even more resistant to change.

When people perceive that being persuaded to do something (e.g., through a message) threatens their freedom, they may experience psychological reactance. Psychological reactance is “an unpleasant motivational arousal that emerges when people experience a threat to or loss of their free behaviors” (Steindl et al., 2015, p. 205). Psychological reactance often shows up as anger or counterarguing (Rains, 2013).

When messages elicit reactance, they may motivate the person to do the opposite of what the message intended (Brehm & Brehm, 1981). Messages that use strong, directive, or controlling language like “you must” or “you should” can increase psychological reactance (Miller et al., 2007; Shen, 2015). Further, messages framed as a loss can elicit stronger psychological reactance than messages using a gain frame (Shen, 2015).

5. CONCLUSIONS

In this report (Task 1), we provide a narrative summary of the main conclusions supported by the literature review. The next task will distill recommendations and guidance for designing effective belief change strategies based on this literature review.

To the extent that the behaviors we want to change are based on our beliefs, we need to understand how such beliefs form and change in order to design effective behavior change strategies. This narrative review of the literature helps to support that understanding. Two key conclusions from this narrative review include:

- We may form a new belief when we perceive an event (i.e., a precursor event) that we cannot explain. These types of events tend to be unexpected because we do not yet have any beliefs that enable us to predict them. In this instance, our goal is to form a belief that accurately represents the event.
- We may form a belief because it makes us feel good (i.e., the belief generates a positive emotion). This also includes forming a belief that removes an existing negative emotion. In this instance, our goal is to regulate our emotions.

This implies that effective strategies to change beliefs – and therefore behavior – should alert the perceiver to the unexpected consequences and contradictions of their beliefs and demonstrate positive emotions that may be experienced with alternative beliefs.

Admittedly, the majority of the available literature on belief formation and belief change is based on research in Western societies and so predominately reflects Western thinking (Seitz et al., 2017). Therefore, this review may be limited and not reflect the process of belief formation in various other societies and cultures.

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