Health Communication

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/hhth20

Increasing Perceived Risk of Opioid Misuse: The Effects of Concrete Language and Image

Yan Qin , Junhan Chen , Kang Namkoong , Victoria Ledford & Jungkyu Rhys Lim

To cite this article: Yan Qin , Junhan Chen , Kang Namkoong , Victoria Ledford & Jungkyu Rhys Lim (2020): Increasing Perceived Risk of Opioid Misuse: The Effects of Concrete Language and Image, Health Communication, DOI: 10.1080/10410236.2020.1846323

To link to this article: https://doi.org/10.1080/10410236.2020.1846323

Published online: 18 Nov 2020.

HEALTH COMMUNICATION
https://doi.org/10.1080/10410236.2020.1846323

Increasing Perceived Risk of Opioid Misuse: The Effects of Concrete Language and Image

Yan Qin, Junhan Chen, Kang Namkoong, Victoria Ledford, and Jungkyu Rhys Lim

Department of Communication, University of Maryland

ABSTRACT

Risk perception is a critical determinant for individuals' health behavior change, especially for behaviors with distal future consequences. Building on construal-level theory, this study investigates if and how thinking concretely about the negative consequences of opioid misuse influences people's risk perception toward opioid misuse. Two message cues – images and concrete (vs. abstract) language – are proposed to influence concrete thinking and perceived temporal distance, which in turn influence risk perception directly and through negative affect. Using a factorial online experiment with Amazon Mechanical Turk workers (N = 220), this study found that messages using concrete language made people think more concretely about the negative consequences of opioid misuse. Perceived concreteness, in turn, increased risk perception and negative affect. Negative affect also increased risk perception. The use of images decreased perceived temporal distance, which in turn, changed risk perception through its influence on negative affect. Theoretical and practical implications are discussed.

Opioid misuse and addiction are a serious health crisis in the United States (National Institute on Drug Abuse, 2019). Many negative consequences caused by opioids addiction start from misusing prescribed opioids. For instance, about 232,000 people died in the United States because of overdoses related to prescription opioids from 1999 to 2018 (Centers for Disease Control and Prevention, 2019), and about 1.7 million people in the United States suffer from drug addiction related to prescription opioids (Substance Abuse and Mental Health Services Administration, 2017). Strategically communicating about the negative consequences and risks of opioid misuse is essential to combat the opioid crisis (Volkow, 2014). As risk perception concerns the beliefs about potential harm (Brewer et al., 2007), investigating people's perceived risk of opioid misuse thus well suits this purpose.

Risk perception is a critical determinant for individuals' health behavior change (Parsons et al., 2018) and one of the central constructs in many theoretical frameworks designed to predict people's initiation and engagement in health behaviors (Ferrer et al., 2016). However, research has long shown that it is challenging to influence individuals' risk perception (e.g., Kiviniemi & Rothman, 2006; Weinstein, 1989), partially because people tend to underestimate their own risk (Weinstein, 1989). This type of inaccurate risk perception is a fairly common bias and has been shown to have important consequences for health (Ferrer & Klein, 2015; Thakkar et al., 2016).

One factor associated with people's risk perception is how risky events are mentally represented. Construal-level theory (CLT, Trope & Liberman, 2010) presents a theoretical perspective for investigating how people mentally represent future events. According to the CLT, thinking concretely about the negative consequences of a risky event or behavior could increase people's risk perception by reducing the psychological distance between an individual and the negative consequences (Lermer et al., 2015, 2016). As for opioids misuse, there is usually a time lag between the instant gratification (of using the drug) and potential negative health, social, and financial consequences. In other words, the potential negative consequences of misuse are more distant outcomes compared to the instant gratification of drug use. As a result, thinking concretely about the negative consequences of opioid misuse may overcome people's tendency to underestimate their risks. However, less is known about whether message cues could influence how concretely or abstractly people think and how they relate to risk perception. It is important to study the effects of different message cues on risk perception because many health interventions, such as opioids addiction prevention, rely heavily on communicating the risk through preventative health messages (Ferrer & Klein, 2015). Thus, this study examines the effect of preventative health messages with concrete (vs. abstract) language and the use of images on people's risk perceptions about opioid misuse from a construal-level perspective.

Another reason why it is difficult to influence people's risk perception concerns the way we approach risk perception. Traditional frameworks of risk perception usually treat it as deliberative risk perception. Under such theorization, people form their risk perception based on analysis of their probability to a particular risk (Slovic et al., 2004). More recent frameworks have started to incorporate affect, "an umbrella term that encompasses feelings of all sorts" (Dillard & Seo, 2013, p. 150), as a way through which people form their risk perception (Loewenstein et al., 2001). Ample research has shown that affect or emotions can exert direct effects on judgment and risk

CONTACT Yan Qin fionaqy318@gmail.com Department of Communication, University of Maryland, College Park, MD 20742, USA

perception (e.g., Keller et al., 2006; Nan, 2017; Xie et al., 2011). According to the risk-as-feelings hypothesis (Loewenstein et al., 2001), among the determinants of emotional responses to risk are the vividness with which future outcomes are mentally represented and the perceived immediacy of those outcomes. Messages using different cues such as concrete language or image might trigger responses from emotional reactions that cannot be captured well with traditional cognitive-focused risk models. Thus, this study proposes negative affect as the mediating variable through which perceptions of message concreteness and temporal distance of the consequences of opioid misuse influence risk perception.

In all, building on the CLT and the "risk-as-feelings" hypothesis, this study examines the effect of preventative health messages with concrete (vs. abstract) language and the use of images on people's risk perceptions about opioid misuse, and the mediating role of negative affect.

Literature review

Construal-level theory and message cues

Thinking concretely or abstractly is studied under the concept of mental construal in the CLT. Mental construal refers to how objects, events, and constructs are represented in mind, which could be abstract (i.e., high construal level, or CL) or concrete (i.e., low CL). Another core idea of the CLT is psychological distance. Psychological distance refers to "the subjective experience that something is close or far away from self, here and now" (Trope & Liberman, 2010, p. 440). It includes four dimensions – temporal, spatial, social, and hypothetical, which influence one another and affect mental construal. Psychologically distal targets lead to more abstract thinking, such as thinking about the broad concepts of an object, whereas psychologically close targets lead to more concrete thinking, such as thinking about the discrete features of an object. The relationship between mental construal and psychological distance is bidirectional such that people adopting an abstract mind-set judge objects to be psychologically more distal, whereas those who adopt a concrete mind-set judge objects as psychologically more proximal (Chandran & Menon, 2004).

A large body of research has investigated the effective methods for changing the individual mind-set in terms of abstraction. Most methods changed an individual's abstract vs. concrete mind-set by making them perform various mental tasks, such as asking individuals to complete some picture completion tasks or focus on similarities vs. differences across objects (Burgoon et al., 2013; Chan & Wang, 2019). However, previous studies have understudied what message cues influence an individual's mind-set regarding abstract vs. concrete thinking. Cues refer to communication elements interpreted by the message recipients to create a setting for a message (Areni & Cox, 1995). Studying message cues is important because people encounter a variety of health intervention messages daily. Focusing on message cues and their relationship with construal level and risk perception has practical implications for health communication and theoretical implications for the CLT (Katz & Byrne, 2015). In the current study, we focus on two message cues – language concreteness and use of images – and their influence on mental construal, perceived temporal distance, and risk perception.

Language concreteness and its impact on mental construal

Messages can change individuals' mental construal by using low or high construal cues (S. J. Katz & Byrne, 2013). One type of message cue is psychological distance. Research indicates that high (vs. low) construal level can be indirectly induced by message cues such as distant (vs. proximal) social targets (e.g., Nan, 2007), future (vs. present) temporal distance (e.g., J. Kim & Nan, 2019), and global (vs. local) spatial distance (e.g., Line et al., 2016).

Another type of message cue is its concreteness level. The linguistic categorization model (Semin & Fiedler, 1988) posits that linguistic categories at a more concrete level (e.g., descriptive action verbs) are associated with concrete evidence and a direct reference to an empirical event, while linguistic categories at a more abstract level (e.g., adjectives) are decontextualized. High construal levels are associated with relatively abstract mental representations, whereas low construal levels are associated with concrete representations of an object (Trope & Liberman, 2010). The difference between concrete and abstract language thus matches the difference between high and low construal levels. Fujita et al. (2006) found that manipulating message concreteness successfully changed mental construal such that an abstract (vs. concrete) description of a self-control conflict situation activated high (vs. low) levels of construal of the situation. As such, the concreteness of messages describing health consequences should also affect individuals' mental construal. Accordingly, the current study proposes the following hypothesis concerning language concreteness and concrete mental construal (termed perceived concreteness in the current study):

H1a: Participants who read concrete (vs. abstract) health messages about the negative consequences of opioid misuse will perceive those consequences to be more concrete (vs. abstract).

Language concreteness and its impact on temporal distance

The CLT contends that lower CL is associated with closer temporal distance (Trope & Liberman, 2010). If the relationship between language concreteness and mental construal holds, message concreteness should also be able to shift one's perceived temporal distance. Lempert and Phelps (2016) argued that various strategies could be used to shift people's time perception to make future events seem closer. Such strategies include framing future events to be more concrete or easier to imagine, using more fine-tuned descriptors of time, or providing a richer context in the description. Semin and Smith (1999) found that presenting an abstract statement to participants can induce memories of events more distant in the past than presenting a concrete statement. As a result, higher message concreteness should induce the perception of an event happening in the near (vs. distant) future. Thus, this study proposes an additional hypothesis regarding language concreteness:

H1b: Participants who read concrete (vs. abstract) health messages about the negative consequences of opioid misuse will perceive those consequences to be closer (vs. distal) in time.

Images and their impact on mental construal and temporal distance

Images are associated with lower construal levels and more proximal temporal distance than words (Amit et al., 2009; Rim et al., 2015). Rim et al. (2015) found that images (vs. words) prompted low-level construal and led to the more detailed categorization of information being presented in the image (vs. words). Amit et al. (2012) found that people preferred to use pictures over words when communicating with someone who was temporally, socially, or geographically proximal (vs. distal). Another study by Amit et al. (2009) showed that participants responded faster to pictures of modern objects than ancient objects. On the contrary, participants responded faster to words denoting ancient objects than to those denoting modern objects. According to these findings, a message using images to accompany word descriptions should induce a lower construal level and more proximal temporal distance than a message using only word descriptions. Thus, the current study proposes that:

H2a: Participants who read messages with images (vs. no image) will perceive the negative consequences of opioid misuse to be more concrete (vs. abstract).

H2b: Participants who read messages with images (vs. no image) will perceive the negative consequences to be closer (vs. distal) in time.

Mental construal, temporal distance, and risk perception

Research on the relationship between mental construal and risk perception has shown that different mind-sets (i.e., abstract vs. concrete) influence people's risk estimate and risk-taking behavior (Lermer et al., 2015, 2016). For example, Lermer et al. (2016) found that, when primed to think concretely, participants had higher risk estimates for adverse events with small and large probabilities, compared to those who were primed to think abstractly. Lermer et al. (2015) also found that participants who adopted an abstract mental construal were more risk-taking across five scenarios than those with concrete mental construal.

Some research also suggests that presenting risks in near vs. distant future time frames can influence people's risk perception and behavioral intentions. For example, Chandran and Menon's study (Chandran & Menon, 2004) found that participants perceived the risks to be more probable, proximal, threatening, and concrete when the risks were presented in a day frame compared to a year frame. Kim and Kim (2018) found that messages using the near-future frame (featuring a risk perceived to be more temporally proximal such as a heart attack) induced shorter perceived temporal distance, greater perceived susceptibility to the risk, and greater intention to quit smoking, than messages using the distant-future frame (featuring a risk perceived to be more temporally distant such as larynx cancer).

Overall, research has shown that concrete mental construal and proximal temporal distance might lead to higher risk estimates and result in lower risk-taking behavior compared to abstract mental construal and distal temporal distance. Accordingly, this study proposes the following three hypotheses:

H3: Perceived concreteness will be positively related to risk perception of opioid misuse.

H4: Perceived temporal distance will be negatively related to risk perception of opioid misuse.

H5: Perceived concreteness will be negatively related to perceived temporal distance.

Affect and risk perception

Risk perception is an essential concept in many theoretical frameworks regarding health behavior change, e.g., the health belief model (HBM, Champion & Skinner, 2008), the protection motivation theory (Rogers, 1975), and the extended parallel process model (EPPM; Witte, 1992). Risk perception in these frameworks has usually been conceptualized as cognitive or deliberative risk perception that involves assessing the probabilities of developing a disease/illness or engaging in a risky behavior, or computing the utilities for various available options and then choosing the option with the highest subjective expected utility (Ferrer et al., 2016).

Decision-making about risk is cognitive and affective (Slovic et al., 2004). Newer models of judgment and decision-making about risk emphasize the role of affect and emotions (Ferrer et al., 2016). The notion that affect or emotions play crucial roles in decision-making situations is highlighted in several models such as the affect-as-information hypothesis (Clore et al., 1994), the affect heuristic (Slovic et al., 2007), and the risk-as-feelings hypothesis (Loewenstein et al., 2001).

The terms affect and emotion have been used to mean similar or different things depending on the conceptualization of the studies, for example, whether the conceptualization is valence-based (e.g., positive vs. negative) or from a discrete emotion (e.g., fear, anger, hope, etc.) perspective (Dillard & Seo, 2013; Nabi, 2010). Peters and Slovic (2007) examined the reliability and predictive power of various measures for the affective component of attitudes. They found that an evaluative average of discrete emotion terms generated good reliability and predictive power (which they called "holistic, unipolar, discrete emotion evaluative measures"), compared to other types of measures such as "holistic, bipolar, and valenced evaluation" measures. Given the above discussion and given that people may experience mixed emotions when they respond to risky events (Peters et al., 2004), the current study uses the term affect to refer to a composite holistic evaluation averaged from discrete emotions rated by participants after they read preventative messages about opioid misuse.

Negative affect and risk perception

Research has shown that affect is associated with individuals' risk perception and risk-taking behavior. Specifically, positive affect has been shown to correlate with lower perceived risk, whereas negative affect has been correlated with higher perceived risk

(Slovic et al., 2004). A variety of empirical evidence has supported this relationship (e.g., Finucane et al., 2000). For example, Keller et al.'s (2006) study found that the evocation of negative affect through different presentation formats increased risk perception about flooding. Xie et al.'s (2011) study showed that negative emotions, such as fear and anxiety, mediated the effect of hazard type (natural vs. technological) and image on risk perception, with a positive relationship between negative emotion and risk perception. Nan's (2017) study showed that participants induced to feel the emotion fear had a higher perceived risk of skin cancer and gum diseases. Based on these findings, this study proposes the following hypothesis:

H6: Negative affect will be positively related to risk perception about opioid misuse.

Determinants of emotional responses

The risk-as-feelings hypothesis (hereafter referred to as RaF hypothesis) is one of the newer models about risk that emphasizes the important role of affect and emotions. It was proposed by Loewenstein et al. (2001) and assumes two pathways – feelings (i.e., emotional responses to risky decision situations) and cognitive evaluations – through which several determinants influence behavior under risk and uncertainty. Among the various determinants for the emotional responses, the vividness and immediacy of the outcomes correspond to concrete thinking and temporal distance in the current study and are discussed in more detail below.

The RaF hypothesis defines vividness as "the vividness with which the outcomes are described or represented mentally" (Loewenstein et al., 2001, p. 275) and argues that vividness can be influenced by individual differences in mental imagery, personal experience, or characteristics of a stimulus. For example, vividness has been manipulated through concrete (vs. abstract) words, the presence (vs. absence) of pictures, and narratives (vs. statistical) evidence (Blondé & Girandola, 2016). In the current study, vividness is defined as perceived concreteness (i.e., a mental representation) of the negative consequences of opioid misuse influenced by the use of concrete (vs. abstract) language and images in a health message.

The RaF hypothesis posits that a vivid mental representation of a risky situation might produce intense feelings. For example, Holmes and Mathews (2005) found that participants who were instructed to imagine unpleasant events (i.e., more vivid mental representation) reported more anxiety than those instructed to think about the verbal meaning of the descriptions. Traczyk et al. (2015) found that participants' negative mental images of the consequences of some risky scenarios elicited negative affect and feelings of stress. Taken together, higher levels of vivid mental representation of negative consequences should be associated with more intense negative affect and result in heightened perceived risk. As a result, the current study proposes the following hypotheses:

H7a: Perceived concreteness will be positively related to negative affect.

H7b: Perceived concreteness will be positively related to risk perception through negative affect.

The RaF hypothesis defines immediacy as the time interval between the decision and the realization of its outcome (Loewenstein et al., 2001). Temporal distance is defined as the subjective experience that something is close or far away in time from the self, here, and now (Trope & Liberman, 2010), which is similar to immediacy in the RaF hypothesis. Thus, the current study defines immediacy as the perceived temporal distance of the negative consequences of opioid misuse that are influenced by the use of concrete (vs. abstract) language and images in a health message.

The RaF hypothesis proposes that when the time of an uncertain aversive event draws near, fear tends to increase, even when the probability or severity of the event remains constant (Loewenstein et al., 2001). In other words, as perceived temporal distance decreases, feelings of fear will increase. Another study showed that increases in perceived temporal distance were associated with reductions in feelings of distress for those who experienced a stressful life event within the prior two weeks (Bruehlman-Senecal & Ayduk, 2015). However, when it comes to feelings of anxiety, the relationship seems to reverse. That is, increases in perceived temporal distance were associated with increases in feelings of anxiety (Rinaldi et al., 2017). Thus, it is less clear how negative affect in general changes with the change in perceived temporal distance. Still, negative affect should mediate the effect of perceived temporal distance on risk perception. As a result, this study proposes one last hypothesis and a research question for the relationship between perceived temporal distance and negative affect:

H8: Perceived temporal distance will be negatively related to risk perception through negative affect.

RQ: What is the relationship between negative affect and perceived temporal distance in the context of opioid misuse?

Finally, building on the above hypotheses, this study proposes a theoretical model concerning the relationships among language concreteness, use of images, perceived concreteness, perceived temporal distance, negative affect, and risk perception. Because the relationship between mental construal and psychological distance is bidirectional (Trope & Liberman, 2010), this study employs model comparison to test the causal relationship between perceived concreteness and perceived temporal distance in the context of opioid misuse. The theoretical model shown in Figure 1 specifies a causal link from perceived concreteness to perceived temporal distance, whereas an alternative model specifies a causal link in the opposite direction.

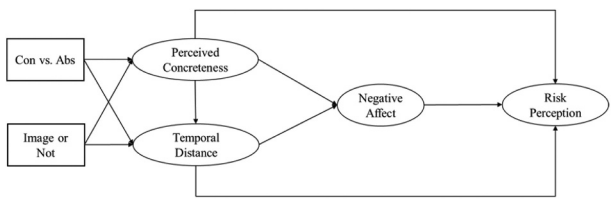


Figure 1. Theoretical model.

Methods

Design and participants

This study employed a between-subjects factorial design in which language concreteness (abstract vs. concrete) and the use of images (no images vs. images) were manipulated. A total of 252 complete responses were collected, and 32 were eliminated because they did not pass attention check questions, resulting in 220 participants. Of the participants, 71% of them were male (n = 157). Participants' ages ranged from 21 to 64. The average age was 34.5 years old (SD = 9.84). The sample consisted of 68.6% White (n = 151), 20.9% Asian (n = 46), 6.8% African American (n = 15), and 2.3% American Indian or Alaska Native (n = 5).

Procedure

Participants were recruited through Amazon Mechanical Turk (MTurk). All the participants were 18 or older. After consenting to study participation, participants were randomly assigned to one of the four conditions (i.e., abstract text-only condition, concrete text-only condition, abstract text+image condition, and concrete text+image condition). In each condition, participants were asked to read the corresponding stimuli articles. Because the stimuli articles described three negative consequences, six different orders could be arranged for the three consequences. To rule out the ordering effect of the three negative health consequences, participants were randomly shown one of the stimuli's possible orders. Participants were asked to answer questions after reading the article. Participants received two dollars for their participation in the 20-minute study.

Stimulus materials

The experimental messages were shown in a format as if it were from a professional health promotion website and described three aspects of negative consequences of opioid misuse – physical, financial, and social (see Appendix A for full stimuli). The content of negative health consequences was adapted from several addiction prevention websites (e.g., American Addiction Centers, Substance Abuse and Mental Health Services Administration, etc.). The concrete and abstract language was distinguished based on Burgoon et al.'s (2013) suggestion. The concrete language was manipulated using examples/observable characteristics, whereas abstract language was manipulated using categories and non-observable words to summarize the negative consequences of opioid misuse. Images were chosen based on the three types of consequences (i.e., physical, financial, and social). The researchers chose images that did not have a clear indication of age, gender, or ethnicity characteristics with which participants could discern or identify.

Measures

Key measures

Perceived concreteness. Perceived concreteness was measured based on a scale used to measure the concreteness of words (Brysbaert et al., 2014). Participants were asked how much they thought the description of the negative consequences of opioids misuse was concrete. Participants rated their perceived concreteness on each of the three consequences (i.e., physical, social, financial) on a 7-point scale ranging from 1 (very abstract) to 7 (very concrete) (α = .78, M = 6.56, SD = 1.25).

Perceived temporal distance. The measure of the perceived temporal distance of the consequences was adapted from K. Kim and Kim (2018) measured by asking participants to rate how far in the future they thought each of the three consequences would happen if they misused opioids. The scale used ranges from 1 (in the near future) to 7 (in the distant future) (α = .77, M = 3.38, SD = 1.52).

Negative affect. The measure of negative affect was adopted from Barrett and Russell (1998). Participants were asked to indicate how much they felt furious, stressed out, and fearful after reading the article on a 7-point scale ranging from 1 (definitely do not feel) to 7 (definitely feel) (α = .85, M = 3.32, SD = 1.79).

Risk perception. The measure of risk perception was adapted from Bachman et al.'s (1990) questionnaire about cocaine use. Participants were asked to estimate the risk to misuse opioids for themselves, for their friends, and for someone in their family from 1 (not at all risky) to 7 (extremely risky) (α = .85, M = 3.80, SD = 1.90).

Other measures

Consideration of future consequences (CFC). CFC was measured through eight items adapted from Petrocelli (2003). The Cronbach's alpha of the eight items was .687 (M = 3.68, SD = 1.41). The result indicated that deleting the first item would improve reliability. We examined the items and found that the first item emphasized the future outcomes, whereas the rest of the items focused on immediate outcomes. We thus deleted this item (α = .72, M = 3.71, SD = 1.59).

Opioids knowledge and experience. Because there is no existing measurement tool to assess the general public's knowledge of opioids misuse, the researchers developed the measurement of opioid knowledge based on opioid-related information posted on government health agencies websites. Participants answer "True" or "False" to nine statements. For example, the correct answer to the item "I have an opioid prescription from my doctor; so, they can't be that bad, even if I do not take them as prescribed" should be "False." The number of correct answers was used as the score of opioids knowledge. A higher score represents more knowledge about opioids (M = 7.79, SD = 1.72). The researchers developed the measurement of opioids experience, asking participants to indicate if they, their friend or family, and someone they knew either used or misused opioids before. For example, participants chose "True" or "False" for the statement "I have a friend or family member who uses opioids." There were six statements in total. The number of Trues was used as the indicator of opioids experience (M = 2.41, SD = 1.95).

Health condition and experience with chronic pain. Health condition was measured by the question, "In general, would

you say your health is … " (Houston & Allison, 2002). Participants answered the question by choosing from poor (1), fair (2), good (3), and very good (4). Fifty-four percent of participants chose "good" (M = 3.04, SD = 0.69). The measurement of experience with chronic pain was adapted from the Chronic Grade Pain Scale (Von Korff et al., 1992). An example item was "In the past six months, how intense was your worst pain?" with a scale ranging from No pain (0) to Pain as bad as it could be (10) (α = .92, M = 3.69, SD = 2.13).

Results

Manipulation check

Perceived concreteness was measured to check if using concrete language and images in the message made participants think of the message as more concrete than those with abstract language and those without images. The result of one-way analysis of variance (ANOVA) showed that perceived concreteness was significantly higher for participants in concrete message groups (M = 6.78, SD = 1.18) than participants in abstract message groups (M = 6.36, SD = 1.29, $F(1, 218)$ = 6.35, p < .05). There was no significant difference in perceived concreteness between participants in text+image (M = 6.57, SD = 1.25) and participants in text only group (M = 6.55, SD = 1.26, $F(1, 128)$ = 0.02, p = .89).

ANCOVA results

A two-way analysis of covariance (ANCOVA) was conducted to test the direct effects of the manipulations and their interaction on the four dependent variables of interest. The results showed that, after controlling for four covariates: CFC, opioids knowledge and experience, health condition and experience with chronic pain, and demographics, there was a significant main effect of language concreteness on perceived concreteness (F = 4.285, p < .05, partial η^2= .021), a significant main effect of image on perceived temporal distance (F = 4.424, p < .05, partial η^2= .021). H1a and H2b were supported, while H1b and H2a were not supported. In addition, there was a close to significant main effect of image on risk perception (F = 3.632, p = .058, partial η^2= .017), and a significant interaction effect on negative affect (F = 6.311, p < .05, partial η^2= .030, Figure 2).

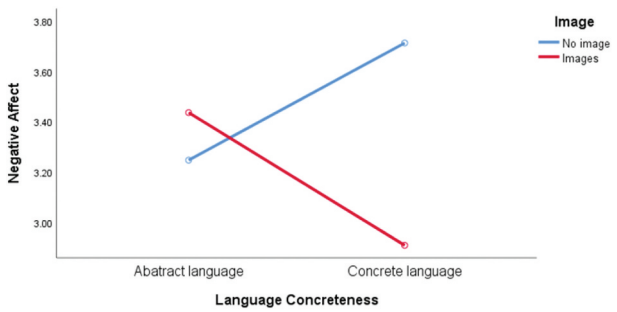


Figure 2. Interaction between language concreteness and use of images on negative affect.

Structural equation modeling (SEM) results: Model fit and hypothesis testing

This study also employed SEM to examine the proposed model and the associating hypotheses. SEM was conducted using the R package lavaan (Revelle, 2019). As its default, the R package lavaan fixes the loading of the first indicator of a latent factor to 1 and uses maximum likelihood (ML) estimation to estimate parameters. A two-phase modeling process was conducted with the measurement phase being implemented first, followed by structural phase. For the structural phase, maximum likelihood estimation with robust standard errors and a Satorra-Bentler scaled test statistic (Revelle, 2019) was used to address nonnormality for some factors. Indirect effects were estimated using bootstrapping procedures. Multiple fit indices were employed. The cutoff criteria were based on Hu and Bentler (1999) recommendations: CFI close to .95, SRMR close to .08; RMSEA close to .06. Chi-Square to degrees of freedom ratio (<2) was also used to examine the data model fit (Schreiber et al., 2006).

Exogenous variables in the model were the two manipulations – message concrete level (abstract = 0 vs. concrete = 1) and use of images (no image = 0 vs. image = 1). Endogenous variables included perceived concreteness, perceived temporal distance, negative affect, and risk perception, all of which were treated as latent factors. Table 1 presents the bivariate correlations between all variables in the model.

The measurement phase consisted all four latent variables and 12 indicators. The factors were allowed to covary, which enabled researchers to examine problems with measurement issues (Hancock et al., 2010). We tested this initial measurement model, which fits the data reasonably well (all data model fit results are presented in Table 2). Modification indices showed that a correlation between two affect items – stressed-out and fear – would further increase data model fit. Because fear and stressed-out share a foundation in anxiety arousal (Smith & Ellsworth, 1985), we considered it reasonable to add this correlation. The final measurement model fit the data well (see Table 2).

Attaining good model fit, we proceeded to test the structural model. The initial structural model (Figure 3) fits the data well (see Table 2). Consistent with the ANCOVA results, path coefficients showed that the effect of language concreteness was significant on perceived concreteness but not on perceived temporal distance ($\hat{\beta}_{LC-PC}$= 0.392, p < .05; $\hat{\beta}_{LC-TD}$= −0.010, p = .943), whereas the effect of image was significant on perceived temporal distance but not on perceived concreteness

Table 1. Correlation matrix for variables in the model.

	PC	TD	NA	RP	Con vs. Abs	Image vs. Not
PC	1					
TD	−.268**	1				
NA	0.074	.328**	1			
RP	.159*	.188**	.440**	1		
Con vs. Abs	.168*	−0.070	0.028	0.027	1	
Image vs. Not	0.009	−.144*	−0.084	−0.104	0.026	1
SD	1.25	1.52	1.790	1.900	0.50	0.50
Mean	6.56	3.38	3.320	3.800	0.49	0.49

PC = Perceived concreteness, TD = Perceived temporal distance, NA = Negative affect, RP = Risk perception. **. Correlation is significant at the 0.01 level (2-tailed), *. Correlation is significant at the 0.05 level (2-tailed).

Table 2. Data model fit results.

	χ^2 (*df*)	χ^2/*df ratio*	*CFI*	*SRMR*	*RMSEA (95% CI)*
Initial measurement model	91.372 (48)	1.90	0.961	0.056	0.064 (0.039, 0.087)
Final measurement model	73.016 (47)	1.55	0.977	0.051	0.050 (0.018, 0.075)
Initial structural model (Figure 3)	84.464 (68)	1.24	0.985	0.048	0.035 (0.000, 0.059)
Final structural model (Figure 4)	84.651 (70)	1.21	0.987	0.048	0.032 (0.000, 0.057)
Structural model with interaction term (Figure 5)	99.607 (78)	1.27	0.979	0.047	0.037 (0.000, 0.059)
Alternative model 1 (Figure 6)	86.173 (70)	1.23	0.986	0.050	0.034 (0.000, 0.058)
Alternative model 2 (Figure 7)	87.483 (70)	1.25	0.984	0.054	0.035 (0.000, 0.059)

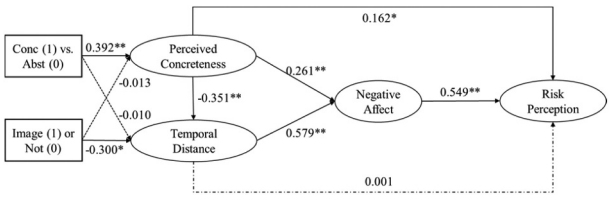


Figure 3. Original structural model with path coefficients. * significant at 0.05 level, ** significant at 0.01 level. Non-significant paths are in dotted line

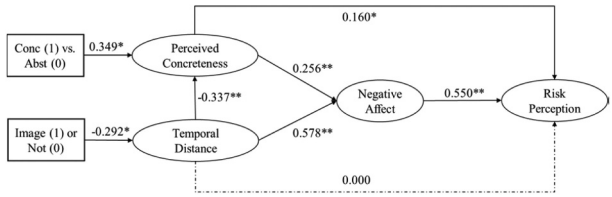


Figure 6. Alternative model 1 with causal link from perceived temporal distance to perceived concreteness.

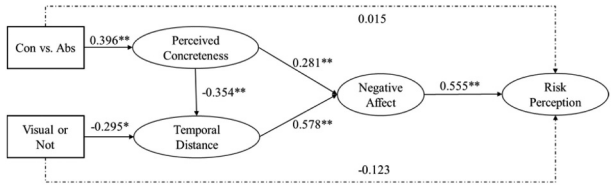


Figure 7. Alternative model 2 with direct paths from the two manipulated IVs to risk perception.

($\hat{\beta}_{IMA-TD}$= −0.299, p < .05; $\hat{\beta}_{IMA-PC}$= −0.013, p = .930). We further constrained the path coefficient from language concreteness to perceived temporal distance and that from image to perceived concreteness to be zero and tested the refined model (Figure 4). This model also fits the data well (see Table 2). A test of change in chi square showed that the refined model was not statistically significantly worse than the original model ($\Delta\ \chi^2$ = 0.187, df = 2, p = .911).

Because the ANCOVA results showed that the interaction between language concreteness and image was significant on negative affect, a model with the interaction term added was also tested (Figure 5). This model fit the data well. We adopted the refined model (shown in Figure 4) as the final model given theoretical (how we proposed the model based on the literature) and practical (data model fit results) considerations.

The standardized path coefficients (standardized on the latent factors as suggested by Breitsohl, 2019) for the final structural model are shown in Figure 4. The results showed that concrete language (vs. abstract language) increased perceived concreteness in a statistically significant way ($\hat{\beta}_{LC-PC}$= 0.392, p < .01). On the other hand, the use of images (vs. no image) influenced participants' perceived temporal distance in a statistically significant way ($\hat{\beta}_{IMA-TD}$= −0.299, p < .05). The direct effect of perceived concreteness on risk perception was significant ($\hat{\beta}_{PC-RISK}$= 0.162, p < .05), whereas that of perceived temporal distance was not ($\hat{\beta}_{TD-RISK}$= 0.001, p = .990). H3 was supported, while H4 was not. Perceived concreteness had a statistically significant effect on perceived temporal distance ($\hat{\beta}_{PC-TD}$= −0.353, p < .001). H5 was supported. Negative affect influenced risk perception significantly ($\hat{\beta}_{AFF-RISK}$= 0.549, p < .001). H6 was supported. Perceived concreteness and perceived temporal distance influenced negative affect significantly ($\hat{\beta}_{PC-AFF}$= 0.261, p < .01; $\hat{\beta}_{TD-AFF}$= 0.579, p < .001). H7a was supported. The indirect effect of perceived concreteness on risk perception through negative affect was not significant, whereas that of perceived temporal distance was significant ($\hat{\gamma}_{TD-RISK}$= 0.318, p < .001, 95% *CI*: 0.208, 0.688). H7b was not supported, while H8 was supported.

Mediation analyses were also performed to gauge the effect of the two manipulations on risk perception and negative affect. For risk perception, the indirect effect of language concreteness was close to significant ($\hat{\gamma}_{LC-RISK}$= 0.075, p = .070, 95% *CI*: 0.012, 0.286), whereas that of image was not. As for negative affect, the indirect effect of image was marginally

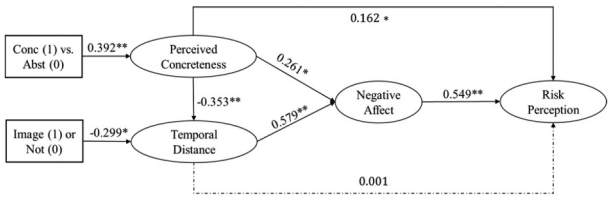


Figure 4. Final structural model with path coefficients.

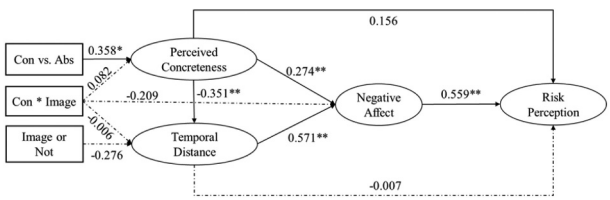


Figure 5. Structural model with interaction term between concrete language and image.

significant ($\hat{\gamma}_{IMA-AFF}$= −0.173, p = .052, 95% *CI*: −0.661, −0.008) whereas that of language concreteness was not.

SEM results: Alternative model testing

There are two alternative models in the current study, one (Alternative model1) tests the plausibility of a causal link from perceived temporal distance to perceived concreteness, whereas the other (Alternative model2) tests the plausibility of assuming the indirect (vs. the direct) effects as the effects of the manipulated independent variables (IVs) on the dependent variables (DVs). We briefly explain the rationale behind alternative model 2 below.

MacKenzie (2001) and O'Keefe (2003) suggest that, when research focus is on the impact of a message variation (i.e., a manipulated IV) on an outcome variable through a hypothesized explanatory mediating state, the indirect effects of the manipulated IV be used as its effect on the DV. Specifically, the indirect effect involves a path from the manipulated IVs (i.e., the manipulations) to the conceptual IVs (which are usually manipulation checks) and then to the DVs. This is because "most experimental manipulations are intended to influence some conceptual variable that cannot be measured or manipulated without error" (MacKenzie, 2001, p. 161). For example, in the current study, we wanted to see how thinking concretely (vs. abstractly) influenced people's risk perception. We manipulated language concreteness and the use of images to try to achieve this goal. Breitsohl (2019) suggested that model comparison could be used to test the plausibility of the assumption that manipulated IVs influence conceptual DVs through their influence on the conceptual IVs. That is, compare a model starting from the conceptual IVs (i.e., manipulation checks) to one that starts from the manipulated IVs (i.e., manipulations), which could be realized through SEM.

The two alternative models were run and fit the data well (see Table 2). Between the original model and Alternative model1, the path coefficients and mediation results were similar except that the indirect effect of language concreteness on risk perception and the indirect effect of images on negative affect were more significant in Alternative model1 ($\hat{\gamma}_{LC-RISK}$= 0.105, p = .049, 95% *CI*: 0.026, 0.346; $\hat{\gamma}_{IMA-AFF}$= −0.199, p = .044, 95% *CI*: −0.746, −0.025). Between the original model and Alternative model2, because both models had the same degrees of freedom and thus were equal in their parsimony, we chose the original model because it represented what was going on in the experiments more accurately (MacKenzie, 2001).

Discussion

Building on construal-level theory (CLT), the current study investigates whether thinking concretely (vs. abstractly) and proximal (vs. distal) temporal distance could increase people's risk perception toward opioid misuse. Two message cues – language concreteness and use of images – are proposed to influence individual mental construal and temporal distance, which in turn, are hypothesized to influence their risk perception directly and through their impact on negative affect. Using an online experiment, we test a model connecting the variables mentioned above and eleven hypotheses.

The proposed model fitted the data well, and seven out of the eleven hypotheses were supported. Specifically, messages using concrete language made people think more concretely about the negative consequences of opioid misuse. Perceived concreteness (i.e., thinking more concretely) increased risk perception and negative affect, and negative affect also increased risk perception. The use of images made people feel that the negative consequences of opioid misuse were more proximal in time. An increase in temporal distance (i.e., perceiving the negative consequences to be distal in time) increased risk perception directly and through negative affect. Concrete language and image worked together to influence negative affect such that when concrete language was used, the addition of image decreased negative affect toward opioid misuse compared to that without images. The current study has theoretical implications for risk communication and the CLT literature and practical implications for health communication about opioids misuse.

Theoretical implications

Theoretical implications for risk communication

First, the current study's findings are consistent with a growing literature that supports the importance of affect in risk perception. The significant effect of negative affect on risk perception shows that elevated negative affect could increase risk perception. This result is consistent with previous empirical work on affect and risk perception (e.g., Nan, 2017; Xie et al., 2011). Affect and emotions are important factors that influence risk perception and should be considered in risk communication studies.

Although more and more theoretical and empirical work has considered the effect of affect or emotions on risk perception, it is as important as it is challenging to identify what information about risks influences the affective/emotional reactions to risk perception (Dickert et al., 2015). This study takes a stab at addressing this challenge by connecting message cues to risk perception through the lens of the CLT. The indirect effects from the two message cues to negative affect and risk perception through perceived concreteness and perceived temporal distance show that message cues can influence individuals' risk perception through their impact on mental construal and/or psychological distance. This indicates that the vividness (e.g., use of concrete language) with which the negative consequences are described influences people's affective reaction to a certain risk. As such, this study sheds some light on communicating health risks through message cues.

Theoretical implications for the CLT

The findings of the current study lend empirical support to some of the propositions of the CLT. First, the model comparison shows that a model with a causal link from mental construal to psychological distance is equally plausible as a model with a reversed causal link. This result supports the bidirectional relationship between mental construal and psychological distance proposed by the CLT. Moreover, low-level mental construal (i.e., thinking concretely) is associated with decreased

temporal distance and an increase in risk perception, which are consistent with the propositions derived from the CLT (e.g., Lermer et al., 2015, 2016).

This study also adds to the CLT literature by examining the effect of message cues – language concreteness and image – on mental construal and temporal distance. Within social psychology studies, construal levels or psychological distance are most often manipulated through performing mental tasks (Burgoon et al., 2013). Research on how message elements could be employed to change people's mental construal or psychological distance is equally needed, because such an examination has practical implications for health communication. The results of the current study show that language concreteness and use of images have the potential to influence mental construal and temporal distance. This study thus adds knowledge on changing construal levels and psychological distance through communication message design. Future studies could keep exploring different message elements and their relations to mental construal, psychological distance, and other meaningful outcomes such as risk perception.

The relationship between perceived temporal distance and risk perception was contrary to our hypotheses: the direct effect was not significant, whereas the indirect effect showed that an increase in perceived temporal distance was associated with an increase in negative affect, which was associated with an increase in risk perception. We propose two explanations.

The first explanation concerns the concurrent effect of the four dimensions of psychological distance. The CLT posits that the four dimensions of psychological distance – temporal, spatial, social, and hypothetical – are congruent and influence one another (Trope & Liberman, 2010). Among these dimensions, hypothetical distance refers to the "perceived certainty associated with a future event" (McDonald et al., 2015, p. 112). As a result, an increase in the temporal distance might increase the uncertainty associated with the event under consideration. Uncertainty is associated with emotions such as fear, surprise, and anxiety (Miceli & Castelfranchi, 2005; Smith & Ellsworth, 1985), which might explain why temporal distance is positively related to negative affect. The current study did not examine perceived uncertainty but had one measure for perceived susceptibility of opioid misuse. Perceived susceptibility consisted of questions such as "it is likely that I will misuse opioids," "it is possible that I will misuse opioid," which, to some extent, tapped into individuals' perception of uncertainty. The results showed that an increase in temporal distance was associated with an increase in perceived susceptibility. Considering that participants were mostly unfamiliar with opioid misuse ($\hat{M}$= 2.41 out of 6, SD = 1.95), it seems plausible that the uncertainty elicited by an increase in perceived temporal distance/hypotheticality about opioid misuse overshadowed the impact of less vividness elicited by an increase in temporal distance. This might also explain why there was no significant direct effect of perceived temporal distance on risk perception. Future studies on the CLT applications might want to take into account the issue under investigation and pay attention to the possibility that the four dimensions of psychological distance may work differentially or even contrarily to affect choices and decisions.

Related to the above point, unfamiliar or new events might cause another concern when examined through the lens of the CLT. That is, people do not perceive events from the here and now when they mentally represent events unfamiliar to them. Instead, these events might be constructed within an unspecified interval between two time points. According to Maglio et al. (2013), when the time interval of an event happening is not anchored from the here and now, but just an interval between two time points, people consider these two points in time (sooner vs. later) to be closer to each other as temporal distance increased. If that is the case, shifting this unspecified time interval further away might make them felt shorter, which could, in turn, influence risk perception. Alternatively, the perceived temporal distance could also be perceived as the time period in which participants eventually suffer from the negative consequences of opioid misuse, since opioids misuse is an unfamiliar but widespread event that can happen potentially once in a lifetime. In other words, an increase in temporal distance could be perceived as an increase in time period participants have in the future to be exposed to the potential risk of opioid misuse, which would make participants feel more susceptible to the risk and increase their risk perception. Whichever case, there might be some systematic difference in mentally imagining familiar vs. unfamiliar events. Future studies could use hypothetic health topics that are new to participants to test whether this is the case.

Practical implications

This study shows that using concrete language to describe the negative consequences of opioid misuse could make people think more concretely about negative consequences and increase their risk perception. The findings have practical implications for health message designers aiming to influence people's risk perception. Describing the negative consequences using concrete language with observable characteristics could help increase people's risk perception through an increase in negative affect. For topics such as opioid misuse, people who read preventative health messages might not have direct experience with it and thus might usually underestimate their own risk for the behavior addressed. Under such circumstances, message cues that help increase the negative "gut-feelings" and risk perception toward certain behavior may help prevent future engagement with such behavior.

This study also offers some insight into using images to communicate health risks. First, previous studies have generally shown that image is associated with low-level construal and words with high-level construal (e.g., Rim et al., 2015). This is consistent with what is found in the current study. As a result, health practitioners aiming to communicate the consequences of unfamiliar health topics or those with distal consequences might consider using images to help reduce the psychological distance of those topics. Still, images are freighted with multiple meanings and their effect is not monotonic, especially when used in combination with words (Lee et al., 2014; Seo & Dillard, 2019; Seo et al., 2013). For example, Seo et al.'s (2013) study found that the addition of image produced more fear when words described the negative consequences of not adopting a behavior (vs. positive consequences of adopting a behavior). In another study, Seo and

Dillard (2019) found that image interacts with message framing to influence emotion such that images amplified the effects of words when both are positive valenced (i.e., describing the positive aspects of something) vs. negative valenced. This study also showed that images have different effects on negative emotion when accompanying messages with different concreteness levels. Health communication practitioners might want to pay attention to such interaction effects between image and different message styles (e.g., framing, concreteness) when using visual and multimodal information (Seo et al., 2013).

Limitations

A couple of limitations need to be addressed. First, there could be other ways to manipulate language concreteness and other message elements to change mental construal. One concern of this study is that the information length was not equivalent in the abstract vs. concrete groups, which might have influenced participants' cognitive processing. Inequivalent messages appeared in some previous studies and were shown to be unlikely to affect the main effect of the messages (e.g., exemplar effect; Kim et al., 2012). Also, previous research showed that informational length influenced information processing such that lengthier information was usually more difficult to process and was shown to have a persuasive impact only when individual motivation was high (Pierro et al., 2005). If that is the case, the effect of concrete language in the current study should be attenuated, not inflated. So, the whole results should still hold. Still, future studies could adopt other methods to manipulate language concreteness while keeping the length equivalent. For example, Hansen and Wänke (2010) applied linguistic category model to develop concrete vs. abstract versions of some statements with relatively equivalent length. The second limitation relates to perceived concreteness. The mean scores for perceived concreteness were high across conditions (M_{con} = 6.78; M_{abs} = 6.36). The reason for such results might be because opioid misuse was an unfamiliar issue for the majority of the participants, evidenced by the low mean score for opioid misuse experience (M = 2.41/6, SD = 1.95). As a result, any information might make the issue more concrete for the participants. However, we intended to compare messages that were more concrete with those that were less concrete. The difference rather than the absolute value was the focus of our study. That said, a pretest for the effect of the stimuli on perceived concreteness might be preferable if it is possible to do so (Miller et al., 2007).

Conclusion

There is no silver bullet solution to the current opioid misuse and addiction crises. Results of this study suggest that healthcare professionals can use message elements that induce vivid mental representations to increase risk perception of opioid misuse, which would play a critical role in preventing opioid misuse. Health communication scholars and practitioners often need to raise people's risk perception toward unfamiliar health topics or behaviors with negative consequences that are uncertain or distant in the future, which is usually done through health messages. This study offers some insight into the use of two message elements – concrete language and images – and their impact on risk perception. Future research could consider other message elements often used in health messages and explore their impact on risk perception. Ultimately, how healthcare professionals communicate the opioid misuse can prevent opioid misuse and save lives.

ORCID

Kang Namkoong http://orcid.org/0000-0002-2246-6210

References

Amit, E., Algom, D., Trope, Y., & Liberman, N. (2009). "Thou shalt not make unto thee any graven image": The distance-dependence of representation. In K. D. Markman, W. M. P. Klein, & J. A. Suhr (Eds.), *The handbook of imagination and mental simulation* (pp. 53–68). Psychology Press. https://scholar.harvard.edu/files/amit/files/amit%20et%20al%202009.pdf

Amit, E., Wakslak, C., & Trope, Y. (2012). The use of visual and verbal means of communication across psychological distance. *Personality & Social Psychology Bulletin*, *39*(1), 43–56. https://doi-org.proxy-um.researchport.umd.edu/10.1177/0146167212460282

Areni, C., & Cox, K. (1995). Assessing the impact of message cues and arguments in persuasion: Conceptual and methodological issues. *Advances in Consumer Research, 22*, 198-198. In F. R. Kardes & M. S. Provo (Eds.), *NA - Advances in Consumer Research* (Vol. 22, pp. 198–202). Association for Consumer Research. https://www.acrwebsite.org/volumes/7698

Bachman, J., Johnston, L., & O'Malley, P. (1990). Explaining the recent decline in cocaine use among young adults: Further evidence that perceived risks and disapproval lead to reduced drug use. *Journal of Health and Social Behavior*, *31*(2), 173–184. http://www.jstor.org/stable/2137171

Barrett, L. F., & Russell, J. A. (1998). Independence and bipolarity in the structure of current affect. *Journal of Personality and Social Psychology*, *74*(4), 967–984. https://doi.org/10.1037/0022-3514.74.4.967

Blondé, J., & Girandola, F. (2016). Revealing the elusive effects of vividness: A meta-analysis of empirical evidences assessing the effect of vividness on persuasion. *Social Influence*, *11*(2), 111–129. https://doi-org.proxy-um.researchport.umd.edu/10.1080/15534510.2016.1157096

Breitsohl, H. (2019). Beyond ANOVA: An introduction to structural equation models for experimental designs. *Organizational Research Methods*, *22*(3), 649–677. https://doi-org.proxy-um.researchport.umd.edu/10.1177/1094428118754988

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 behavior: The example of vaccination. *Health Psychology*, *26*(2), 136–145. https://doi.org/10.1037/0278-6133.26.2.136

Bruehlman-Senecal, E., & Ayduk, O. (2015). This too shall pass: Temporal distance and the regulation of emotional distress. *Journal of Personality and Social Psychology*, *108*(2), 356–375. https://doi.org/10.1037/a0038324

Brysbaert, M., Stevens, M., De Deyne, S., Voorspoels, W., & Storms, G. (2014, July). Norms of age of acquisition and concreteness for 30,000 Dutch words. *Acta psychologica*, *150*, 80–84. https://doi.org/10.1016/j.actpsy.2014.04.010

Burgoon, E. M., Henderson, M. D., & Markman, A. B. (2013). There are many ways to see the forest for the trees: A tour guide for abstraction. *Perspectives on Psychological Science*, *8*(5), 501–520. https://doi.org/10.1177/1745691613497964

Centers for Disease Control and Prevention. (2019, August 13). *Opioid overdose overview*. https://www.cdc.gov/drugoverdose/data/prescribing/overview.html

Champion, V. L., & Skinner, C. S. (2008). The health belief model. In K. Glanz, B. K. Rimer, & K. Viswanath (Eds.), *Health behavior and health education: Theory, research, and practice* (4th ed., pp. 45–65). John Wiley & Sons.

Chan, E. Y., & Wang, Y. (2019). Mindfulness changes construal level: An experimental investigation. *Journal of Experimental Psychology. General*, *148*(9), 1656–1664. https://doi.org/10.1037/xge0000654

Chandran, S., & Menon, G. (2004). When a day means more than a year: Effects of temporal framing on judgments of health risk. *Journal of Consumer Research*, *31*(2), 375–389. https://doi.org/10.1086/422116

Clore, G. L., Schwarz, N., & Conway, M. (1994). Affective causes and consequences of social information processing. In R. S. Wyer & T. K. Srull (Eds.), *Handbook of social cognition* (Vol. 1, pp. 323–417). Erlbaum.

Dickert, S., Västfjäll, D., Mauro, R., & Slovic, P. (2015). The feeling of risk: Implications for risk perception and communication. In H. Cho, T. Reimer, & K. A. McComas (Eds.), *The Sage handbook of risk communication* (pp. 41–54). SAGE Publications.

Dillard, J. P., & Seo, K. (2013). Affect and persuasion. In J. P. Dillard & L. Shen (Eds.), *The Sage handbook of persuasion: Developments in theory and practice* (2nd, ed., pp. 150–166). Sage. https://doi.org/10.4135/9781452218410

Ferrer, R. A., & Klein, W. M. (2015). Risk perceptions and health behavior. *Current Opinion in Psychology*, *5*(October), 85–89. https://doi.org/10.1016/j.copsyc.2015.03.012

Ferrer, R. A., Klein, W. M. P., Persoskie, A., Avishai-Yitshak, A., & Sheeran, P. (2016). The tripartite model of risk perception (tririsk): Distinguishing deliberative, affective, and experiential components of perceived risk. *Annals of Behavioral Medicine*, *50*(5), 653–663. https://doi-org.proxy-um.researchport.umd.edu/10.1007/s12160-016-9790-z

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), 1–17. https://doi.org/10.1002/(SICI)1099-0771(200001/03)13:1<1::AID-BDM333>3.0.CO;2-S

Fujita, K., Trope, Y., Liberman, N., & Levin-Sagi, M. (2006). Construal levels and self-control. *Journal of Personality and Social Psychology*, *90*(3), 351–367. https://doi.org/10.1037/0022-3514.90.3.351

Hancock, G. R., Mueller, R. O., & Stapleton, L. M. (2010). *The reviewer's guide to quantitative methods in the social sciences*. Routledge.

Hansen, J., & Wänke, M. (2010). Truth from language and truth from fit: The impact of linguistic concreteness and level of construal on subjective truth. *Personality & Social Psychology Bulletin*, *36*(11), 1576–1588. https://doi-org.proxy-um.researchport.umd.edu/10.1177/0146167210386238

Holmes, E. A., & Mathews, A. (2005). Mental imagery and emotion: A special relationship? *Emotion*, *5*(4), 489–497. https://doi.org/10.1037/1528-3542.5.4.489

Houston, T. K., & Allison, J. J. (2002). Users of Internet health information: Differences by health status. *Journal of Medical Internet Research*, *4*(2), e7. https://www.jmir.org/2002/2/e7/pdf

Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal*, *6*(1), 1–55. https://doi-org.proxy-um.researchport.umd.edu/10.1080/10705519909540118

Katz, S., & Byrne, S. (2015, January). *Connecting abstract goals with the means to achieve them: Construal level theory, strategic messages, and mobile technology* [Unpublished doctoral dissertation]. Cornell University. https://ecommons.cornell.edu/bitstream/handle/1813/39411/sjk237.pdf?sequence=1&isAllowed=y

Katz, S. J., & Byrne, S. (2013). Construal level theory of mobile persuasion. *Media Psychology*, *16*(3), 245–271. https://doi-org.proxy-um.researchport.umd.edu/10.1080/15213269.2013.798853

Keller, C., Siegrist, M., & Gutscher, H. (2006). The role of the affect and availability heuristics in risk communication. *Risk Analysis*, *26*(3), 631–639. https://doi.org/10.1111/j.1539-6924.2006.00773.x

Kim, H. S., Bigman, C. A., Leader, A. E., Lerman, C., & Cappella, J. N. (2012). Narrative health communication and behavior change: The influence of exemplars in the news on intention to quit smoking. *Journal of Communication*, *62*(3), 473–492. https://doi-org.proxy-um.researchport.umd.edu/10.1111/j.1460-2466.2012.01644.x

Kim, J., & Nan, X. (2019). Temporal framing effects differ for narrative versus non-narrative messages: The case of promoting HPV vaccination. *Communication Research*, *46*(3), 401–417. https://doi-org.proxy-um.researchport.umd.edu/10.1177/0093650215626980

Kim, K., & Kim, H. S. (2018). Time matters: Framing antismoking messages using current smokers' preexisting perceptions of temporal distance to smoking-related health risks. *Health Communication*, *33*(3), 338–348. https://doi-org.proxy-um.researchport.umd.edu/10.1080/10410236.2016.1266579

Kiviniemi, M. T., & Rothman, A. J. (2006). Selective memory biases in individuals' memory for health-related information and behavior recommendations. *Psychology & Health*, *21*(2), 247–272. https://doi-org.proxy-um.researchport.umd.edu/10.1080/14768320500098715

Lee, H., Deng, X., Unnava, H. R., & Fujita, K. (2014). Monochrome forests and colorful trees: The effect of black-and-white versus color imagery on construal level. *Journal of Consumer Research*, *41*(4), 1015–1032. https://doi-org.proxy-um.researchport.umd.edu/10.1086/678392

Lempert, K. M., & Phelps, E. A. (2016). The malleability of intertemporal choice. *Trends in Cognitive Sciences*, *20*(1), 64–74. https://doi.org/10.1016/j.tics.2015.09.005

Lermer, E., Streicher, B., Sachs, R., Raue, M., & Frey, D. (2015). The effect of construal level on risk-taking. *European Journal of Social Psychology*, *45*(1), 99–109. https://doi-org.proxy-um.researchport.umd.edu/10.1002/ejsp.2067

Lermer, E., Streicher, B., Sachs, R., Raue, M., & Frey, D. (2016). Thinking concretely increases the perceived likelihood of risks: The effect of construal level on risk estimation. *Risk Analysis*, *36*(3), 623–637. https://doi-org.proxy-um.researchport.umd.edu/10.1111/risa.12445

Line, N. D., Hanks, L., & Zhang, L. (2016). Sustainability communication: The effect of message construals on consumers' attitudes towards green restaurants. *International Journal of Hospitality Management*, *57*(August), 143–151. https://doi.org/10.1016/j.ijhm.2016.07.001

Loewenstein, G. F., Weber, E. U., Hsee, C. K., & Welch, N. (2001). Risk-as-feelings. *Psychological Bulletin*, *127*(2), 267–286. https://doi.org/10.1037/0033-2909.127.2.267

MacKenzie, S. B. (2001). Opportunities for improving consumer research through latent variable structural equation modeling. *Journal of Consumer Research*, *28*(1), 159–166. https://doi-org.proxy-um.researchport.umd.edu/10.1086/321954

Maglio, S. J., Trope, Y., & Liberman, N. (2013). Distance from a distance: Psychological distance reduces sensitivity to any further psychological distance. *Journal of Experimental Psychology. General*, *142*(3), 644–657. https://doi.org/10.1037/a0030258

McDonald, R. I., Chai, H. Y., & Newell, B. R. (2015). Personal experience and the 'psychological distance' of climate change: An integrative review. *Journal of Environmental Psychology*, *44*(December), 109–118. https://doi.org/http://dx.doi.org/10.1016/j.jenvp.2015.10.003

Miceli, M., & Castelfranchi, C. (2005). Anxiety as an "epistemic" emotion: An uncertainty theory of anxiety. *Anxiety, Stress, and Coping*, *18*(4), 291–319. https://doi-org.proxy-um.researchport.umd.edu/10.1080/10615800500209324

Miller, C. H., Lane, L. T., Deatrick, L. M., Young, A. M., & Potts, K. A. (2007). Psychological reactance and promotional health messages: The effects of controlling language, lexical concreteness, and the restoration of freedom. *Human Communication Research*, *33*(2), 219–240. https://doi-org.proxy-um.researchport.umd.edu/10.1111/j.1468-2958.2007.00297.x

Nabi, R. L. (2010). The case for emphasizing discrete emotions in communication research. *Communication Monographs*, *77*(2), 153–159. https://doi.org/10.1080/03637751003790444

Nan, X. (2007). Social distance, framing, and judgment: A construal level perspective. *Human Communication Research*, *33*(4), 489–514. https://doi.org/10.1111/j.1468-2958.2007.00309.x

Nan, X. (2017). Influence of incidental discrete emotions on health risk perception and persuasion. *Health Communication*, *32*(6), 721–729. https://doi.org/10.1080/10410236.2016.1168004

National Institute on Drug Abuse. (2019, January 22). *Opioid overdose crisis*. https://www.drugabuse.gov/drugs-abuse/opioids/opioid-overdose-crisis

O'Keefe, D. J. (2003). Message properties, mediating states, and manipulation checks: Claims, evidence, and data analysis in experimental

persuasive message effects research. *Communication Theory*, *13*(3), 251–274. https://doi.org/10.1111/j.1468-2885.2003.tb00292.x

Parsons, J. E., Newby, K. V., & French, D. P. (2018). Do interventions containing risk messages increase risk appraisal and the subsequent vaccination intentions and uptake? – A systematic review and meta-analysis. *British Journal of Health Psychology*, *23*(4), 1084–1106. https://doi.org/10.1111/bjhp.12340

Peters, E., & Slovic, P. (2007). Affective asynchrony and the measurement of the affective attitude component. *Cognition & Emotion*, *21*(2), 300–329. https://doi.org/10.1080/02699930600911440

Peters, E. M., Burraston, B., & Mertz, C. K. (2004). An emotion-based model of risk perception and stigma susceptibility: Cognitive appraisals of emotion, affective reactivity, worldviews, and risk perceptions in the generation of technological stigma. *Risk Analysis: An International Journal*, *24*(5), 1349–1367. https://doi-org.proxy-um.researchport.umd.edu/10.1111/j.0272-4332.2004.00531.x

Petrocelli, J. V. (2003). Factor validation of the consideration of future consequences scale: Evidence for a short version. *The Journal of Social Psychology*, *143*(4), 405–413. https://doi.org/10.1080/00224540309598453

Pierro, A., Mannetti, L., Erb, H. P., Spiegel, S., & Kruglanski, A. W. (2005). Informational length and order of presentation as determinants of persuasion. *Journal of Experimental Social Psychology*, *41*(5), 458–469. https://doi.org/10.1016/j.jesp.2004.09.003

Revelle, W. (2019, January 12). *Using the psych package to generate and test structural models*. https://cran.r-project.org/web/packages/psych/vignettes/psych_for_sem.pdf

Rim, S., Amit, E., Fujita, K., Trope, Y., Halbeisen, G., & Algom, D. (2015). How words transcend and pictures immerse: On the association between medium and level of construal. *Social Psychological and Personality Science*, *6*(2), 123–130. https://doi-org.proxy-um.researchport.umd.edu/10.1177/1948550614548728

Rinaldi, L., Locati, F., Parolin, L., & Girelli, L. (2017). Distancing the present self from the past and the future: Psychological distance in anxiety and depression. *Quarterly Journal of Experimental Psychology*, *70*(7), 1106–1113. https://doi.org/10.1080/17470218.2016.1271443

Rogers, R. W. (1975). A protection motivation theory of fear appeals and attitude change1. *The Journal of Psychology*, *91*(1), 93–114. https://doi.org/10.1080/00223980.1975.9915803

Schreiber, J. B., Stage, F. K., King, J., Nora, A., & Barlow, E. A. (2006). Reporting structural equation modeling and confirmatory factor analysis results: A review. *The Journal of Educational Research*, *99*(6), 323–337. https://doi-org.proxy-um.researchport.umd.edu/10.3200/JOER.99.6.323-338

Semin, G. R., & Fiedler, K. (1988). The cognitive functions of linguistic categories in describing persons: Social cognition and language. *Journal of Personality and Social Psychology*, *54*(4), 558–568. https://www.researchgate.net/profile/Guen_Semin/publication/232495898_The_Cognitive_Functions_of_Linguistic_Categories_in_Describing_Persons_Social_Cognition_and_Language/links/0912f50bcf9f71fcd0000000.pdf

Semin, G. R., & Smith, E. R. (1999). Revisiting the past and back to the future: Memory systems and the linguistic representation of social events. *Journal of Personality and Social Psychology*, *76*(6), 877–892. https://doi.org/10.1037/0022-3514.76.6.877

Seo, K., & Dillard, J. (2019). The persuasive effects of two stylistic elements: Framing and imagery. *Communication Research*, *46*(7), 891–907. https://doi-org.proxy-um.researchport.umd.edu/10.1177/0093650215626979

Seo, K., Dillard, J. P., & Shen, F. (2013). The effects of message framing and visual image on persuasion. *Communication Quarterly*, *61*(5), 564–583. https://doi-org.proxy-um.researchport.umd.edu/10.1080/01463373.2013.822403

Slovic, P., Finucane, M. L., Peters, E., & MacGregor, D. G. (2004). Risk as analysis and risk as feelings: Some thoughts about affect, reason, risk, and rationality. *Risk Analysis: An International Journal*, *24*(2), 311–322. https://doi.org/10.1111/j.0272-4332.2004.00433.x

Slovic, P., Finucane, M. L., Peters, E., & MacGregor, D. G. (2007). The affect heuristic. *European Journal of Operational Research*, *177*(3), 1333–1352. https://doi.org/10.1016/j.ejor.2005.04.006

Smith, C. A., & Ellsworth, P. C. (1985). Patterns of cognitive appraisal in emotion. *Journal of Personality and Social Psychology*, *48*(4), 813–838. https://doi.org/10.1037//0022-3514.48.4.813

Substance Abuse and Mental Health Services Administration. (2017). *Reports and detailed tables from the 2017 national survey on drug use and health (NSDUH)*. https://www.samhsa.gov/data/nsduh/reports-detailed-tables-2017-NSDUH

Thakkar, J., Heeley, E., Chalmers, J., & Chow, C. (2016). Inaccurate risk perceptions contribute to treatment gaps in secondary prevention of cardiovascular disease. *Internal Medicine Journal*, *46*(3), 339–346. https://doi.org/10.1111/imj.12982

Traczyk, J., Sobkow, A., & Zaleskiewicz, T. (2015). Affect-laden imagery and risk taking: The mediating role of stress and risk perception. *PLoSONE*, *10*(3), e0122226. https://doi.org/10.1371/journal.pone.0122226

Trope, Y., & Liberman, N. (2010). Construal-level theory of psychological distance. *Psychological Review*, *117*(2), 440–463. https://www-ncbi-nlm-nih-gov.proxy-um.researchport.umd.edu/pmc/articles/PMC3152826/pdf/nihms314649.pdf

Volkow, N. D. (2014). America's addiction to opioids: Heroin and prescription drug abuse. *Senate Caucus on International Narcotics Control*, *14*, 1–16. https://www.nih.gov/sites/default/files/institutes/olpa/20140514-senate-testimony-volkow.pdf

Von Korff, M., Ormel, J., Keefe, F. J., & Dworkin, S. F. (1992). Grading the severity of chronic pain. *Pain*, *50*(2), 133–149. https://doi.org/10.1016/0304-3959(92)90154-4

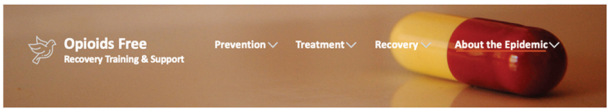
Weinstein, N. D. (1989). Optimistic biases about personal risks. *Science*, *246*(4935), 1232–1233. https://doi.org/10.1126/science.2686031

Witte, K. (1992). Putting the fear back into fear appeals: The extended parallel process model. *Communication Monographs*, *59*(4), 329–349. https://doi.org/10.1080/03637759209376276

Xie, X. F., Wang, M., Zhang, R. G., Li, J., & Yu, Q. Y. (2011). The role of emotions in risk communication. *Risk Analysis: An International Journal*, *31*(3), 450–465. https://doi-org.proxy-um.researchport.umd.edu/10.1111/j.1539-6924.2010.01530.x

Appendix A

Stimuli



Negative impacts of opioid misuse

Misusing prescription opioids will increase the risk of dependence and addiction to opioids. Misuse of opioids refers to any use outside of prescription parameters, including misunderstanding of instructions, self-medication of sleep, mood, or anxiety symptoms, and compulsive use driven by an opioid use disorder. Often, the facts about the effects of opioids misuse focus mainly on the short-term impact. For example, opioids misuse could cause vomiting and diarrhea, sedation, and delayed reactions in the short term. What's not often mentioned, however, are the long-term impact of opioids misuse, which includes but not limited to the following:

Abstract group

- Physical problems
  - Opioids misuse could lead to physical dependence and withdrawal symptoms;
  - It could have serious impact on your physical wellbeing and affect several parts of your body;
  - It could potentially lead to damage to your health or even risk your life.
- Social isolation
  - Opioids misuse could lead to various negative emotions;
  - It could lead to a feeling of being isolated;
  - It might cause feelings of abandonment and loneliness.
- Financial pressure
  - Opioids misuse may cause you to lose financial means;
  - It could lead to personal financial crises;
  - It could also cause family income volatility.

If you are prescribed with opioids medication make sure to follow the directions explained by the pharmacist and avoid misusing opioids.

Concrete group

- Physical problems
  - As a result of continued opioids misuse, you may need to take more and more opioids to alleviate physical and emotional pain. When you are unable to use it, you could have runny nose, teary eyes, hot and cold sweats, muscle aches and pains, abdominal cramping, and nausea; you may also feel low energy, irritable, anxious, agitated, and experience insomnia.
  - Opioids make you more sensitive to pain (damage to your nervous system), and actually lead to pain in your head, your knees, your back, and your chest. It weakens your heart and immune system, slows your breathing and your digestive system, and even cause damage to your brain.
  - You may suddenly feel faint, panic attacks, and difficult to breath because your heart is damaged every time you use opioids. You might even get into comma and never be awake when you just want to try the drug one more time.
- Social isolation
  - As a result of continued opioids misuse, you may experience depression, anxiety, stress or fear, and guilt. It may cause you to have the feeling that you are unable to connect with others, being sad that there is no one around to talk to, no one wants you around, understands you, or cares about you.
  - Such feelings, combined with opioids misuse, may actually drive away the people who care about you such that your friends and families may end up ignoring your pain or even leave you, stop their regular check-in or even holiday visits.
  - You may feel that drugs are your only friends when you continue misusing opioids because you have no one to talk to or to be with, no one to care for you, and to understand you in the darkness and loneliness.
- Financial pressure
  - As a result of continued opioids misuse, you may lose your job because you cannot concentrate at work due to physical dependence or other drug-related symptoms. You may be unemployed for quite a while with no income nor health insurance.
  - You may end up with nothing left after spending all your money on opioids as you need to constantly increase the use of opioids over time; your credits may be destroyed; you might even go into debt and bankruptcy.
  - As a result, you might not be able to take care of your loved ones. Your family could face significant changes in household income and life quality as you might be out of job, lose your normal productivity, or need extra care from family members.

If you are prescribed with opioids medication, make sure to follow the directions explained by the pharmacist and avoid misusing opioids.