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How We Feel About Numbers: The Impact of Framing and Number Format on Emotion and Decision Making

Kwame Poku-Acheampong
DePaul University, kpokuach@depaul.edu

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Kwame Poku-Acheampong

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Department of Psychology

College of Science and Health

DePaul University

Chicago, Illinois

Thesis Committee

Joseph A. Mikels, PhD, Chair

Jessica M. Choplin, PhD

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Abstract

The impact of framing and number format on people's comprehension of and feelings about information they encounter has been documented and replicated (Kühne et al., 2015; Lee et al., 2019, 2021). However, existing research does not extend beyond specific feelings such as anger and fear. The goal of this thesis was to address this gap by broadening the scope of affect from specific emotions to positive and negative affect. This thesis also aimed to extend the line of research to investigate how message frames and numerical formats impact comprehension, feelings, perceived issue seriousness, and judgements by using a 2 (Frame: gain, loss) x 2 (Number format: frequency, percentages) x 3 (Domain: impaired driving, wild species extinction, juvenile crime) mixed factorial design, with frame and number format as between-subjects factors and domain as a within-subjects factor. Frame was found to have the most consistent effect. In terms of comprehension accuracy, participants had greater comprehension accuracy for information presented as a gain relative to a loss. Frame also had an impact and varied depending on how people felt (both positively and negatively) and what domain they evaluated. Number format, similarly, had a significant effect on comprehension accuracy but not on the other dependent variables in the study. The implications are discussed.

Keywords: framing, number format, prospect theory, integral affect

How We Feel About Numbers: The Impact of Framing and Number Format on Emotion and Decision Making

As we make decisions every day, our exposure to relevant information is higher than ever before. For example, technological advancements have made information more accessible. People make countless decisions every day ranging from the mundane, such as where to go for dinner, to incredibly important decisions such as deciding where to live. The extent to which people understand information, particularly numerical information such as prevalence statistics, can have drastic implications for how people use such information to guide their decision-making processes (Lee et al., 2019). Not only are decisions impacted by the extent to which people comprehend relevant information, but they are also impacted by how people feel about the information. These two factors – comprehension and emotional reactions – can be influenced by the ways in which information is presented (Lee et al., 2019).

One of the aims of decision-making research is to understand the conditions under which people deviate from normative principles and demonstrate biases when making decisions. One such example is the framing effect (Tversky & Kahneman, 1974), which highlights how people differentially react to numerically equivalent information that is presented either as a positive gain or negative loss. For example, people may be exposed to headlines negatively emphasizing the number of juveniles committing crimes (e.g., "10% of juveniles will commit a crime") or positively emphasizing the number of juveniles not committing crimes (e.g., "90% of juveniles will not commit a crime"). Although the difference in those statements is subtle, it can lead to differences in comprehension levels, emotional reactions, and perceived issue seriousness, and ultimately preference for punitive measures (Kühne et al., 2015; Lee et al., 2021).

The potential impact of how we understand information and the degree to which it can influence our decision making is what makes this topic important for research. Given the

objective and persuasive nature of numbers, depending on how it is presented to us can lead to highly misleading and deadly information. A recent example of this is an op-ed piece (Horowitz, 2022) that discusses the association between receiving the COVID-19 vaccine and the number of people who have died. With the use of accurate but misleading statistics, the piece frames an argument that because there is a higher correlation between people who received a COVID-19 vaccine and died compared to the number of people who did not receive a COVID-19 vaccine and died, COVID-19 vaccines should be avoided. Dangerous rhetoric like this can deceptively and harmfully inform people's decision making regarding their health and lead to poor outcomes and even their deaths in worst case scenarios.

Another challenging aspect of numbers is that they tend to have an anchoring effect, which is the tendency for a person to rely heavily on the first piece of information they receive when making decisions (Caceres-Santamaria, 2021). Studies on the continued influence effect (CIE) suggest that corrections cannot unring the bell—individuals will, to a certain extent, stay biased in their beliefs and attitudes (Stubenvoll & Matthes, 2022). Sometimes even finding out the correct information afterward may not be sufficient, as the anchoring effect states that numbers can induce a bias in our judgments even when we find them inapplicable and irrelevant, leading to misinformation persisting (Stubenvoll & Matthes, 2022). Similarly, these effects can be taken advantage of for positive outcomes. Organizations like the World Health Organization could benefit from knowing the most persuasive numerical frames to effectively communicate statistics about the costs of unhealthy lifestyles such that the right frames in advertisement in the media might even encourage people to consider adopting environmentally friendly alternatives such as public transportation or switching to electric or hybrid cars (Burtka, 2017).

The effect of numbers on our decision making, intuitively at least, we would assume would be only logical and objective, but these examples highlight how polarizing they can be. It

could be the case that people are not fully comprehending the numbers and the extent to which they understand and feel about the numbers guides how they make their decisions. In this thesis, I explored this further by examining how factors such as framing and number presentation format can influence the extent to which people comprehend a message and how they feel about it, and ultimately how that impacts perceived issue seriousness and preference for punitive measures. Each of these factors are discussed in greater detail in the sections to follow.

Framing Effects

People are often assumed to behave rationally, and many theories and policies have been built on this assumption. Rational behavior dictates that our decisions should follow some level of consistency and coherence according to our wants and the resources available to us (Camerer, 1999). This, however, is not always the case.

In 1981, the seminal work of Kahneman and Tversky introduced prospect theory, which describes how people make decisions when the choices or options carry some level of risk. Prospect theory proposes that people think in terms of expected utility relative to a reference point (e.g., current wealth) rather than absolute outcomes. Consider the following example: you are on a game show where you can both win and lose money. You initially win $100 in your first turn and then make an error and lose $80. It would likely feel like you made a net loss even though you are $20 better off than when you started. Reverse the order of winning and losing money, and you lost $80 on your first turn but win $100 on your next. Here, you might feel like you made a net gain. In this example, the absolute outcome ($20) is the same but the two reference points (in this case +$100 and -$80) alter how we feel about the final outcome. The utility or the feeling derived from moving from minus $80 to plus $20 for most people is more positive than moving from $100 to $80.

Prospect theory was developed to explain "irrational" biased decision making; individuals dislike losses more than equivalent gains, and they are more willing to take risks to avoid a loss (Kahneman, 2011). There are three main principles that guide prospect theory. The first principle is that evaluation is relative to a reference point; outcomes that are better than the reference points are gains, and those below the reference point are losses. The second principle is that of diminishing sensitivity to both sensory dimensions and the evaluation of changes of wealth (Kahneman, 2011). A simple illustration of this is how the subjective difference between $900 and $1000 is much smaller than the difference between $100 and $200. According to the theory, changes in value loom larger, or have a greater impact, near the reference point than away from the reference point. Thus, there is a big difference between a $100 gain and a $200 gain, but a much smaller difference between gains of $1100 and $1200. Similarly, a loss of $100 seems quite distinct from a loss of $200, but losses of $1100 and $1200 seem pretty similar (Chiu & Wu, 2010). In a situation where you are first given $1000, when presented with the choice between a guaranteed additional $500 and 50-50 chance at winning an additional $1000 or $0, most people would likely opt for the sure gain of $500. Diminishing sensitivity suggests that because the first $500 is closer to the reference point, it is more pleasurable or there is more utility derived than from the second $500. When this choice is changed to losses, however, preferences switch. In a situation where you are first given $2000, when presented with the choice between a sure loss of $500 from the $2000 and a 50-50 chance at losing $1000 or $0, most individuals would opt for a 50-50 chance at losing $1000 or losing $0 to making a sure loss of $500. This preference is also consistent with the concept of diminishing sensitivity, because the first $500 loss is a much more painful than the second $500 loss (Chiu & Wu, 2010).

The third and most defining of the principles is what is known as loss aversion. Loss aversion refers to widespread behavioral avoidance of choices that can lead to losses, even if

these choices could result in equal or much larger gains for the individual (Martino et al., 2006). This aversion can lead us to fear losses more than we desire gains, even if the fear is not justified. The feeling of losing out presents itself in overly cautious behavior particularly in situations where risk is involved. Kahneman and Tversky (1981) found that people are averse or fearful of a loss almost twice as much as they would prefer a gain.

There are many real-world implications of the concept of loss aversion, as it has become accepted by many fields. Particularly in the field of business, researchers have examined how individuals will work harder to avoid losing some of their endowment than they would to gain a similar amount. For example, researchers have designed incentive contracts that leverage people's aversion to losses to increase effort and performance in the workplace (Hossain & List, 2009). Hossain and List (2009) found that incentives framed as a loss (e.g., a deduction for failing to meet a threshold) lead to increases in productivity compared to incentives framed as a gain (e.g., a bonus for meeting a threshold). In a later study, it was found that people preferred the loss contracts to gain contracts. Even when people do anticipate loss aversion, they willfully opt into loss contracts for the contract to serve as a commitment device to improve performance (Imas et al., 2016).

In addition to loss aversion, there are various other versions of framing that highlight how people's decisions can change with subtle changes in the presentation of information or choices. Equivalency framing is one such form of framing that accomplishes this. This type of framing refers to the phenomenon that people respond differently to the logically equivalent information that is presented in alternative ways (Lee et al., 2021). The most popular example of this form of framing is the "Disease Problem" posed by Tversky & Kahneman (1981). Participants are tasked with picking a strategy to handle an outbreak. Participants are presented with specific implications of choosing one strategy over the other, framed in terms of the number of lives

saved or the number of lives lost. Out of the two strategies, one was a sure option (a specified number would be certainly saved/lost) and the other was a probabilistic option (a specified number would have a probability of being saved/lost). In the gain frame, the sure option is framed positively in terms of the number of lives saved (e.g., "Out of the 600 people, 200 lives will be saved"). In the loss frame, the sure option is framed negatively in terms of the number of lives lost (e.g., "Out of the 600 people, 400 lives will be lost"). Though both of these options are mathematically equivalent, the idea of saving 200 people as opposed to letting 400 people die is much more palatable to most people. Thus, in the gain frame, people are more likely to select the sure gain option of saving 200 people over the 1/3 probability of saving everyone. However, when presented in a loss frame, people's preference shift to select the 1/3 probability that no one will die over the sure option of letting 400 people die. This suggests that people are sensitive to minor changes in wording that convey a particular meaning or implications, and this has an impact on decision making.

Framing effects have emerged in multiple domains, from the business domain as described above as well as the health domain. People are often faced with making important decisions about their health, and the ways in which outcomes associated with such decisions (e.g., side effects of taking a medication) influence people's health-related decisions. For example, Minton et al. (2020) examined attribute framing in a health context. Compared to risky choice framing described above, attribute framing, as the name suggests, examines how people evaluate an object depending on how a specific characteristic is described (Levin et al., 1998; Minton et al., 2020). In the study conducted by Minton et al. (2020), participants were tasked with reading pamphlets about medications with unique side effects presented as a gain (e.g., "86% of people who took this medication did not experience nausea") or loss (e.g., "14% of people who took this medication did experience nausea") in experimental designs to investigate

whether their perceptions of risk and likelihood to take hypothetical medications could be altered based on how the information was presented. When the side effects (e.g., heartburn, diarrhea) of taking a hypothetical medication for a common illness (e.g., insomnia) were framed positively in terms of the percentage of people who did not experience said side effects (i.e., gain frame), participants were more like to take the medication compared to when participants were presented with the percentage of people who did experience said side effects (i.e., loss frame). It is important to note, however, that the percentages of people who did or did not experience the side effects were equivalent, highlighting how subtle changes to presentation can lead to changes in judgments and decision making.

Another typical example is seen in a study where beef described as "75% lean" was given higher ratings than beef described as "25% fat" (McKenzie, 2004). The main finding from this work is what is termed as valence-consistent shift (Levin et al., 1998), which refers to the positive valenced proportion being more favorable than the negative valanced proportion although they are equivalent. In this example, the 75% lean option is the positive valanced option as it is presented as the more health friendly than the 25% fat option. So robust is this finding, that attribute framing is perhaps the most common form of framing as it is employed in many commercial sectors to help maximize profits and in even in the health sector to improve health decisions (Krishnamurthy et al., 2001). In a study by Peng and his colleagues (2008), they found that if the drug effect was described as "of 100 patients taking this kind of medicine, 70 patients became better," people tended to make more positive evaluations, compared with described as "of 100 patients taking this kind of medicine, 30 patients didn't become better." Doctors' advice was respectively described in a baneful (i.e., loss) or beneficial (i.e., gain) frame and the former one resulted in a better compliance (Peng et al., 2013). Aside from the change in judgements

made, another important factor these examples highlight is that the way we feel about our options also changes with framing and subtle changes to presentation.

How can the changes in judgments as a function of frame be explained? Research has illuminated the role of affect as a potential mechanism for guiding one's judgment and decision making (Lerner et al., 2015; Loewenstein et al., 2001; Slovic et al., 2007), especially when understanding framing effects (Cheung & Mikels, 2011; Lerner & Keltner, 2001; Loewenstein et al., 2001; Martino et al., 2006; Stark et al., 2017; Young et al., 2019). People use affect as information that guides decision-making and judgments of risks and benefits – i.e., the affect heuristic (Finucane et al., 2000; Slovic et al., 2007). Although not an error free strategy, employing heuristics allows us to save time and cognitive energy and as result we default to using heuristics both consciously and unconsciously in many situations in our daily lives. The affect heuristic refers to the phenomenon that people make judgments based on representations of objects or events that are marked with valenced feelings (Skagerlund et al., 2020). The idea is that by consulting the affective impression with which something is tagged instead of performing deliberate or careful calculations and utility maximizations for every problem, choice, or dilemma we face, one can save time and effort that works sufficiently well in many situations for both humans and animals (Skagerlund et al., 2020). Thus, affect is considered an important information processing heuristic that helps us in assessing the pros and cons of our options and the choices that we make via how we feel about the decisions we make when considering options. Indeed, research has found that people make more optimistic judgments when feeling good but make more pessimistic judgments when feeling bad (Edmans et al., 2007; Han et al., 2007; Hirshleifer & Shumway, 2003; Kamstra et al., 2003; Keltner & Lerner, 2010; G. Loewenstein & Lerner, 2003).

Moreover, affect can influence the judgments and decisions people make in multiple ways (Lerner et al., 2015; Peters et al., 2006). One route is associated with *incidental affect*, or affect unrelated to the decision or task at hand (Lerner et al., 2015). Incidental affect in one situation has been shown to influence decisions or judgments in new situations when they normatively should not (Dorison et al., 2020; Lerner et al., 2015). This carryover of incidental affect has been shown to introduce bias, with research finding that people who were in good moods made more optimistic judgments whereas people who were in bad moods made more pessimistic judgments (Han et al., 2012; Keltner & Lerner, 2010; Loewenstein & Lerner, 2003). Within the context of risky choice framing, researchers have examined the influence of one's dispositional affect on their risk preferences, finding that fearful individuals were more risk-averse but angry individuals were more risk-seeking (Lerner & Keltner, 2001). Conversely, after experimentally inducing participants with positive or negative emotional contexts, Cassotti et al. (2012) found that positive emotional contexts eliminated framing effects through reduced risk seeking in loss frames, but no effect of negative contexts were found. These results align with past research demonstrating that positive affect is associated with risk aversion (Isen & Geva, 1987; Isen & Patrick, 1983). Researchers interpreted these findings to suggest that positive affect guides people to focus on gains, thereby reducing the impact of potential losses (Cassotti et al., 2012). In the context of attribute framing, positive compared to negative moods have been found to elicit more favorable thoughts of gain-framed attributes, ultimately leading to an increased persuasiveness of positive attributes (Putrevu, 2014).

The second route through which affect can influence judgments and decisions is through *integral affect*, or feelings about the decision at hand (Lerner et al., 2015). Researchers have examined the influence of affect in risky choice framing, demonstrating that integral affect guides guide preferences for sure and risky choices (see, e.g., (Stark et al., 2017; Young et al.,

2019). Moreover, integral affect was a better predictor of risk perceptions than incidental affect within risky choice framing (Young et al., 2019). Within the health domain, in the work conducted by Minton et al. (2020) described above, integral affect partially mediated the effects of frame on likelihood to take medications. Across two studies, they found that gain-framed attributes led to more positive integral affect, subsequently increasing likelihood to take medications, whereas loss-framed attributes led to more negative feelings and increased perceived riskiness of medications (Han et al., 2012; Keltner & Lerner, 2010; Loewenstein & Lerner, 2003). Relatedly, public health campaigns commonly evoke emotional reactions to discourage people from engaging in potentially harmful behaviors by highlighting the side effects or consequences. For example, a study by Hammond et al. (2004) examined how cigarette warning labels influenced people's emotional reactions and motivations to quit smoking. They found that although participants reported negative emotional responses to the cigarette warning labels including fear and disgust, smokers who reported greater negative emotion were more likely to have quit, attempted to quit, or reduced their smoking three months later whereas participants who attempted to avoid the warnings were no less likely to think about the warnings or engage in cessation behavior at follow-up (Hammond et al., 2004). Taken together, these findings point to the critical role of affect when making health-related decisions.

In addition to the health domain, the influence of loss- and gain-framed information on how people feel has been explored in social and political domains. For example, a study by Kühne et al. (2015) examined the influence of emphasis framing on people's emotional reactions and preference for punitive measures. Specifically, their design involved manipulating the framing of a news article about youth violence where the level of responsibility differed. Information in the high-responsibility frame emphasized the personal responsibility for causing a problem to a social group, specifically highlighting the juvenile originators of violence (e.g.,

"The propensity of violence of young people increases:"; Kühne et al., 2015). Conversely, the ambivalent information included information that did not explicitly emphasize the human causation (i.e., juvenile offenders) for causing a social problem (e.g., "Federal council reacts to rising youth violence"). They found that participants in the high responsibility frame not only reported feeling more anger than those in the ambivalent frame, but they also reported being more in favor of punitive measures.

Relatedly, researchers have used safety assertion frames that involve information as to whether current or future conditions are safe or unsafe from the given risk (Lee et al., 2019). Lee et al. (2019) presented participants with a short article about violent crime that either emphasized whether one was safe from violent crime or unsafe from violent crime. After reading the article, participants provided their emotional responses (i.e., anger, sadness, fear, pride, hopefulness, and happiness) and their perceptions of violent crime. They found that participants in the unsafe assertion condition reported experiencing more negative emotions such as anger and sadness than those in the safe assertion condition, which in turn produced more pessimistic views on violent crime (Lee et al., 2019). Conversely, those in the safe assertion condition reported experiencing more positive emotions such as happiness as compared to those in the unsafe assertion condition. It is important to note, though, that these findings were driven by the use of probability formats (e.g., X out of Y Americans) relative to absolute frequencies (e.g., X number of Americans) or percentages (e.g., X% of Americans) when describing the statistics about violent crime (Lee et al., 2019). As such, it seems that framing effects are not solely based on cognitive processes but on the emotional processes as well. However, framing effects can have an interactive influence on people's judgments and decisions via how they feel about the information as well as the extent to which they understand the information, which could vary depending not only on the frame but also by the number presentation format *within* the frame.

Effects of Number Formats

Statistical information is presented almost everywhere, and depending on how the information is presented, people may have different reactions. In newspapers, some headlines might contain percentages, like “40% of Americans have had Covid this year”, whereas others might contain absolute values, like “132 million Americans have had Covid this year.” Natural frequencies may also be used, like “132 million out of 322 million Americans have had COVID this year.” Depending on how this information is presented, people may have positive or negative reactions to it because they carry different connotations, though all of the statistics are equivalent. In this manner, it seems that number presentation format can provide its own unique framing effect.

In the same way “illegal immigrants” and “undocumented immigrants” refer to the same group of people with different terms (with the former being more negative than the latter), “22.6 million of the 319 million Americans” and “7.1% of Americans” point to the same subset of the population but the differing formats may evoke different assumptions or understanding even though they are equivalent (Lee et al., 2021). An example of this is a study conducted by Halpern et al. (1989) regarding statistical risk information. In investigating the effect of variations in the presentation of oral contraceptive risk information on perceived safety, they found that respondents do not focus on foreground numbers when risk was represented as a natural frequency (i.e., “X out of Y occurrences”). When prompted, participants judged a risk of “4.15 times greater” as less likely than when the information was presented as ‘415% greater risk’ even though they are equivalent (Halpern et al., 1989). The authors concluded that consumers convert statistical risk information into judgements about the magnitude of the number presented (small or large number) and utilize this more meaningful information when making risk judgements (Halpern et al., 1989).

Statistical format can also influence how we comprehend situations, problems, dilemmas and, in turn, can influence how our judgments and decision making. In another study by Monahan et al. (2002), researchers evaluated the likelihood that an inpatient with a mental illness would commit a violent act within six months of being discharged from the hospital. Participants were divided into two groups and provided with statistical evidence to inform their decision. One group had information presented as a frequency: "20 out of every 100 patients similar to Mr. Jones are estimated to commit an act of violence." The second group had information presented as a percentage: "patients similar to Mr. Jones are estimated to have a 20% chance of committing an act of violence" (Monahan et al., 2002). Monahan et al. (2002) found that clinicians were more likely to keep a patient in the hospital if the patient's violence risk had been communicated in a frequency format (e.g., "20 out of 100 patients") as compared to a probability format (e.g., "20% likely"). The authors interpreted this finding to suggest that it is easier to visualize frequencies than probabilities. From this study we can see that if this example took place for a real patient, the statistical format would have played a role in the clinician deciding whether the patient is discharged. The objective value of the information remained exactly the same but the manner in which it is presented can significantly influence judgments and decisions.

Though frequencies may be considered more informative because they include the reference class, percentages may allow for a quicker and easier understanding of messages or information, particularly in terms of national- or global-level statistics (Brase, 2002). Frequency formats include both the actual number of people (as the numerator) and the total number of people (the denominator). When dealing with large-scale statistics, people may be less familiar with the reference class, and therefore, percentages may be preferred because the percentage converts the frequency format into an easier to understand format that is out of 100. Percentages place information in a simplified range (i.e., 0% to 100%), allowing people to more quickly

evaluate how close it is to one's perceived critical point (Slovic, 1972). Moreover, people may not take the necessary mental steps to convert frequencies into a format that is easier for them to understand and instead interpret the information in the given format (Slovic, 1972). As such, depending on how the information is presented, people may reach inaccurate conclusions or understandings of the given information (Johnson et al., 1988) or even ignore it (Slovic, 1972).

The extent to which one comprehends statistical information can vary not only by the number format through which it is expressed but also by frame. Gain- and loss-framed information presented as a frequency or percentage can produce different levels of comprehension. For example, presenting people with loss-framed statistics in a frequency format (e.g., "14.9 million out of 222 million licensed drivers will engage in drunk driving in the next 12 months") may be harder to visually reproduce compared to gain-framed statistics in a frequency format (e.g., "207.1 million out of 222 million licensed drivers will not engage in drunk driving in the next 12 months"). The logic behind this is that for gain-framed frequency formats, the numerator (i.e., 207.1 million) is much closer to the denominator (i.e., 222 million), making it easier to visualize how close the numerator is to the denominator. In contrast, for loss-framed frequency formats, the numerator (i.e., 14.9 million) is much further from the denominator (i.e., 222 million), making it harder to reproduce mentally and ultimately comprehend. However, reproducing and comprehending statistical information in a percentage format presented either as a gain (e.g., 94% of licensed drivers will not engage in drunk driving) or a loss (e.g., 6% of licensed drivers will engage in drunk driving) may not differ. Indeed, one study examined how presenting statistical information as a natural frequency or percentage in a gain or loss frame impacted one's affective reactions, comprehension accuracy, and perceived issue seriousness (Lee et al., 2021). They found that logically equivalent information embedded in gain/loss frames generated different levels of comprehension, specifically, when presenting

the loss framed information in frequency format, the level of comprehension was reduced (Lee et al., 2021). This gap in level of comprehension, however, was not seen when information was presented in the percentage format.

The extent to which one comprehends statistical information presented in gain or loss frames can have downstream influences on how one feels about the information, risk perceptions, and policy preferences. For example, Lee et al. (2021) found that different comprehension levels then shaped negative emotions differently (e.g., anger and fear), which in turn affected perceived issue seriousness. The authors reasoned that when comprehension of statistical information is low, people may not fully understand the magnitude of the information, which will not allow them to have an emotional response (Lee et al., 2021). Conversely, when people fully comprehend and can reproduce statistical information, they may experience more of an emotional reaction, which could ultimately end up guiding their risk perceptions or assessments and how seriously they take the issue. Put simply, if people comprehend the prevalence with which people will engage in drunk driving (e.g., 10% of drivers will drive drunk in the next 12 months), they may have a greater emotional reaction to that information and take the issue more seriously (Lee et al., 2021). Taken together, frame and number format can have an interactive effect on people's emotional reactions, judgments, and decisions.

The Current Study

The current study sought to extend the work of Lee et al. (2021) who examined the interactive effect of gain/loss frames and number format on emotional reactions and perceived issue seriousness for drunk driving and wildlife species. In this study, participants were presented with either gain- or loss-framed information about three domains: drunk driving, wildlife species (both modeled from Lee et al., 2021) and juvenile crime (modeled from Kühne et al., 2015) as either a natural frequency or a percentage. Lee et al (2021) measured specific

discrete emotions including fear and anger. Although pinpointing specific emotions regarding a social issue is salient, it is difficult to narrow one's feelings about an issue to a solitary emotion. In this study, a broader valence approach to measuring emotion was employed. Specifically, both positive and negative affect was measured, as it is possible to harbor both positive and negative feelings regarding an issue, especially one that could be framed differently to elicit different results. Moreover, the judgements about how seriously they take the issue (modelled from Lee et al., 2021) and their preference for punitive measures (modelled from Kühne et al., 2015) were measured.

The main research questions driving this work focused on understanding how message frames and numerical formats impact comprehension, feelings, issue seriousness, and judgements about these three domains.

Given the prior literature, there were five hypotheses:

Hypothesis 1: Participants would have lower comprehension for information presented as a loss relative to a gain for frequency formats but no differences for percentages.

Hypothesis 2: Participants would feel more positively about information presented as a gain relative to a loss and as a percentage relative to a frequency.

Hypothesis 3: Participants would feel more negatively about information presented as a loss relative to a gain and as a frequency relative to a percentage.

Hypothesis 4: Participants would report higher perceived issue seriousness in the loss frame compared to the gain frame, especially the loss frame by frequency format condition.

Hypothesis 5: Participants would have higher preferences for punitive measures in the loss frame compared to the gain frame, particularly when information was presented as a frequency relative to a percentage.

Method

Participants

To determine adequate sample size, an a priori power analysis was conducted using G*Power (Faul et al., 2007). The design of this study was partially borrowed from Lee et al. (2021) who did not report any effect sizes. Therefore, to be conservative, the power analysis for this study assumed a small to moderate effect size of 0.20 for the interaction at an alpha level of .05, which indicated that a total sample of 199 participants will be needed to detect differences among four groups with 80% power. To maximize power and account for participants who would be excluded from analyses for failing attention checks[1], I aimed to recruit a total of 220 participants (roughly 55 participants in each group). This target sample size was similar to the final sample size obtained for the impaired driving (N = 261) and wildlife species (N = 266) scenarios in Lee et al. (2021).

This study was programmed into Qualtrics. Half the sample (N = 117; M_{age} = 19.64, SD_{age} = 2.09, age range: 18-30 years; 69% female; 24% Hispanic or Latino) was recruited from undergraduate psychology courses at DePaul University and received one course credit for participating in this one-hour online survey. The other half of the sample (N = 193; M_{age} = 25.76, SD_{age} = 3.28, age range: 20-45 years; 57% female; 7.% Hispanic or Latino) was recruited from Amazon Mechanical Turk (MTurk), and participants were compensated $3.00 for participating.

All participants were required to provide informed consent prior to data collection. This study was approved by the Institutional Review Board (IRB) and meets ethical guidelines. Participants were debriefed after the study was completed.

Study Design

This study employed a 2 (Frame: gain, loss) x 2 (Number format: frequency, percentages) x 3 (Domain: impaired driving, wild species extinction, juvenile crime) mixed factorial design, with frame and number format as between-subjects factors and domain as a within-subjects factor. Participants were randomly assigned to one of four conditions for each domain: gain-framed statements presented as a frequency (n = 80), gain-framed statements presented as a percentage (n = 78), loss-framed statements presented as a frequency (n = 80), and loss-framed statements presented as a percentage (n = 71).

Materials and Measures

Current state affect. Participants completed a measure of current state affect to control for any potential baseline group differences in state affect. Specifically, participants completed the Modified Differential Emotion Scale (Fredrickson et al., 2003) (mDES; see Appendix A), which is a 20-item scale measuring current positive and negative state affect using 12 positive emotion triads (amusement, awe, compassion, contentment, gratitude, hope, interest, joy, love, pride, surprise, flirtatious) and 8 negative emotion triads (anger, contempt, disgust, embarrassment, fear, guilt, sadness, shame). Participants indicated how much they were feeling each emotion triad at that moment on a 5-point scale (0 = *Not at all*, 4 = *Extremely*). Responses to positive and negative items were averaged to create current state positive (α = .92) and negative affect (α = .95) subscales, with higher scores indicating greater levels of positive and negative affect, respectively.

Scenarios. Four versions of the scenario on the issue of juvenile crime in the United States were created and modeled after work conducted by Kühne et al. (2015) and Lee et al. (2021). Participants were presented with general information about juvenile crime (e.g., examples of crimes committed by juveniles) that was equivalent across frames. Following the design of Lee et al. (2019) and Lee et al. (2021), in each scenario, statistics about juvenile crime were presented in either a gain frame (e.g., X juveniles will not commit crimes) or a loss frame (e.g., X juveniles will commit crimes). The frames differ by using positive phrasing (will not commit) in the gain frame and negative phrasing (will commit) in the loss frame, and this was used for the juvenile crime domain and impaired driving domain. There are other ways to achieve the framing effect but this positive/negative phrasing setup is consistent with the design in the Lee et al. (2019) design and was replicated in the current study. The manner in which the statistics will be presented was also manipulated. Specifically, juvenile crime statistics were presented in either a frequency format (e.g., X out of Y juveniles in the U.S.) or percentage (e.g., X% of juveniles in the U.S.). The number format was mathematically equivalent across both frames and number formats. Four scenarios on the issues of impaired driving and wildlife species extinction were also adapted from Lee et al. (2021). This resulted in four separate conditions for each domain, and the scenarios can be found in Appendix B.

Emotional reactions. Lee et al. (2021) measured specific discrete emotions (i.e., anger and fear). In this study, a valence approach to measuring emotion was used instead to extend the findings from that work. Rather than taking a discrete emotion approach, measuring positive and negative valence regarding the scenarios allowed for a broader understanding of how both positive and negative feelings about the framed information impacts the other dependent variables. Participants were instructed to recall the information regarding juvenile crime, impaired driving and wildlife species extinction and indicate how positively (i.e., “How

positively did you feel while reading this information?") and negatively (i.e., "How negatively did you feel while reading this information?") they felt about what they read. Responses will be made on a 7-point scale (1 = *Not at all*, 7 = *Extremely*). Positive feelings ($\alpha = .91$) and negative feelings ($\alpha = .83$) were comparably reliable across the three domains.

Comprehension accuracy. In addition to emotional reactions, I also measured the extent to which participants comprehended the statistical information regarding juvenile crime, impaired driving and wildlife species extinction borrowing from Lee et al. (2021). Comprehension, for the purposes of the experiment, refers to how well participants understood the statistical information regarding juvenile crime and how accurately they can reproduce an estimate of it on a slider bar. The logic behind this stems from past work on prevalence statistics (e.g., Peters et al., 2007). When people understand and comprehend how prevalent a certain situation or event is, they should be able to reproduce it. If one comprehends "115 million out of 403 million", then one should be able to visualize this information as a pie chart, with roughly one fourth of it filled (Bower & Morrow, 1990; Dickert et al., 2011).

After engaging with the initial information regarding each domain, participants were asked to reproduce the statistical information by filling up a slider bar, with the colored portion to the left of the indicator representative of the proportion they were presented and are reproducing. The slider bar did not contain any numerical demarcations that indicate distance. The instructions for this measure were in accordance with the condition to which they were assigned. For example, the participants in the gain frame of the juvenile crime domain were asked to "fill up the bar below to indicate the proportion of adolescents in the United States that will not engage juvenile crime during the next 12 months."

The absolute value of the distance between the hidden correct point (i.e., the correct split point based on given statistics) and the point on which a respondent placed the indicator was calculated and then reverse coded. Thus, greater scores represent more accurate comprehension (Lee et al., 2021).

Perceived issue seriousness. As in Lee et al. (2021), I measured perceived issue seriousness. The items for perceived issue seriousness for impaired driving and wildlife species extinction will be adapted from Lee et al. (2021). The items for perceived issue seriousness for juvenile were modeled from the ones for impaired driving and wildlife species extinction.

The perceived issue seriousness of juvenile crime was measured with seven items and response options: (1) "How urgent do you think it is to reduce juvenile crime in America?" (1 = *Not at all urgent,* 7 = *Very urgent*), (2) "How severe do you think the current juvenile crime rate is in the U.S.?" (1 = *Not at all severe,* 7 = *Very severe*), (3) "How important is the issue of juvenile crime to you personally?" (1 = *Not at all important,* 7 = *Very important*), (4) "Are you personally concerned about becoming a victim of juvenile crime?" (1 = *Not at all concerned,* 7 = *Very concerned*), (5) "Are you concerned about the safety of your loved ones from juvenile crime?" (1 = *Not at all concerned,* 7 = *Very concerned*), (6) "How likely do you think you will encounter an adolescent engaging juvenile crime in the next 12 months?" (1 = *Not at all likely*, 7 = *Very likely*), and (7) "Generally speaking, how important do you think the issue of juvenile crime is to the average Americans?" (1 = *Not at all important,* 7 = *Very important*). Responses to these items will be averaged to create a composite average of perceived issue seriousness. Perceived issue seriousness was comparably reliable for the juvenile crime domain ($\alpha = .90$), drunk driving domain ($\alpha = .81$), and the wildlife species domain ($\alpha = .86$).

Preference for punitive measures. A novel addition to this study that was not included in Lee et al. (2021) is a measure of preference for punitive measures. This measure was modeled from Kühne et al. (2015) and adapted for the three domains. For example, preference for punitive measures in the domain of juvenile crime was measured with three items: (1) "Juveniles must be legally held accountable for the crimes they commit", (2) "Juveniles must be severely punished for the crimes they commit", and (3) "Juveniles should be arrested and prosecuted for their crimes." Responses were made on a 6-point Likert scale (-3 = *Strongly disagree*, 3 = *Strongly agree*) and averaged across to create a composite average of preference for punitive measures. There was not be a neutral midpoint. Preference for punitive measures was comparably reliable for the juvenile crime domain ($\alpha = .70$), drunk driving domain ($\alpha = .65$), and the wildlife species domain ($\alpha = .65$). This setup applied to the juvenile crime domain and wildlife species domain as well.

Numeracy Scale. Participants completed the numeracy measure developed by Lipkus, Samsa, and Rimer (2001). This numeracy measure is an 11-item questionnaire that includes two multiple-choice and nine open-ended questions assessing individuals' ability to interpret probability and numerical concepts ($\alpha = .78$) (Lipkus et al., 2001; Minton et al., 2020). The scale assessed how well participants were able to differentiate and compute simple mathematical operations on risk magnitudes using percentages and proportions, convert percentages to proportions, convert proportions to percentages, and convert probabilities to proportions (Minton et al., 2020). The number of correct responses for each participant were summed to create a total numeracy ability score.

Procedure

After providing informed consent, participants were randomly assigned to one of the four conditions in each domain described above. Prior to reading the scenarios, participants

completed the measure of current state affect. Next participants were presented with the brief article with statistical information regarding one of the domains. Participants read through the general information and framed statements regarding the prevalence rates presented as either a frequency or a percentage depending on the condition to which they were assigned. After that, participants completed the following measures in this order: (1) emotional reactions, (2) comprehension accuracy, (3) perceived issue seriousness, and (4) preference for punitive measures. This was repeated for the next two domains. Participants then provided demographic information (e.g., gender, age range, education level, household income, etc.; see Appendix C). Finally, participants were debriefed and thanked for their participation.

Results

Data Analysis Strategy

The goal of this study was to explore how frame (gain versus loss) and number format (frequency versus percentage) impact comprehension accuracy, positive and negative feelings, perceived issue seriousness and preference for punitive measures. The positive affect, negative affect, level of comprehension, perceived issue seriousness and preference for punitive measures served as the dependent variables. Frame, number format, and domain served as independent variables. Five separate 2 (frame: gain, loss) x 2 (number format: frequency, percentage) x 3 (domain: juvenile crime, impaired driving, wildlife species extinction) analyses of variance (ANOVAs) were conducted on the dependent variables. Any significant two-way interaction was decomposed by a test of simple effects to examine the means. No significant three-way interaction was expected but would be further investigated if necessary. All reported p-values for pairwise comparisons in the ANOVA's run are Holm's corrected. Table 1 contains the means and standard deviations by frame and number format in each domain.

Control Variables

Before running the primary analyses, I analyzed the control variables, positive state affect (from mDES), negative state affect (from mDES), and numeracy ability, to check for group differences. Positive and negative state affect and numeracy ability were submitted to a 2 (frame) x 2 (number format) ANOVA. For the main analyses, a 2 (frame) x 2 (number format) x 3 (domain) mixed factorial ANOVAs using the repeated measures function for all five dependent variables was used.

For positive state affect, neither the main effects of frame, $F(1, 305) = 1.42$, $p = 0.235$, $\eta_p^2 = .005$, nor number format, $F(1, 305) = 0.44$, $p = .508$, $\eta_p^2 = .001$, were significant. The interaction was also not significant, $F(1, 305) = 3.52$, $p = .062$, $\eta_p^2 = .011$.

For negative state affect, neither the main effects of frame, $F(1, 305) = 0.02$, $p = 0.881$, $\eta_p^2 = .000$, nor number format, $F(1, 305) = .13$, $p = .716$, $\eta_p^2 = .000$, were significant.

However, the frame by number format interaction was significant, $F(1, 305) = 4.92$, $p = .027$, $\eta_p^2 = .016$. Follow-up comparisons indicated that for the gain frame, participants in the frequency format ($M = 1.73$, $SD = 1.17$) reported higher negative state affect than participants in the percentage format ($M = 1.50$, $SD = 1.08$). However, For the loss frame, participants in the percentage format ($M = 1.76$, $SD = 1.11$) reported higher negative state affect than participants in the frequency format ($M = 1.43$, $SD = 1.12$). As such, negative state affect will be included as a covariate in the analysis for negative feelings.

For numeracy ability, there was a main effect of frame, $F(1, 305) = 10.11$, $p = .002$, $\eta_p^2 = .032$, with participants in the gain frame ($M = 6.64$, $SD = 2.91$) having higher numeracy ability than participants in the loss frame ($M = 5.64$, $SD = 2.91$). Although it trended towards significance, there was not a main effect of number format, $F(1, 305) = 3.77$, $p = .053$, $\eta_p^2 =$

.012. The frame x number format interaction was significant, $F(1, 305) = 5.84$, $p = .016$, $\eta_p^2 = .019$. Follow-up comparisons indicated that for the gain frame, participants in the percentage format ($M = 6.72$, $SD = 2.73$) had higher numeracy scores than participants in the percentage format ($M = 6.56$, $SD = 3.50$). For the loss frame, participants in the frequency format ($M = 6.31$, $SD = 2.74$) had higher numeracy scores than participants in the percentage format ($M = 4.89$, $SD = 2.93$). As such, numeracy ability will be included as a covariate in the analyses for comprehension accuracy.

Positive Feelings

A mixed factorial repeated measures ANOVA was conducted to examine the effects of frame, number format, and domain on positive feelings with positive state affect as a covariate.

This analysis revealed a significant main effect of domain, $F(2, 602) = 10.77$, $p < .001$, $\eta_p^2 = .035$, and frame, $F(1, 301) = 12.28$, $p < .001$, $\eta_p^2 = .039$, with juvenile crime domain having the highest positive feelings reported followed by drunk driving and then wildlife species extinction. The main effect of frame indicated participants in the gain frame reported more positive feelings ($M = 7.38$, $SE = 0.24$) about the information presented than participants in the loss frame ($M = 6.83$, $SE = 0.25$). Neither the main effect of number format $F(1, 301) = 2.36$, $p = .125$, $\eta_p^2 = .008$, nor the frame by number format interaction $F(1, 301) = 0.89$, $p = .898$, $\eta_p^2 = .344$, was significant. The three-way interaction between frame, number format and domain was also not significant $F(2, 602) = 0.40$, $p = .670$, $\eta_p^2 = .001$.

Frame did interact significantly with domain, $F(2, 602) = 4.43$, $p = .012$, $\eta_p^2 = .015$. Follow up post hoc analyses revealed that participants felt more positively about gain framed messages than loss framed messages in the juvenile crime domain, mean difference = .762, $t = 4.28$, $p_{holm} < .001$, Cohen's $d = 0.49$, and in the drunk driving domain, mean difference = .559, t

= 3.14, p_{holm} = .018, Cohen's *d* = 0.36, but not in the wildlife domain, mean difference = .330, *t* = 1.86, p_{holm} = .384, Cohen's *d* = 0.21.

Number format also interacted with domain, $F(2, 602) = 3.37$, $p = .035$, $\eta_p^2 = .011$. However, post hoc comparisons did not reveal significant differences for the critical comparisons of how positively participants felt about gain- versus loss-framed messages by domain. Rather, the mean difference between percentage formatted information in the juvenile crime domain and percentage formatted information in the wildlife extinction domain was significant, but that is not meaningful to this work.

Negative Feelings

A mixed factorial repeated measures ANOVA was conducted to examine the effects of frame, number format, and domain on the negative feelings with negative state affect as a covariate.

This analysis revealed a significant main effect of domain, $F(2, 602) = 21.07$, $p < .001$, $\eta_p^2 = .065$, and frame, $F(1, 301) = 26.68$, $p < .001$, $\eta_p^2 = .081$, with wildlife species extinction domain having the highest negative feelings reported followed by drunk driving and then juvenile crime. The main effect of frame indicated that participants in the loss frame reported more negative feelings ($M = 5.79$, $SE = 0.14$) about the information presented than participants in the gain frame ($M = 5.10$, $SE = 0.14$).

Neither the main effect of number format $F(1, 301) = .59$, $p = .442$, $\eta_p^2 = .002$, nor the frame by number format interaction $F(1, 301) = .53$, $p = .469$, $\eta_p^2 = .002$, was significant. The three-way interaction between frame, number format and domain was also not significant $F(2, 602) = .04$, $p = .957$, $\eta_p^2 < .001$.

Frame did interact significantly with domain, $F(2, 602) = 3.18$, $p = .042$, $\eta_p^2 = .010$. Follow up post hoc analyses revealed that participants felt less negatively about gain-framed messages than loss-framed messages in the juvenile crime domain, mean difference = -.90, $t = -5.57$, $p_{holm} < .001$, Cohen's $d = -0.64$, and in the drunk driving domain, mean difference = -.67, $t = -4.13$, $p_{holm} < .001$, Cohen's $d = -0.47$, and in the wildlife domain as well, mean difference = -.51, $t = -3.13$, $p_{holm} = .013$, Cohen's $d = -0.36$.

Number format also interacted with domain, $F(2, 602) = 4.98$ $p = .007$, $\eta_p^2 = .016$. However, similar to positive feelings, follow up comparisons did not reveal significant differences for the comparisons central to this work. Specifically, how negatively participants felt about gain- versus loss-framed messages did not differ significantly in each domain. Rather, the mean difference between percentage formatted information in the juvenile crime domain and percentage formatted information in the wildlife extinction domain as well as percentage formatted information in the impaired driving domain and percentage formatted information in the wildlife extinction domain was significant but that is not meaningful to this work.

Comprehension Accuracy

A mixed factorial repeated measures ANOVA was conducted to examine the effects of frame, number format, and domain on comprehension accuracy with numeracy ability as a covariate. This analysis revealed a significant main effect of frame, $F(1, 302) = 57.58$, $p < .001$, $\eta_p^2 = .160$, and number format, $F(1, 302) = 7.50$, $p = .007$, $\eta_p^2 = .024$ and domain, $F(2, 604) = 5.05$ $p = .007$, $\eta_p^2 = .016$, with drunk driving domain having the highest comprehension accuracy reported followed by juvenile crime and then wildlife species extinction.

The main effect of frame indicated that participants in the gain frame had greater comprehension accuracy ($M = 80.26$, $SD = 16.13$, range: 7.63 - 98.97) than participants in the

loss frame (*M* = 58.88, *SD* = 27.68; range: 14.97 - 99.63). The main effect of number format indicated that participants who read information presented as a percentage had greater comprehension accuracy (*M* = 72.38, *SD* = 25.50; range: 14.97 - 99.63) than those presented with information in a frequency format (*M* = 67.48, *SD* = 24.14 range: 7.63 - 99.77).

The frame by number format interaction was not significant, $F(1, 302) = 2.37$, $p = .125$, $\eta_p^2 = .008$. The three-way interaction between frame, number format and domain was also not significant $F(2, 604) = 1.24$, $p = .289$, $\eta_p^2 = .004$. Domain did not significantly interact significantly with frame, $F(2, 604) = .54$ $p = .580$, $\eta_p^2 = .002$, or with number format, $F(2, 604) = .45$ $p = .640$, $\eta_p^2 = .001$.

Perceived Issue Seriousness

A mixed factorial repeated measures ANOVA was conducted to examine the effects of frame, number format, and domain on perceived issue seriousness with positive state affect, negative state affect and numeracy ability as covariates.

This analysis revealed a significant main effect of domain, $F(2, 598) = 6.30$, $p = .002$, $\eta_p^2 = .021$. A paired sample *t*-test revealed all the domains were significantly different from each other. Specifically, perceived issue seriousness was highest in the impaired driving domain (*M* = 5.09, *SD* = 0.84) compared to the wildlife species domain (*M* = 4.83, *SD* = 1.02), $t(305) = 5.183$, $p_{holm} < .001$, Cohen's $d = 0.25$, and the juvenile crime domain, (*M* = 4.57, *SD* = 1.20), $t(305) = -8.913$, $p_{holm} < .001$, Cohen's $d = -0.50$. Perceived issue seriousness was higher in the wildlife species domain compared to the juvenile crime domain, $t(305) = -4.71$, $p_{holm} < .001$, Cohen's $d = -0.25$.

The main effect of frame was not significant, $F(1, 299) = 1.21$, $p = .272$, $\eta_p^2 = .004$. Neither the main effect of number format, $F(1, 299) = 1.18$, $p = .280$, $\eta_p^2 = .004$, nor the frame by

number format interaction, $F(1, 299) = .53$, $p = .469$, $\eta_p^2 = .002$, was significant. Domain did not interact significantly with frame, $F(2, 598) = .33$, $p = .720$, $\eta_p^2 = .001$, or with number format, $F(2, 598) = .66$, $p = .520$, $\eta_p^2 = .002$. The three-way interaction between frame, number format and domain was also not significant, $F(2, 598) = .72$, $p = .400$, $\eta_p^2 = .002$.

Preference for Punitive Measures

A mixed factorial repeated measures ANOVA was conducted to examine the effects of frame, number format, and domain on preference for punitive judgements with positive state affect, negative state affect and numeracy ability as covariates.

This analysis revealed a significant main effect of domain, $F(2, 596) = 3.82$, $p = .020$, $\eta_p^2 = .013$. Impaired driving had the highest preference for punitive measures ($M = 1.701$, $SD = 0.877$) compared to wildlife species extinction ($M = 1.541$, $SD = 0.859$), $t(304) = 2.963$, $p_{holm} = .003$, Cohen's $d = 0.17$, and juvenile crime ($M = 1.252$, $SD = 1.100$), $t(304) = -6.591$, $p_{holm} < .001$, Cohen's $d = -0.47$. Preference for punitive measures was higher in the wildlife species domain than in the juvenile crime domain, $t(305) = -4.315$, $p_{holm} < .001$, Cohen's $d = -0.30$.

Neither the main effect of frame, $F(1, 298) = 1.242 \times 10^{-4}$, $p = .992$, $\eta_p^2 < .001$, nor the main effect of number format, $F(1, 298) = .91$, $p = .342$, $\eta_p^2 = .003$, were significant.

However, the frame by number format interaction was significant, $F(1, 298) = 11.19$, $p < .001$, $\eta_p^2 = .036$. Follow up post hoc analyses revealed that participants reported lower preference for punitive measures about loss-framed messages presented in a frequency format than loss-framed messages presented in a percentage format, mean difference = -.334, $t = -2.99$, $p_{holm} = .018$, Cohen's $d = -.374$. There was no significant difference between gain framed messages presented in a frequency format and those presented in a percentage format, mean difference = 0.189, $t = 1.77$, $p_{holm} = .23$, Cohen's $d = 0.21$.

Domain did not interact significantly with frame, $F(2, 596) = .19$, $p = .831$, $\eta_p^2 < .001$, or with number format, $F(2, 596) = .18$, $p = .843$, $\eta_p^2 < .001$. The three-way interaction between frame, number format, and domain was not significant $F(2, 596) = 1.95$, $p = .144$, $\eta_p^2 < .006$.

Table 1. Mean Values of the Outcome Variables by the Experimental Conditions.

	Juvenile Crime				Drunk Driving				Wildlife Species			
	Gain Frame		Loss Frame		Gain Frame		Loss Frame		Gain Frame		Loss Frame	
Variable	*M*	*(SD)*	*M*	*(SD)*	*M*	*(SD)*	*M*	*(SD)*	*M*	*(SD)*	*M*	*(SD)*
Positive Feelings												
Percentage	4.77	(1.63)	3.87	(2.07)	4.58	(1.63)	3.76	(2.07)	4.14	(1.96)	3.51	(2.12)
Frequency	4.48	(1.62)	3.57	(1.88)	4.22	(1.94)	3.63	(1.94)	4.08	(2.03)	3.71	(2.00)
Negative Feelings												
Percentage	3.75	(1.69)	4.92	(1.31)	3.86	(1.72)	4.77	(1.30)	4.46	(1.67)	5.20	(1.34)
Frequency	4.14	(1.59)	4.75	(1.54)	4.41	(1.50)	4.80	(1.61)	4.51	(1.55)	4.77	(1.8)
Comprehension Accuracy												
Percentage	83.7	(19.4)	60.9	(32.1)	83.9	(15.5)	63.3	(29.3)	78.8	(24.6)	61.8	(31.9)
Frequency	77.8	(20.3)	56.8	(28.5)	81.6	(17.3)	58.1	(25.8)	76.7	(21.8)	53.5	(30.7)
Perceived Issue Seriousness												
Percentage	4.56	(1.21)	4.63	(1.25)	5.07	(0.78)	5.22	(0.80)	4.88	(0.89)	4.8	(1.08)
Frequency	4.55	(1.30)	4.56	(1.06)	5.11	(0.98)	4.98	(0.78)	4.78	(1.17)	4.84	(0.95)
Preference for Punitive Measures												
Percentage	1.23	(1.15)	1.40	(1.02)	1.60	(1.07)	1.82	(0.83)	1.52	(0.91)	1.60	(0.94)
Frequency	1.28	(1.15)	1.12	(1.08)	1.92	(0.68)	1.46	(0.82)	1.65	(0.72)	1.41	(0.86)

Note. Responses for positive and negative feelings were made on a 7-point scale (1 = *Not at all*, *7* = Extremely). Responses for comprehension accuracy were made on a bar task where the absolute value of the distance between the hidden correct point and the point on which a respondent placed the indicator was calculated and then reverse coded on a scale 0 to 100 with higher scores indicating greater comprehension accuracy. Responses for perceived issue seriousness were made on a 7-point scale (1 = *Not at all...*, *7* = Very...). Responses for preference for punitive measures were made on a 6-point Likert scale (-3 = *Strongly disagree*, 3 = *Strongly agree*). Standard deviations are in parentheses.

Discussion

In this study, we investigated how framing and number presentation format independently and interactively impact the extent to which participants understand the information as well as how positively and negatively they feel about the information, how seriously they take the issue, and their preferences for punitive measures. It was predicted that participants would have lower comprehension accuracy for loss- relative to gain-framed information, especially when presented as a frequency (Hypothesis 1). In addition, it was predicted that participants would feel more positively and less negatively about gain- relative to loss-framed information and when presented as a percentage relative to a frequency (Hypotheses 2 and 3, respectively). Finally, it was predicted that participants would report higher perceived issue seriousness and preference for punitive measures for loss- relative to gain-framed information and for information presented as a frequency relative to a percentage (Hypotheses 4 and 5, respectively).

The most consistent effect was the main effect of frame. For comprehension accuracy, participants had greater comprehension accuracy for information presented as a gain relative to a loss. This finding is consistent with past work demonstrating that people tend to process unfamiliar messages more cautiously than familiar messages and because risk messages generally aim to increase the awareness of a certain risk by highlighting its prevalence, emphasizing the extent to which people stay safe may be much less common, and thus sound unfamiliar which in turn would lead to information being processed more thoroughly in comparison to familiar information (Lee et al., 2021).

In addition, for feelings, participants reported feeling more positively and less negatively about gain-framed relative to loss-framed messages. This also tracks with past research

demonstrating that affect, and in particular integral affect, is influenced by how information is framed. Similar to the prior work of Lee where in the unsafe assertion condition (loss-framed information), participants reported experiencing more negative emotions such as anger and sadness than those in the safe assertion condition (Lee et al., 2019). The results are also consistent with prior work of Kuhne et al. (2015) who examined the influence of emphasis framing on people's emotional reactions and preference for punitive measures and found that participants in the high responsibility frame not only reported feeling more anger than those in the ambivalent frame, but they also reported being more in favor of punitive measures. These studies measured discrete emotions (e.g., anger), but the current work took a valence-based approach. The findings from the current work are consistent with other studies that examined the impact of frame on positive and negative feelings (Han et al., 2012; Keltner & Lerner, 2010; Loewenstein & Lerner, 2003; Minton et al., 2020).

The effect of frame varied by domain as well, such that people felt significantly more positively and less negatively about gain framed messages than loss framed messages in the juvenile crime domain and in the drunk driving domain than they did in the wildlife species domain. One reason for this could be the nature of the topic of wildlife species extinction may not hit as close to home as say the issues of juvenile crime and drunk driving and hence may elicit less of an emotional reaction.

However, the impact of frame did not reach statistical significance for neither perceived issue seriousness nor preference for punitive measures. Based off past research from Lee et al. (2019), significant results were expected but although results trended towards it, it did not reach significance. One possible reason could be that unlike in Lee et al. (2019), this study did not specifically test participants' perception of risk in these domains before the study. A prior familiarity or even an overestimation of the statistics could have plausibly biased how people felt

about the information (better or worse than they expected) and that in turn could have impacted how seriously they perceived the issue and their preference for punitive measures.

The effect of number format was only significant for comprehension accuracy, demonstrating that participants had higher comprehension accuracy for information presented as a percentage relative to a frequency, which is consistent with my hypothesis and past research. This finding lends further evidence that percentages may allow for a quicker and easier understanding of messages or information, particularly in terms of national- or global-level statistics (Brase, 2002) and that percentages may be preferred because percentages place information in a simplified range (i.e., 0% to 100%), allowing people to more quickly evaluate how close it is to one's perceived critical point as compared to frequencies which may require more cognitive effort or mental steps to convert to a form that is easily used (Slovic, 1972).

Although a significant two-way interaction between frame and percentage format was expected for the variables of interest, the only significant interaction was preference for punitive measures. Specifically, participants reported lower preference for punitive measures about loss-framed messages presented in a frequency format than loss-framed messages presented in a percentage format. In other words, participants reported lower preference for punitive measures for messages that emphasize the number of people who will engage in juvenile crime, for example, as a frequency relative to a percentage. The differences by number format were not significant in the gain frame, e.g., for messages that emphasize the number of people who will not engage in juvenile crime. This finding was opposite to what we predicted based off prior research. Perhaps the statistics we used or the nature of the domains themselves played a role in people's preferences for punitive measures. The average person is likely unaware of the severity of the punishments that come with engaging in activities that could endanger wildlife and that may have led to varying responses. Conversely, juvenile crime is another domain, particularly in

the Chicagoland area that is very relevant and as such people may have strong opinions one way or the other depending on what they have seen be effective or otherwise in the communities.

Number format, overall, did not yield many two-way interactions despite predictions based off prior research. Potential reason behind the lack evidence for interaction could be the domains were largely social issues. Perhaps domains regarding health or financial issues would highlight the interaction more. It could be that if the domains were more personally relevant, participants may be more motivated to comprehend the information, which may lead to differences in how they feel about the domain and how seriously they take the issue.

Limitations and Future Directions

Looking forward, there is a lot more potential in the area of study for more research. When looking at perceived issue seriousness and preference for punitive measures, one of the possible limitations could be that a good portion study was conducted among college students and an online survey sample. Although this study had a good amount of variety, it cannot match that of a purely general public sample. The US is a very varied population especially when it comes to education and SES. The majority of the people who took part in this study were college educated and/or had the means to take a survey online for compensation. Future studies could have larger and more varied samples and could tackle more hypothesis looking at these factors affecting decision making, cross culturally and across different SES groups given the social domains being looked at.

One potential limitation that was hinted at earlier was the positive/negative phrasing that was used in setting up the gain frame or loss frame in this study. This was replicated since a similar design was used in Lee et al. (2021). As discussed in the method, there are other means of achieving the framing effect in each frame. Future studies could run the design where rather

than setting up the gain frames by using negative statements "will not commit juvenile crime" and "will not drive impaired" for juvenile crime condition and impaired driving condition respectively, positive statements such as "will be a law-abiding citizen over the next 12 months" and "will only drive sober" could be used and having both frames with positive statements may highlight the differences in the frames and interaction effects more clearly.

Another potential limitation could be the design of the study. Although meaningful extensions were made, more nuanced designs involve mediators and moderators could perhaps paint an even clearer picture behind the impact on decisions. Given the close nature of the relationship between affect and judgement, studies involving incidental affect and integral affect as mediators or moderators could lead to further insight and more conclusive findings.

Conclusions

The main takeaway from this study is that the manner in which information is presented to us has considerable impact on how we feel and the decisions we make. Although just being aware of this or certain biases is not enough to completely remove these effects, it could help in making fewer rash decisions or at the very least, understanding why we tend to do so. From an application standpoint, it could be beneficial in public policy domain where a lot of decisions (both high and low stakes) are regularly being made and a lot of trust (sometimes blind trust) is put in the hands of those in positions of power and elected officials. Another dynamic that would make the public policy domain relevant would be given how policies are conveyed, people's view on social policies can be influenced and to a larger extent, which government candidates they decide to vote for during election. Knowledge from this area of study can help make people more attentive to the factors that influence their decision making process and more broadly, help them make more informed decisions, especially during election periods, where people are

bombarded with policies and statistical information, and electing the right people can potentially have long term effects on their quality of life.

References

Bower, G. H., & Morrow, D. G. (1990). Mental models in narrative comprehension. *Science (New York, N.Y.), 247*(4938), 44–48. https://doi.org/10.1126/science.2403694

Brase, G. L. (2002). Which statistical formats facilitate what decisions? The perception and influence of different statistical information formats. *Journal of Behavioral Decision Making*, *15*, 381–401. https://doi.org/10.1002/bdm.421

Burtka, A. (2017, January 16). The Importance of Framing in Presenting Numbers. *U-M Erb*. https://erb.umich.edu/2017/01/16/the-importance-of-framing-in-presenting-numbers/

Caceres-Santamaria, A. J. (2021). *The Anchoring Effect*. https://research.stlouisfed.org/publications/page1-econ/2021/04/01/the-anchoring-effect

Camerer, C. (1999). Behavioral economics: Reunifying psychology and economics. *Proceedings of the National Academy of Sciences*, *96*(19), 10575–10577. https://doi.org/10.1073/pnas.96.19.10575

Cassotti, M., Habib, M., Poirel, N., Aïte, A., Houdé, O., & Moutier, S. (2012). Positive emotional context eliminates the framing effect in decision-making. *Emotion (Washington, D.C.), 12*(5), 926–931. https://doi.org/10.1037/a0026788

Cheung, E., & Mikels, J. A. (2011). I'm feeling lucky: The relationship between affect and risk-seeking in the framing effect. *Emotion*, *11*, 852–859. https://doi.org/10.1037/a0022854

Chiu, A., & Wu, G. (2010). *Prospect Theory*. https://doi.org/10.1002/9780470400531.eorms0687

DePaul University | Data USA. (n.d.). Retrieved July 7, 2022, from https://datausa.io/profile/university/depaul-university

Dickert, S., Kleber, J., Peters, E., & Slovic, P. (2011). Numeracy as a precursor to pro-social behavior: The impact of numeracy and presentation format on the cognitive mechanisms underlying donation decisions. *Judgment and Decision Making*, *6*(7), 638–650.

Dorison, C. A., Wang, K., Rees, V. W., Kawachi, I., Ericson, K. M. M., & Lerner, J. S. (2020). Sadness, but not all negative emotions, heightens addictive substance use. *Proceedings of the National Academy of Sciences of the United States of America*, *117*(2), 943–949. https://doi.org/10.1073/pnas.1909888116

Edmans, A., García, D., & Norli, O. (2007). Sports Sentiment and Stock Returns. *Journal of Finance*, *62*(4), 1967–1998.

Faul, F., Erdfelder, E., Lang, A.-G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods*, *39*(2), 175–191. https://doi.org/10.3758/bf03193146

Finucane, M. L., Alhakami, A., Slovic, P., & Johnson, S. M. (2000). The affect heuristic in judgments of risks and benefits. *Journal of Behavioral Decision Making*, *13*, 1–17. https://doi.org/10.1002/(SICI)1099-0771(200001/03)13:1<1::AID-BDM333>3.0.CO;2-S

Fredrickson, B. L., Tugade, M. M., Waugh, C. E., & Larkin, G. R. (2003). What Good Are Positive Emotions in Crises? A Prospective Study of Resilience and Emotions Following the Terrorist Attacks on the United States on September 11th, 2001. *Journal of Personality and Social Psychology*, *84*(2), 365–376.

Halpern, D. F., Blackman, S., & Salzman, B. (1989). Using statistical risk information to assess oral contraceptive safety. *Applied Cognitive Psychology*, *3*(3), 251–260. https://doi.org/10.1002/acp.2350030305

Hammond, D., Fong, G. T., McDonald, P. W., Brown, K. S., & Cameron, R. (2004). Graphic Canadian Cigarette Warning Labels and Adverse Outcomes: Evidence from Canadian

Smokers. *American Journal of Public Health*, *94*(8), 1442–1445. https://doi.org/10.2105/AJPH.94.8.1442

Han, S., Lerner, J. S., & Keltner, D. (2007). Feelings and consumer decision making: The appraisal-tendency framework. *Journal of Consumer Psychology*, *17*, 158–168. https://doi.org/10.1016/S1057-7408(07)70023-2

Han, S., Lerner, J. S., & Zeckhauser, R. (2012). The disgust-promotes-disposal effect. *Journal of Risk and Uncertainty*, *44*, 101–113. https://doi.org/10.1007/s11166-012-9139-3

Hirshleifer, D., & Shumway, T. (2003). Good Day Sunshine: Stock Returns and the Weather. *Journal of Finance*, *58*(3), 1009–1032.

Horowitz, D. (2022). *Horowitz: The failure of the mRNA shots is on display for all with open eyes - TheBlaze*. https://www.theblaze.com/op-ed/horowitz-the-failure-of-the-mrna-shots-is-on-display-for-all-with-open-eyes

Hossain, T., & List, J. A. (2009). *The Behavioralist Visits the Factory: Increasing Productivity Using Simple Framing Manipulations* (Working Paper No. 15623). National Bureau of Economic Research. https://doi.org/10.3386/w15623

Imas, A., Sadoff, S., & Samek, A. (2016). Do People Anticipate Loss Aversion? *Management Science*, *63*(5), 1271–1284. https://doi.org/10.1287/mnsc.2015.2402

Isen, A. M., & Geva, N. (1987). The influence of positive affect on acceptable level of risk: The person with a large canoe has a large worry. *Organizational Behavior and Human Decision Processes*, *39*, 145–154. https://doi.org/10.1016/0749-5978(87)90034-3

Isen, A. M., & Patrick, R. (1983). The effect of positive feelings on risk taking: When the chips are down. *Organizational Behavior & Human Performance*, *31*, 194–202. https://doi.org/10.1016/0030-5073(83)90120-4

Johnson, E. J., Payne, J. W., & Bettman, J. R. (1988). Information displays and preference reversals. *Organizational Behavior and Human Decision Processes*, *42*, 1–21. https://doi.org/10.1016/0749-5978(88)90017-9

Kahneman, D. (2011). *Thinking, fast and slow*. Farrar, Straus and Giroux.

Kamstra, M., Kramer, L., & Levi, M. (2003). Winter Blues: A SAD Stock Market Cycle. *American Economic Review*, *93*(1), 324–343.

Keltner, D., & Lerner, J. S. (2010). Emotion. In *Handbook of social psychology, Vol. 1, 5th ed* (pp. 317–352). John Wiley & Sons, Inc. https://doi.org/10.1002/9780470561119.socpsy001009

Krishnamurthy, P., Carter, P., & Blair, E. (2001). Attribute Framing and Goal Framing Effects in Health Decisions. *Organizational Behavior and Human Decision Processes*, *85*(2), 382–399. https://doi.org/10.1006/obhd.2001.2962

Kühne, R., Weber, P., & Sommer, K. (2015). Beyond Cognitive Framing Processes: Anger Mediates the Effects of Responsibility Framing on the Preference for Punitive Measures. *Journal of Communication*, *65*(2), 259–279. https://doi.org/10.1111/jcom.12151

Lee, B., Liu, J., Choung, H., & McLeod, D. (2019). Framing Risk with Numbers: The Framing Effects of Risk Assertions and Number Formats on Emotions and Risk Perceptions. *Mass Communication and Society*, *22*(3), 344–364. https://doi.org/10.1080/15205436.2018.1536790

Lee, B., Liu, J., Choung, H., & McLeod, D. M. (2021). Exploring Numerical Framing Effects: The Interaction Effects of Gain/Loss Frames and Numerical Presentation Formats on Message Comprehension, Emotion, and Perceived Issue Seriousness. *Journalism & Mass Communication Quarterly*, *98*(2), 387–406. https://doi.org/10.1177/1077699020934195

Lerner, J. S., & Keltner, D. (2001). Fear, anger, and risk. *Journal of Personality and Social Psychology*, *81*, 146–159. https://doi.org/10.1037/0022-3514.81.1.146

Lerner, J. S., Li, Y., Valdesolo, P., & Kassam, K. S. (2015). Emotion and decision making. *Annual Review of Psychology*, *66*, 799–823. https://doi.org/10.1146/annurev-psych-010213-115043

Levin, I. P., Schneider, S. L., & Gaeth, G. J. (1998). All Frames Are Not Created Equal: A Typology and Critical Analysis of Framing Effects. *Organizational Behavior and Human Decision Processes*, *76*(2), 149–188. https://doi.org/10.1006/obhd.1998.2804

Lipkus, I. M., Samsa, G., & Rimer, B. K. (2001). General Performance on a Numeracy Scale among Highly Educated Samples. *Medical Decision Making*, *21*(1), 37–44. https://doi.org/10.1177/0272989X0102100105

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

Loewenstein, G., & Lerner, J. S. (2003). The role of affect in decision making. In *Handbook of affective sciences* (pp. 619–642). Oxford University Press.

Martino, B. D., Kumaran, D., Seymour, B., & Dolan, R. J. (2006). Frames, Biases, and Rational Decision-Making in the Human Brain. *Science*, *313*(5787), 684–687. https://doi.org/10.1126/science.1128356

McKenzie, C. R. M. (2004). Framing effects in inference tasks—And why they are normatively defensible. *Memory & Cognition*, *32*(6), 874–885. https://doi.org/10.3758/BF03196866

Minton, A., Young, N., Nievera, M., & Mikels, J. (2020). Positivity helps the medicine go down: Leveraging framing and affective contexts to enhance the likelihood to take medications. *Emotion*, *21*. https://doi.org/10.1037/emo0000798

Monahan, J., Heilbrun, K., Silver, E., Nabors, E., Bone, J., & Slovic, P. (2002). Communicating Violence Risk: Frequency Formats, Vivid Outcomes, and Forensic Settings. *International Journal of Forensic Mental Health*, *1*(2), 121–126. https://doi.org/10.1080/14999013.2002.10471167

Peng, J., Li, H., Miao, D., Feng, X., & Xiao, W. (2013). Five Different Types of Framing Effects in Medical Situation: A Preliminary Exploration. *Iranian Red Crescent Medical Journal*, *15*(2), 161–165. https://doi.org/10.5812/ircmj.8469

Peters, E., Hibbard, J., Slovic, P., & Dieckmann, N. (2007). Numeracy skill and the communication, comprehension, and use of risk-benefit information. *Health Affairs (Project Hope)*, *26*(3), 741–748. https://doi.org/10.1377/hlthaff.26.3.741

Peters, E., Lipkus, I., & Diefenbach, M. A. (2006). The Functions of Affect in Health Communications and in the Construction of Health Preferences. *Journal of Communication*, *56*(s1), S140–S162. https://doi.org/10.1111/j.1460-2466.2006.00287.x

Putrevu, S. (2014). The Influence of Mood and Attribute Framing on Consumer Response Toward Persuasive Appeals. *Journal of Current Issues & Research in Advertising*, *35*(2), 107–125. https://doi.org/10.1080/10641734.2014.899528

Skagerlund, K., Forsblad, M., Slovic, P., & Västfjäll, D. (2020). The Affect Heuristic and Risk Perception – Stability Across Elicitation Methods and Individual Cognitive Abilities. *Frontiers in Psychology*, *11*. https://www.frontiersin.org/articles/10.3389/fpsyg.2020.00970

Slovic, P. (1972). *From Shakespeare to Simon: Speculations--and some evidence-- about man's ability to process information*. https://scholarsbank.uoregon.edu/xmlui/handle/1794/22179

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

Stark, E., Baldwin, A. S., Hertel, A. W., & Rothman, A. J. (2017). The role of rational and experiential processing in influencing the framing effect. *The Journal of Social Psychology*, *157*, 308–321. https://doi.org/10.1080/00224545.2016.1198301

Stubenvoll, M., & Matthes, J. (2022). Why Retractions of Numerical Misinformation Fail: The Anchoring Effect of Inaccurate Numbers in the News. *Journalism & Mass Communication Quarterly*, *99*(2), 368–389. https://doi.org/10.1177/10776990211021800

Tversky, A., & Kahneman, D. (1974). Judgment under Uncertainty: Heuristics and Biases. *Science*, *185*(4157), 1124–1131. JSTOR.

Young, N. A., Shuster, M. M., & Mikels, J. A. (2019). The sure thing: The role of integral affect in risky choice framing. *Emotion*, *19*, 1035–1043. https://doi.org/10.1037/emo0000505

Appendix A.

Modified Differential Emotion Scale (mDES)

Instructions: In any given circumstance, people often have a number of different feelings. Please indicate how much of each emotion you are **feeling right now, at this moment**.

Use the following 0 to 4 scale to make your ratings:

0 = Not at all
1 = A little bit
2 = Moderately
3 = Quite a bit
4 = Extremely

1. To what extent are you currently feeling amused, fun-loving, silly?
2. To what extent are you currently feeling angry, irritated, annoyed?
3. To what extent are you currently feeling ashamed, humiliated, disgraced?
4. To what extent are you currently feeling awe, wonder, amazement?
5. To what extent are you currently feeling contemptuous, scornful, disdainful?
6. To what extent are you currently feeling content, serene, peaceful?
7. To what extent are you currently feeling disgust, distaste, revulsion?
8. To what extent are you currently feeling embarrassed, self-conscious, blushing?
9. To what extent are you currently feeling glad, happy, joyful?
10. To what extent are you currently feeling grateful, appreciative, thankful?
11. To what extent are you currently feeling hopeful, optimistic, encouraged?
12. To what extent are you currently feeling interested, alert, curious?
13. To what extent are you currently feeling love, closeness, trust?
14. To what extent are you currently feeling proud, confident, self-assured?
15. To what extent are you currently feeling repentant, guilty, blameworthy?
16. To what extent are you currently feeling sad, downhearted, unhappy?
17. To what extent are you currently feeling scared, fearful, afraid?
18. To what extent are you currently feeling sexual, desiring, flirtatious?
19. To what extent are you currently feeling surprised, amazed, astonished?
20. To what extent are you currently feeling sympathy, concern, compassion?

Appendix B.

Scenarios

Domain: Juvenile Crime

General Information

According to the Bureau of Justice Statistics, the rate of crimes committed by juveniles (i.e., people under the age of 18), which include assault, armed robbery, arson, theft, has remained quite stable in the United States since 2000.

Gain-framed statement in frequency format

- Specifically, 207.1 million of the 222 million juveniles in the United States will not commit juvenile crimes during the next 12 months.

Gain-framed statement in percentage format

- Specifically, 93.3% of juveniles in the United States will not commit juvenile crimes during the next 12 months.

Loss-framed statement in frequency format

- Specifically, 14.9 million of the 222 million juveniles in the United States will commit juvenile crimes during the next 12 months.

Loss-framed statement in percentage format

- Specifically, 6.7% juveniles in the United States will commit juvenile crimes during the next 12 months.

Domain: Impaired Driving

General Information

According to recent statistics released by the Centers for Disease Control and Prevention (CDC), the rate of impaired driving (which includes drunk driving, drugged driving, and driving while using electronic devices), a common factor in traffic accidents and motor vehicle fatalities, has remained quite stable in the United States since 2000.

Gain-framed statement in frequency format

- According to CDC estimates, 259.6 million of the 296 million licensed drivers in the United States will not drive while impaired during the next 12 months

Gain-framed statement in percentage format

- According to CDC estimates, 87.7% of the licensed drivers in the United States will not drive while impaired during the next 12 months.

Loss-framed statement in frequency format

- According to CDC estimates, 36.4 million of the 296 million licensed drivers in the United States will drive while impaired during the next 12 months.

Loss-framed statement in percentage format

- According to CDC estimates, 12.3% of the licensed drivers in the United States will drive while impaired during the next 12 months.

Domain: Wildlife Species Extinction

General Information

According to recent statistics released by the United Nations' Convention on Biological Diversity (CBD), the number of wildlife species has been on a steady decline since 2000, largely due to human activity. This decline in biological diversity poses a major threat, not only to the species themselves, but also to the resources that provide humans with food, clothing and medicine.

Gain-framed statement in frequency format

- According to CBD estimates, 1.73 million of the 1.8 million wildlife species of plants, insects, birds, and mammals will still be in existence after the next 12 months.

Gain-framed statement in percentage format

- According to CBD estimates, 96.1% of the wildlife species of plants, insects, birds, and mammals will still be in existence after the next 12 months.

Loss-framed statement in frequency format

- According to CBD estimates, 70,000 of the 1.8 million wildlife species of plants, insects, birds, and mammals will become extinct during the next 12 months.

Loss-framed statement in percentage format

- According to CBD estimates, 3.9% of the wildlife species of plants, insects, birds, and mammals will become extinct during the next 12 months.

Appendix C.

Demographics

Age **_____ (years)**

Birthdate: **_____ (MM/DD/YYYY)**

Sex: **M / F / Prefer Not to Answer (circle one)**

What is your marital status? (Please circle one)

1. Single
2. Married
3. Divorced/Separated
4. Widowed
5. Partnered/Cohabiting (unmarried)
6. Other, please specify

What is your current employment status?

1. Working full-time (30 hours or more per week)
2. Working part time (less than 30 hours per week)
3. Employed, but currently not at work due to temporary illness, vacation, or strike
4. Unemployed; laid off; looking for work
5. Retired and not working
6. Retired, but now working part time
7. Other, please specify: _____

How many years of education have you completed (e.g., high school = 12 years; bachelor's degree = 16 years; master's degree = 18 years)? _____

What is your highest completed level of education?

1. Less than high school
2. High school degree or equivalent
3. Some college but no degree

4. Associate's Degree

5. Bachelor's Degree (e.g., BA, BS, AB)

6. Master's Degree (e.g., MA, MS, MBA, MSW, MEng, MED)

7. Doctorate Degree (e.g., PhD, EdD, M.D., J.D.)

Are you a native English speaker or have proficiency in English?

1. Yes

2. No

What best describes your ethnic category? (Please circle one)

1. Hispanic or Latino
2. Not Hispanic or Latino

What best describes your race? (Please circle one)

1. White or Caucasian

2. Black or African American

3. American Indian, Alaska Native

4. Asian

5. Native Hawaiian or Other Pacific Islander

6. Other, please specify: _____

Please circle the number that corresponds to your current socioeconomic level:

1	2	3	4	5
Lower Income	Lower Middle Income	Middle Income	Upper Middle Income	Upper Income

What is your family's/your annual household income (before taxes)?

1. Less than $20,000

2. $20,001 - $35,000

3. $35,001 - $50,000

4. $50,001 - $75,000

5. $75,001 - $100,000

6. $100,001 - $150,000

7. Greater than $150,000

Appendix D.

1. Imagine that we roll a fair six-sided die 1,000 times. Out of 1,000 rolls, how many times do you think the die would come up even?

   _____

2. In the BIG BUCKS LOTTERY, the chances of winning a $10.00 prize is 1%. What is your best guess about how many people would win a $10.00 prize if 1,000 people each buy a single ticket to BIG BUCKS?

   _____

3. In the ACME PUBLISHING SWEEPSTAKES, the chance of winning a car is 1 in 1,000. What percent of tickets to ACME PUBLISHING SWEEPSTAKES win a car?

   _____

4. Which of the following numbers represents the biggest risk of getting a disease?
   a. 1 in 100
   b. 1 in 1000
   c. 1 in 10

5. Which of the following numbers represents the biggest risk of getting a disease?
   a. 1%
   b. 15%
   c. 5%

6. If Person A's risk of getting a disease is 1% in ten years, and person B's risk is double that of A's, what is B's risk?

   _____

7. If Person A's chance of getting a disease is 1 in 100 in ten years, and person B's risk is double that of A's, what is B's risk?

   _____

8. If the chance of getting a disease is 10%, how many people would be expected to get the disease <u>out of 100?</u>

_____

9. If the chance of getting a disease is 10%, how many people would be expected to get the disease out of 1000?

   _____

10. If the chance of getting a disease is 20 out of 100, this would be the same as having a ____% chance of getting the disease.

    _____

11. The chance of getting a viral infection is .0005. Out of 10,000 people, about how many people are expected to get infected?

    _____