HOW IT MEETS THE EYE: ALTERING LOCUS OF CONTROL THROUGH ENVIRONMENTAL DATA VISUALIZATION

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MASTER OF SCIENCE

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ABSTRACT

Locus of control (LOC), first defined as a trait determining one's sense of control over outcomes, continues to be refined. Originally treated as a generalized expectancy, scholars have extended its range for queries in specific domains (e.g., health, workplace, environmental behaviors), and, in more recent years, have suggested reformulating the concept as a state, based on evidence indicating its susceptibility to change. This paper builds on work suggesting a relationship between data visualization techniques and LOC by presenting the results of an experiment aiming to manipulate environmental internal LOC by varying the number of graphical elements in bar charts. Environmental issues, presenting cause for concern and a need for urgent action, provide a timely area for application—and one in which a shift toward internal locus of control carries substantial benefits, as research indicates a strong link between internal LOC and participation in pro-environmental behaviors.

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INTRODUCTION

Research analyzing "locus of control"—its effects on motivation and behavior, as well as its manipulation – has profound implications for activists, policymakers, and others who seek to produce specific behaviors (Levenson and Miller 1976; Legerski, Cornwall, and O'Neil 2006; Galvin, Randel, Collins, and Johnson 2018; Kalamas, Cleveland, and Laroche 2014). Locus of control refers to individuals' beliefs about the amount of control they have over events and varies from individual to individual. Those with an internal locus of control believe outcomes result primarily from personal effort or ability. In contrast, individuals with an external locus of control ascribe outcomes to forces outside of their control (e.g., chance or powerful others). Research shows that locus of control predicts a wide range of outcomes, including motivation and behavior (Galvin et al. 2018).

Social learning theory served as the theoretical foundation for locus of control, but the concept has not remained unchanged since its inception. Though originally understood as a fixed trait, Ryon and Gleason (2014) describe how it functions more like an alterable state. The reformulation is ultimately consistent with social learning theory, which claims that early experiences influence one's learning process and, in turn, behavior. During this learning process, individuals begin to develop a sense that certain types of behaviors result in certain types of reinforcements. Over time, individuals' expectancies about causal links between behaviors and rewards result in more stable differences between individuals (i.e., their locus of control) (Galvin et al. 2018). Conceptualizing locus of control as an alterable state essentially extends this learning process throughout one's lifetime, instead of claiming its crystallization in early development.

The implications of the shift towards reconceptualizing locus of control as a state are profound, not only for the understanding of the concept as a generalized expectancy, but also for its application to understanding behavior in the workplace, as well as the enactment of beneficial behaviors in health and environmental domains (Legerski et al. 2006; Galvin et al. 2018; Ahn, Bailenson, and Park 2014). If locus of control can change and it predicts behavior, it behooves researchers interested in producing certain behaviors to investigate what might provoke or prevent change in an individual's locus of control. One promising area of investigation exists within the field of data visualization. Recent developments suggest that individuals may interpret visualizations (e.g., graphic designs) differently due to differences in loci of control (Ziemkiewicz, Ottley, Crouser, Yauilla, Su, Ribarsky, and Chang 2013). This study tests whether the addition of certain design elements in bar graphs might effectively shift locus of control toward greater internality among users.

My purpose is to determine if locus of control can be modified with the specific aim of increasing the perception that action by an individual can have an outcome on the environment. That is, can those who think that their actions have little impact on the environment experience a shift toward a stronger sense of the impact of their actions? My hypothesis posits that locus of control can change depending on the complexity of the presentation of data in visualizations. My research question is:

> *Can environmental locus of control be altered by manipulating the number of graphical elements in messaging?*

In the following section, the context and motivation of the study is set up in a discussion of environmentalism in the United States. I discuss locus of control and data visualization as a mediating factor between information and behavior in general, and more specifically within the

domain of pro-environmental behavior. I apply theories of data visualization and locus of control to generate a hypothesis and tests, and conclude with a discussion of results, limitations of the study and possible future directions for research.

LITERATURE REVIEW

Environmentalism in the United States

The scientific community agrees that climate change exists, and its origins are human (Feinberg and Willer 2011; Feygina, Jost, and Goldsmith 2010, Steg and Vlek 2008; Ahn et al. 2014). The Intergovernmental Panel on Climate Change asserts that, "Warming of the climate system is unequivocal […]" (IPCC 2007:2). NASA cites the rise of global temperature, increased temperature in oceans, diminishing ice sheets, glacial retreat, rising sea levels, decreasing arctic sea ice, and increased ocean acidity as evidence of climate change (NASA N.d.). Yet, despite the availability of such evidence from reputable sources, only 41% of the American public attribute climate change to anthropogenic causes (Ahn et al. 2014). The variation in opinions seems, in part, to be a consequence of disposition. Some individuals believe strongly in their capacity to control events and outcomes related to the environment, while others believe that outside forces have greater control over environmental outcomes. These beliefs refer to an individual's "environmental locus of control." Beyond claims regarding causes of climate change, those who believe they have greater control over their lives are better poised to make positive environmental decisions (Yuriev, Boiral, Francouer, and Paille 2018; Galvin et al. 2018; Ahn et al. 2014). It follows that successful interventions to reduce harmful environmental practices could be facilitated by creating a greater sense of personal control over outcomes.

Forerunners in the modern environmental movement emphasized that environmental destruction by humans has severe consequences, and that the public has a right to know how these consequences might affect them (Carson [1962] 2000; Stoll 2007). Unfortunately, research suggests that the provision of knowledge alone is insufficient to produce behavior change (Barr and Gilg 2007:362). While policy change has certainly at times proven effective, passing new

legislation or enacting stricter regulations can be a slow and arduous process. By the time changes are codified, the damage may be widespread. For instance, even though DDT was banned well over 40 years ago, a new study suggests a link between lingering levels of the chemical in the bloodstream of mothers from previous contact and the diagnosis of children with autism spectrum disorder (Brown, Cheslack-Postava, Rantakokko, Kiviranta, Hinkka-Yli-Salomäki, McKeague, Surcel, and Sourander 2018:1). Since policy change may be effective, but slow, and public awareness campaigns have been insufficient, it seems incumbent upon us to better understand why some people participate in behaviors that benefit the environment while others do not. Fortunately, significant amounts of research have already been completed on core aspects of this question.

Pro-environmental behaviors

Research into pro-environmental behaviors, and attitudes towards them, is ubiquitous. Stern (2000), for one, worked to advance a more coherent theory of environmentally significant behavior—defining what constitutes environmentally significant behaviors, categorizing such behaviors and their origins, and ultimately seeking ways to influence the factors that determine behaviors (Stern 2000:407). Studies focused on pro-environmental behaviors often discuss the use and effectiveness of interventions aimed at changing behaviors to encourage more ecologically sound practices (see Stern 2000; Barr and Gilg 2007; Kalamas, Cleveland and Laroche 2014). One major intervention is to provide information through educational efforts to change attitudes (Stern 2000:419); this practice has been supported by the information deficit model.

The information deficit model—a causal linear model suggesting behavior occurs through awareness, information, decision, and action—assumes what is now referred to as the

"A-I-D-A logic of behavior," (Barr and Gilg 2007:362). Applying A-I-D-A (awareness, information, decision, and action), the best way to work toward resolution of environmental issues is to make people aware of concerns and then inform them how to engage in better practices. According to the model, once people know the proper response, they decide to act and, ultimately, the behavior creates the desired outcome change (362). Unfortunately, research suggests that simply sharing information, though it may lead to a change in attitude, is insufficient to bring about actual behavioral change (362).

Addressing gaps in environmental knowledge by educating the public is an important component of encouraging action, but awareness efforts alone have not successfully led to behavior change. Kalamas et al. (2014), indicate that, while most consumers are concerned about the environment and their role in its wellbeing or destruction, their level of concern has generally not been commensurate with their behavior (2014:12). Researchers, however, emphasize that, though the information-deficit model may not be holistic enough to withstand the complexities inherent in environmental action, such a finding does not dismiss or diminish the value of research that aims to quantify behaviors or attitudes related to environmental action (Barr and Gilg 2007). Rather, it encourages both the gathering of detailed data about individual lifestyles along with data that can offer a more widescale perspective of daily choices and behaviors (362). Educating the public is important, but not necessarily motivating. The next relevant area of investigation then, examines factors that motivate behavior.

The psychological variable of locus of control, which considers whether individuals believe outcomes result primarily from their own action (i.e., internal control) or from external forces beyond their control (i.e., external control), has been linked to environmental behaviors

and offers perhaps a more effective means of encouraging environmental behaviors (Huebner and Lipsey 1981). The following discusses locus of control and its relation to behavior.

Locus of control

Julian Rotter, a psychologist widely credited with much of the early development of the concept of locus of control, cites his own work on social learning theory as the theoretical foundation for what he initially termed "generalized expectancies for internal versus external control of reinforcement." Rotter's attempt to develop measures of internal-external control was built on previous work by Phares (1957), who constructed a scale with a total of 26 items, half devoted to internal attitudes and half to external attitudes in a study of skill and chance effects on reinforcement expectancies (Rotter 1966:9).

Rotter (1966) points to the relation between reinforcement and performance, noting that some individuals tend to think rewards result from their own actions, while others perceive receipt of a reward as due to some external factors (1966:1). Rotter goes on to explain that, if reinforcement or reward appears to follow from one's action, but not completely depend on it, individuals consider such happenings as resulting from chance, luck, fate, or otherwise controlled by "powerful others." Rotter termed this a "belief in *external control"* while individuals who perceived events as primarily dependent on their own actions were said to have beliefs in internal control (1). The Internal-External Control (hereafter I-E) scale developed by Rotter is a forced-choice test including 29 items, incorporating filler items to make the test's purpose appear ambiguous (1966:10). Results from this original scale inspired the early conception of locus of control.

Rotter relates "locus of control" to "alienation." Following from the classical works of Marx, Durkheim, and Weber, alienated individuals feel incapable of directing their futures and

fulfilling their potential as "a small cog in a big machine and at the mercy of forces too strong or too vague to control" (Rotter 1966:3). Seeman (1959) expands on classical understanding of alienation, offering five "alternative meanings of alienation": powerlessness, meaninglessness, normlessness, isolation, and self-estrangement (1959:783). Seeman joined the concept of alienation, identified as "powerlessness", to the concept of internal and external control (Rotter 1966:3). Discussing alienation as powerlessness from a social psychological perspective, not as based on the "objective conditions in society," but on an, "individual's expectancy for control of events," Seeman links Rotter's (1958) "internal *versus* external control of reinforcements" to alienation (1959:784, emphasis original).

Levenson and Miller (1976) argue that the relation between activism and locus of control as measured by Rotter's I-E scale is inconsistent (1976:199-200). Referencing Strickland (1965) and Gore and Rotter (1963), Levenson and Miller (1976) acknowledge that some early studies support Rotter's theory. However, Huebner and Lipsey (1981) find no significant relation between activism and locus of control and cite three other studies with the same finding: Blanchard and Scarboro (1972), Gootnick (1974), and Evans and Alexander (1970) (1981:55). Levenson and Miller (1976) suggest two reasons for the inconsistent findings in the 1970s: 1) the "changing times" of the United States in the 1960s, and 2) an issue with the conceptualization of the scale (200). They assert that a different conceptualization of locus of control might better capture the concept in studies, whereby studies can more accurately gauge the relation between activism and locus of control (200). Levenson (1974,1981) developed multidimensional scales for locus of control, effectively dividing the measure of external control into two constructs – chance and powerful others – while retaining a measure for internal control, for a total of three scales (Levenson 1981; Levenson and Miller 1976: 200).

Locus of control and environmental behavior

Research indicates that a strong relationship exists between ecologically responsible behavior and locus of control (Ahn et al. 2014:235). According to Huebner and Lipsey (1981), those who participate in pro-environmental behaviors necessarily believe "in the efficacy of their own ameliorative action (i.e., maintain an 'internal' locus of control)" (1981:55). Although the relationship between locus of control and pro-environmental behaviors has been supported (Ahn et al. 2014:235), both Levenson and Rotter's scales have received criticism regarding their applicability to studies on environmental action (Huebner and Lipsey 1981:55). Researchers question the applicability of Rotter's scale for such studies, in part from findings suggesting his I-E measure is not related to social action (55). While also shown to be flawed, Levenson's scales offer an improved means of predicting "willingness to engage in ecologically responsible activities," likely as a result not only of the multidimensional approach, but also the particular dimensions created (55). As Huebner and Lipsey explain, "When environmental action is the practical issue of interest, a distinction between the role of chance and that of powerful outside interests is quite sensible and undoubtedly more useful in the environmental context than might be other multidimensional distinctions" (55).

The operationalization of the locus of control scales has not been the sole cause of inconsistent findings and confusion in studies regarding environmental behaviors. Frequently confused with locus of control, perceived behavioral control includes, " 'people's expectations regarding the degree to which they are capable of performing a given behavior, the extent to which they have the requisite resources and believe they can overcome whatever obstacles they may encounter' " (Ernst, Blood, and Beery 2017: 155). A major concept in Azjen's theory of planned behavior—perceived behavioral control—is composed of two major pieces:

controllability and self-efficacy (2017:155). Self-efficacy within this concept is understood as the ease with which one performs a given behavior, and controllability is understood as how much one believes events are under their influence (155). Ernst et al. (2017) highlight studies which have essentially treated the two concepts as identical by comparing their findings as if they were equivalents (172). Multiple studies have been criticized for operationalizing constructs related to environmental behavior inconsistently: the example of the confusion over the constructs of perceived behavioral control and locus of control serves as one major example (172).

Locus of control: Fixed trait or alterable state?

Perhaps one of the greatest developments regarding the construct of locus of control has been a closer look at whether it is better understood as more of an inherent characteristic, resistant to change over time, or something that can be modified – better termed a "state" than a "trait" (Ryon and Gleason 2014:121). Rotter's I-E locus of control scale placed subjects on a continuum, generally categorizing those whose scores fell within the upper half of the distribution as "externals" and those whose scores fell in the lower half as "internals" (Rotter 1966:19). The implication is twofold: 1) internal/external control exist on the same continuum and 2) locus of control is a fixed trait.

The development of the construct from unidimensional to multidimensional maintains its treatment as a stable trait (Ryon and Gleason 2014:121), but it treats internal control and external control as distinct concepts, each measured by their own scale. While not entirely conclusive, recent research suggests that locus of control may not be as stable a trait as initially conceived. The potential to manipulate locus of control toward internality is worthy of study as it may lead to the adoption of pro-environmental behaviors by those with external locus of control.

Much of the research on locus of control treats the variable primarily as a stable trait, considering it to be more a *cause* of behavior than a *consequence* of social environment. Huebner and Lipsey (1981) examined measures of locus of control and environmental activism, in part to determine locus of control's modifiability "under the pressure of a sociopolitical event," in this case, a ballot referendum regarding the California Nuclear Power Initiative of 1977. According to the study's findings, situation-specific locus of control Powerful Others and situation-specific locus of control Chance scales demonstrated a shift toward externality in a group of activists following California's Nuclear Safeguards Initiative's defeat, while maintaining internality on the situation-specific Internal scale (Huebner and Lipsey 1981: 54-56). In addition, the researchers note that while Rotter's locus of control had generally been understood as a stable personality trait, other studies regarding political events indicated its potential for change (47). Sociopolitical events, however, have not been the only opportunity for considering the construct's modifiability.

Legerski, Cornwall, and O'Neill (2006) revisited the question of whether locus of control might be changed in a study about steelworkers facing forced unemployment, noting the concept was still generally seen as a stable personality characteristic at the time (Legerski et. al 2006:1521). Ultimately, the study does not report an overall change in the locus of control score but does report other findings calling for further research and suggests that life-changing events, like long term unemployment, can alter one's sense of control over the events of their lives (1534).

Although studies conducted by Huebner and Lipsey (1981) and Legerski et al. (2006) both suggest the modifiability of locus of control, counterarguments might be offered on the basis of neuroanatomical claims. Hashimoto et al. (2015) found significant correlations between

gray and white matter volumes and locus of control (Hashimoto, Takeuchi, Taki, Sekiguchi, Nouchi, Kotozaki, Nakagawa, Miyauchi, Iizuka, Yokoyama, Shinada, Yamamoto, Hanawa, Araki, Hashizume, Kunitoki, and Kawashima 2015:146). Although such a finding may seem deterministic, researchers indicate that "a feeling of being in control can be constructed through daily events and this might shape brain structures" (Hashimoto et al. 2015:146). Hashimoto et al.'s (2015) study, from a neuroanatomical perspective, seems to support both the characterization of locus of control as a cause of behavior as well as a consequence of one's social environment.

The ability to modify locus of control could have very significant implications for environmental behaviors. Ahn et al. (2014) state that, although 97% of scientific discourse cited human action as a cause of climate change, only 41% of the general American public made the same attribution (2014:235). They assert that this attribution gap might partially explain the coexistence of vast amounts of information about environmental concerns and lack of behavioral changes, and further suggest that increasing internal control among those who fail to connect their actions to climate change may significantly decrease the attribution gap (235). Ahn et al. (2014) suggest that since those with internal locus of control are more likely to engage in pro-environmental behaviors, the potential to encourage a shift toward greater internality merits greater attention. Although evidence supports the connection between environmental behaviors and locus of control (Bamberg and Möser 2007; Ahn et al. 2014), research attempting to manipulate locus of control to encourage pro-environmental behaviors is severely lacking (Ahn et al. 2014: 235).

Attempts to manipulate locus of control are informed by empirical data from research on decision-making (Ahn et al. 2014:236). The, "time-delayed, abstract, and often-distant nature"

of environmental concerns does not necessarily encourage strong reactions to the threat of climate change (236). Ahn et al. (2014) hypothesized that one's own experience of a negative consequence might make an issue seem more relevant, thereby increasing internal locus of control. To test their hypothesis, Ahn et al. utilized immersive virtual environments to offer a visceral experience of cutting down a virtual tree to make the connection between paper use and deforestation (236).

Beyond locus of control, several factors including moral concerns, moral affect and types of informational and structural strategies, have been analyzed in attempts to encourage pro-environmental behaviors (Steg and Vlek 2008). The following sections discuss three major sources of environmental messaging and present an argument linking the style of message presentation to message clarity, and message clarity to changes in locus of control.

Data visualization

As early as the 1920s, Walter Eells (1926) and Frederick Croxton (1932) began investigating best practices for data visualization. Data visualization refers to the graphical representation of information or data points. Information cannot mediate behavior in the absence of comprehension. Research in this area examines how different possible visualizations affect the degree of comprehension. For example, Eells (1926) and Croxton (1932) identified charts or shapes that best represent data so that individuals grasp data meaning accurately (see Eells, 1926 and Croxton 1932). More recently, Ziemkiewicz et al. (2013) examined effects of layout style, also known as spatial arrangement, and visual encoding, understood as mapping of variables to specific graphical characteristics (such as size or color) on user comprehension (Ziemkiewicz et al. 2013:1).

Ziemkiewicz et al. (2013) found that the way elements are displayed interacts with one's locus of control (13). Their findings suggest that those with more internal locus of control will perform better when given visualizations that minimize use of grouping elements (e.g., borders, outlines, etc.) and are characterized by "simple spatial organization," whereas those with external locus of control may perform better with the inclusion of more grouping elements to "call attention to a specific information structure" (13). The researchers further suggest that those with external locus of control may prefer visualizations which organize information using a two-dimensional layout. Finally, Ziemkiewicz et al. discovered that those with an external locus of control might be more willing to adjust their thinking to accommodate novel visualizations, while those with an internal locus of control might take more time to do so, highlighting an advantage for those with an external locus of control (13). They refer to research that suggests that the "surface learning" practice of those with external locus of control, generally considered to be a negative point academically, might be advantageous in the process of learning a novel visualization system (12).

Whereas prior research focuses on how current locus of control affects comprehension, this investigation will check if comprehension, as affected by type of data visualization, can affect locus of control. In particular, the study will examine if more easily understood graphics produce higher scores on a scale measuring internal locus of control specifically for environmental events.

Images

Images are frequently utilized in communication containing pro-environmental messaging; one reason for their use is their capacity to change mental imagery from abstract to concrete (Wang, Miller, Brown, Jiang and Castellazi 2016:1753; Boomsma, Pahl, and Andrade

2016:1). Research indicates that one of the major issues in communicating environmental problems is that environmental change is perceived as too abstract (Boomsma, Pahl, and Andrade 2016:1). Boomsma et al. (2016) cite research explaining, "external imagery is key in determining how individuals perceive real-world issues and can transform abstract issues into something that can be visualized – and *that individuals can respond to*" (2016:3; emphasis added). Although research on the relationship between behavior and imagery is still regarded as nascent, there exists evidence to suggest that one's mental imagery is linked to perceptions on climate change (Boomsma et al. 2016:3).

Construal Level Theory asserts that those with more concrete mental representations of an event perceive the event to be closer to them, while those with more abstract mental representations tend to see the event as more distant (3). Indeed, research has pointed to the abstract nature of environmental problems (Ahn et al.2014:236). Finding a way to clarify the issues by making them more concrete would, according to Construal Level Theory, make the issues seem closer in terms of time, space, and/or chance of occurring (Boomsma et al. 2016:3), potentially affecting not only one's understanding of the issue, but one's sense of control over it as well. Another means of influencing the public's understanding of an issue is through using text communication that resonates with one's values.

Communication through text and moral reframing

Feinberg and Willer (2012) argue that individuals are more likely to be receptive to messaging that resonates with their moral values, asserting that groups of people will be affected to different degrees by different messages; this idea is referred to as the "logic of segmentation" and is closely related to work on message framing (57). For example, positions on five areas of human morality – harm/care, fairness/reciprocity, in-group/loyalty, authority/respect, and

purity/sanctity – have been shown to correspond in unique ways to liberal and conservative identities (57). Message framing based on moral values has shown significant promise in explaining the relationship between political ideology and environmental behaviors. Feinberg and Willer (2012) found that presenting pro-environmental concerns to conservatives using moral concerns they relate to leads to increased support for pro-environmental behaviors (57).

Deeply held beliefs about the nature of the world and systems one lives in have also been shown to affect the likelihood of pro-environmental behaviors. Just-world belief, the belief that the world is "just, orderly, and stable," is widespread and deep-seated (Feinberg and Willer 2011:34). Similarly, according to Feygina, Jost and Goldsmith, (2010:327), beliefs that justify systems are influenced by a need for stability, and in turn motivate individuals to assess systems as "fair, legitimate, beneficial, and stable." In doing, system justification beliefs rationalize and protect systems. Just-world beliefs and system-justification beliefs have positive qualities, but often conflict with environmental messaging. Research indicates, for example, that dire messaging regarding global warming may ultimately backfire when it conflicts with individuals' just world beliefs (Feinberg and Willer 2011:37). Furthermore, system justification theory asserts that individuals may support harmful practices if it allows them to maintain a sense of stability and a belief in the fairness of the system (Feygina, Jost and Goldsmith 2010:326). For example, individuals might support harmful changes in oil and gas regulatory practices endorsed by elected officials because doing so allows them to continue to believe in the fairness of the system of governance, whereas questioning such elected officials' judgments undermines the system they represent.

Environmental degradation is a pressing issue, and research indicates that those with an internal locus of control are most likely to act to decrease or reverse it. Early environmentalists

championed public awareness campaigns, adopting a logic which assumed the best way to encourage better ecological choices was through information and education. Research indicates that this approach, though important, has been largely unsuccessful. At the same time, environmental communication has been criticized for being too abstract or vague. However, not all efforts to communicate the importance of pro-environmental behaviors have failed. For instance, recent studies about moral reframing serve as an example and precedent for how changing the way in which messages are communicated can lead to positive outcomes. Studies primarily using images suggest that the stronger a mental image, the more an individual might feel empowered to respond to it. At issue then is determining all the means by which physical images can produce vivid mental images.

Locus of control is closely correlated with environmental behaviors for the following reason: if individuals think they do not have an impact on the larger environment, they have no reason to act even should they want to do so. In contrast, if individuals believe their actions have impact, concern should motivate change. For that reason, the potential to shift toward greater internality has considerable potential for impact. I am positing that by using more appropriate messaging strategies, as studies on moral reframing and mental imagery have done in their own way, one's locus of control can be shifted toward internality. This study focuses on the impact of data visualization on locus of control and leaves the impact of locus of control on environmental behavior for future studies.

THEORY AND HYPOTHESIS

Locus of control theory and data visualization theory are central to the investigation. Locus of control theory is an offshoot of Rotter's social learning theory. According to social learning theory, individuals develop expectancies over time that certain behaviors lead to certain reinforcements. This development occurs by way of early experiences and circumstances such as socioeconomic status, parenting style, and environmental factors (Galvin et al. 2018:821). Locus of control develops through this process. Individuals develop either a sense of control over events or a sense that external forces determine their fate. Research finds that those with an external locus of control more frequently adopt a passive stance toward outcomes in their lives (821).

As discussed earlier, locus of control has been conceptualized and measured in several different ways. Rotter's (1966) scale measures external and internal locus of control on one, continuous scale. In contrast, Levenson (1974, 1981) developed distinct scales for internal control, control by powerful others, and outcomes determined by chance. Situation- and domain-specific measures have emerged as well (Huebner and Lipsey 1981; Galvin et al. 2018). This study utilizes a domain-specific scale for internal locus of control, in line with contemporary recommendations and studies (Galvin et al. 2018; Ahn et al. 2014; Kalamas, Cleveland, and Laroche 2014). Huebner and Lipsey's (1981) research compares findings from generalized scales against those from situation-specific scales. They reported greater success with the situation-specific locus of control scales with respect to its ability to differentiate between activists and nonactivists as well as its ability to predict interest in participating in pro-environmental behaviors.

Research links environmental behavior to environmental locus of control but has largely ignored the possibility of manipulating locus of control to encourage pro-environmental behaviors (Ahn et al. 2014:235). One potential way to manipulate locus of control is to manipulate data visualizations. Data visualization studies examine how visualization relates to personality factors and how various visualizations affect the ability of individuals to problem-solve or to understand data (Ziemkiewicz et al. 2013:12).

Tufte's data-ink ratio is an often-cited guideline of design and encourages minimalist visualizations (Ziemkiewicz et al. 2013; Tufte 1983). According to Tufte, a quality graphic presentation of data should maximize data-ink – ink that denotes data on a graph – while minimizing the use of any other ink. However, some theory suggests that what counts as a quality graphic representation of data can vary depending on the person viewing the graph (Ziemkiewicz et al. 2013). The Distributed Cognitive Approach predicts that those who have external locus of control rely more on external representations when interpreting information. From that prediction, it is possible to infer that a minimizing of non-data ink may not be optimal for everyone. According to Ziemkiewicz et al. (2013), individuals with external locus of control may better interpret visualizations with the addition of more non-functional elements (12).There is reason to hypothesize that offering information to users in a format they can more easily comprehend will lead to a greater sense of empowerment .

The proposed study's hypothesis rests on the following assumptions inspired by prior research. 1) Individuals with external locus of control better comprehend data visualizations with more elements and 2) comprehension empowers individuals to act, and that increased *ability* to act can shift the individual toward an internal locus of control for that issue. It follows, then, that the new locus of control might encourage pro-environmental behaviors. The research proposed

here seeks to use principles of data visualization to alter environmental locus of control. The research question follows:

> *Can environmental locus of control be altered by manipulating the number of graphical elements in messaging?*

Following from research presented above, and the basic argument linking data visualization to locus of control, the following hypothesis is provided.

> H: Mean scores for internal locus of control will increase most when data is presented using a high number of supporting, non-data graphical elements, and least when information is not presented in graph form.

The previous sections established the benefit of investigating the malleability of environmental locus of control. Literature in environmental intervention strategies and locus of control were reviewed, and a new strategy for intervention was proposed. Environmentalism in the United States and methods of education aimed at encouraging pro-environmental behaviors continue to evolve, learning from models that ultimately failed (e.g., the information-deficit model), and seeking new methods (e.g., immersive virtual experiences) (Barr and Gilg 2007; Ahn et al. 2014). Locus of control studies investigate what it means for individuals to feel either in control, or at the mercy of, external events. In recent years, domain-specific measures for locus of control have become more commonly used to investigate the particulars of specific domains like the environment. Research on data visualization, which began by looking at the use and study of basic charts and graphs, moves forward by asking questions of how personal characteristics interact with elements of design.

METHODS

The following section discusses the study design and analysis, as well as methodological and ethical issues. I discuss why an experimental pretest posttest design with control is best suited for investigating my research question and outline the procedure in detail. Then, I explain how the literature on locus of control and visualization informs my hypothesis and my choice of scale for measuring the dependent variable, internal locus of control.

Study design

The goal of this study is to determine whether graphical presentation can increase internal locus of control. Using a pre and posttest design, I manipulated the data-ink ratio in two bar graphs, each conveying the same environment-relevant data, and measure locus of control prior and subsequent to the manipulation. Mean scores for internal locus of control were calculated from pre and posttest scores on the Environmental Action Internal Control Index, a domain-specific index for environmental locus of control (Smith-Sebasto 1992; Smith-Sebasto and Fortner 1994).

As shown in Figure 1, the study is a pretest/posttest design with control. In the two experiment conditions, the independent variable, data-ink ratio, is varied. The third condition does not use a graphical presentation, but rather presents data in a written format. In the figure below, “R” refers to random assignment, “O” refers to observation, and “X” refers to the experimental manipulation.

R	O_1		O_2
R	O_2	X_1	O_3
R	O_4	X_2	O_3

Figure 1. Pretest Posttest control group design

The research presented here is motivated by a desire to produce pro-environmental behavior. To that end, I sought to produce a higher internal locus of control in individuals, a factor known to increase the likelihood of such behavior. More particularly, then, my aim was to determine if data visualizations can *cause* changes in locus of control.

Advantages specific to a pre-post randomized design include a generally higher statistical power, when compared against the posttest-only design, as well as an enhanced ability to investigate attrition effects and offer improved causal effect estimates through statistical techniques, such as missing data techniques (West, Biesanz, and Kwok 2004:299). Attrition occurs when study participants are lost from the experiment, thereby weakening the validity of causal inferences (297).

Causal inference may also be undermined by a lack of contiguity between cause and effect. Contiguity refers to the time lag between the experiment manipulation, and measurement of the dependent variable (Thye 2007:61). The hypothesis for this study assumes that exposure to graphs with minimized data-ink ratios causes an increase in mean score on the Environmental Action Internal Control Index. However, I did not anticipate a biasing effect of contiguity as the estimated time gap between the manipulation and the final measure of the dependent variable was less than an hour.

Test-retest effects have been known to reduce internal validity. Test-retest effects occur when initial exposure to a measure influences later responses on measures of the same construct

(Campbell and Stanley 1963:5). Introducing a control condition minimizes the impact of test-retest effects. Since it was not my intent to influence the scores on the post-survey by exposing participants to the same questions in the pretest, I further incorporated a week-long break between administrations of the index.

Recruitment and survey delivery

Research participants were recruited face-to-face from social science classes at a mid-sized midwestern university. They were offered extra credit in return for their participation. Convenience sampling was chosen for the researcher's proximity to the sample population and as a means of reducing cost.

The study was conducted online using Qualtrics. The lack of face-to-face interaction between researcher and participant during the study was intended to decrease participant response bias and researcher bias. The experiment had two phases: a pretest phase to establish baseline measures of internal locus of control, and a manipulation phase, which at its conclusion, again measured internal locus of control. During the pretest phase, participants were asked to complete a Qualtrics survey that included a forced choice acknowledgement of informed consent and the pretest. They were informed of the structure of the study and given notice of a subsequent communication and the average amount of time each phase was expected to last. During phase one, subjects were asked to complete The Environmental Action Internal Control Index (EAICI) in a quiet, distraction-free setting, and return their responses within 48 hours. Communication during this phase was mediated through email. Participants were informed of the dates, times, and duration for phases one and two so response times could be more tightly controlled.

Approximately one week after the 48-hour deadline for phase one, the manipulation phase commenced. A one-week time gap was selected to diminish the effect of the pretest on posttest responses (see Ahn et al. 2014:237). In the period between phase one and two, respondents were randomly assigned to the "high number of graphical elements," "low number of graphical elements," or the control condition. Graphical elements for the purpose of this study refer to borders, outlines, fills, tick marks, grid lines, and text boxes. Random assignment was used to ensure equality of the groups. Both groups were equal regarding historical, social, genetic, personality, and physical factors (see Thye 2007:66).

For the two experimental conditions, each participant received 10 graphs and The Environmental Action Internal Locus of Control Index. Both conditions were created using Qualtrics, and participants were restricted such that they needed to examine the graphs prior to completing the posttest. The control condition did not contain any graphs, but instead, described the same information visualized in the two treatment conditions through descriptive text. After examining the graphs, but prior to the posttest, participants were asked to write a sentence explaining each visualization, followed by a five-point Likert scale question about the perceived clarity of the visualization; these components were included to ensure participant engagement with the visualizations or text.

Figures 2 and 3 offer visual examples of the differences between graphs with contrasting data-ink ratios and numbers of graphical elements. Figure 2 is the "minimized" data-ink ratio and utilizes gridlines, tick marks, and text boxes. Figure 3 is a simpler visualization with a "maximized" data-ink ratio, only containing the basic elements needed to communicate the data. The pre and posttests are available in the appendices (Appendix B-E).

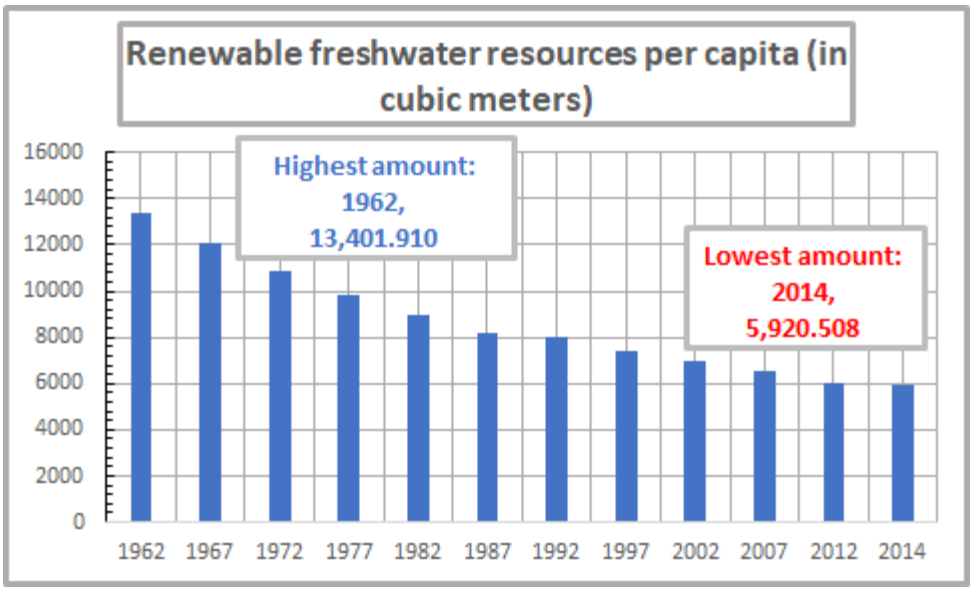

Figure 2. “High graphical elements”/minimized data-ink ratio

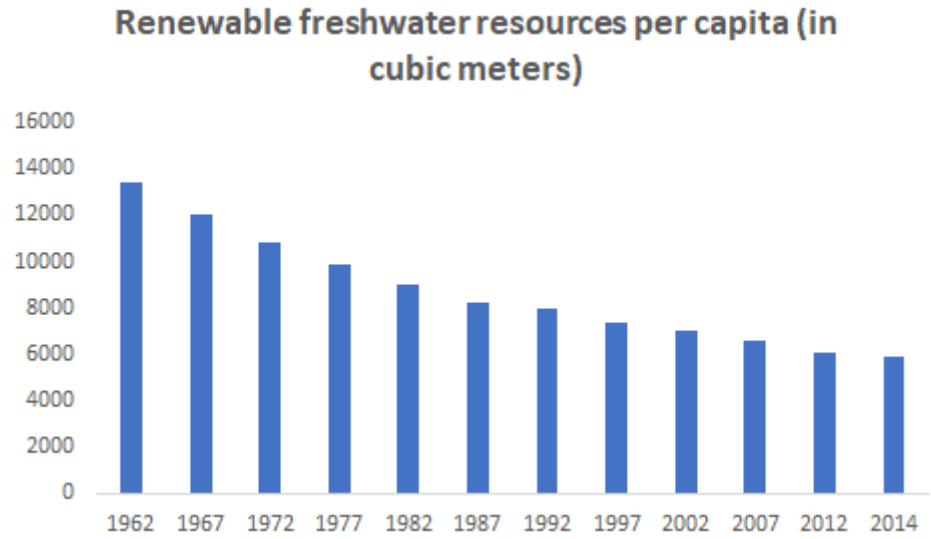

Figure 3. “Low graphical elements”/maximized data-ink ratio

Scale choice and validity/reliability

I chose to use a domain-specific scale, a practice that is in line with other contemporary studies researching locus of control in the context of environmental behaviors, although Rotter's I-E and Levenson's IPC scales are still commonly used (Galvin et al. 2018:8; Ernst et al. 2017:59; Ahn et al. 2014:243). The Environmental Action Internal Control Index is a 28-item instrument, offering response options in a 5-point Likert format, ranging from "strongly disagree" to "strongly agree" (Smith-Sebasto 1992). The index has strong face validity, as participants are asked directly for their level of agreement regarding the effect of their specific individual actions on the environment.

The validity and reliability of the index has previously been assessed through discriminant analysis and Pearson product-moment correlation analysis conducted from field tests which all included the EAICI, the Environmentally Responsible Behavior Inventory (ERBI), and the Inventory of Environmental Action Knowledge and Skill (IEAKS) (Smith-Sebasto 1994). One third of the tests also included the Internal Control Index, another third included the Brown Locus of Control, and a final third included the Need for Control Scale (Smith-Sebasto 1994).

Cronbach's alpha, which tests for relatedness of items within a group, indicated strong reliability in previous studies. The coefficient alpha was 0.94 for the full instrument, indicating good internal consistency (Smith-Sebasto 1995). Smith-Sebasto and Fortner (1994) discovered that the correlations between Duttweiler's Internal Control Index (ICI), which intends to measure internal locus of control generally (i.e., it is not specific to how it relates to the environment) and the EAICI were stronger than those between the EAICI and Brown's Locus of Control measure, which does not specifically test for internal orientation, suggesting convergent validity in the

EAICI (Smith-Sebasto and Fortner 1994:7). Correlations between the EAICI and the Need for Control scale indicated a weak relationship, suggesting discriminant validity for the EAICI, showing they are probably not testing the same construct (1994:7).

Analysis

Analysis of Variance (ANOVA) on gain scores, Analysis of Covariance (ANCOVA), ANOVA on residual scores, and repeated measures ANOVA are all commonly used statistical methods of analysis in pre and posttest designs (Dimitrov and Rumrill, Jr. 2003). ANCOVA was chosen for this study for its ability to remove systematic bias and reduce error variance (Dimitrov and Rumrill, Jr. 2003). The use of ANCOVA assumes randomization, homogeneity of regression slopes, and a linear relationship between pretest and posttest scores (2003:160). One advantage of using ANCOVA over ANOVA on gain scores occurs when the regression slope does not equal 1—a frequent occurrence. When this is the case, ANCOVA offers a more powerful test (2003:161). A second advantage of ANCOVA over ANOVA on gain scores occurs when some assumptions are not upheld. For example, both tests assume a linear relationship between pretest and posttest. If this assumption does not hold, ANCOVA can be adjusted to include a cubic or quadratic component (2003:161). Similarly, if regression slopes are not homogenous, ANCOVA allows for additional procedures, such as the Johnson-Neyman technique, which indicates regions of significance (2003:161). ANOVA on residual scores and repeated measures ANOVA were both also a poorer fit for this study than ANCOVA. ANOVA on residual scores has lower power when compared to ANCOVA (2006:161). Repeated measures ANOVA's results can be misleading when applied to pretest posttest data; since the pretest scores are not influenced by the treatment, the treatment main effect's F test is conservative (163).

Methodological issues

Methodological issues, such as internal and external validity, have been considered in the experimental design. Threats to internal validity in this study included effects from testing (as the pre-test might, simply by raising awareness of the topic, influence participants' scores in the posttest) as well as any unreliability in the measure (see Thye 2007:73-74). As mentioned, I incorporated a break between the pre and posttests to mitigate the threats to internal validity that are inherent in pre-post studies. In addition, I re-established the reliability of the measure to address concerns about internal validity threats due to the choice in instrumentation (see Thye 2007:74).

External validity is concerned with generalizability (Campbell and Stanley 1963:5). Because an experiment may be considered externally valid if it can offer a means of explaining and predicting behavior within the scope conditions of the theory, the design has been constructed using a domain-specific variable (Zelditch 2007:108). The study does not seek to predict or explain either questions of general locus of control or questions of data visualizations that vary in ways other than the data-ink ratio or number of graphical elements.

To protect participants' personal information that were gathered during the study, materials were de-identified; I do not present data on an individual level. Since offering a reward for participation in the study resulted in a power differential, the points offered were minimal to not constitute a form of coercion (see Hegtvedt 2007:149). The issue of objectification is of importance in laboratory experiments where the researcher manipulates the context (147). Instead of using the more objectifying term "subject," I used the more neutral term "participant" (147). Finally, although the threat of physical harm was extremely low or non-existent in this study, other potential harms, such as social or psychological harms or the harm of

inconvenience existed (148). Social harms are those which might negatively influence a participant's social standing; in the case of this study, this concern is closely linked to confidentiality concerns, as shared information about individuals' beliefs regarding environmental behaviors may have social consequences.

This study was determined exempt (category #3 (B)) by the NDSU IRB (see Appendix A). Still, it aimed to fulfill the requirements set forth by the Belmont Report for human subjects' research, namely, respect for persons, beneficence and justice. Respect for persons refers to the understanding that participants have autonomy and should be treated with dignity. The principle of beneficence requires minimizing harm while maximizing benefits, a balance I obtained through the careful design and execution of the experiment, while being attentive to signs of psychological or social distress through any communication from participants. Justice requires that those who bear the burdens of research should receive its benefits (146). College students almost certainly would benefit from research findings that indicate more effective ways of communicating data to shift environmental locus of control toward greater internality.

RESULTS

The investigation presented here asked if locus of control could be altered by manipulating the number of graphical elements in messaging. Drawing on social learning theory and theories of data visualization, I derived the following hypothesis.

> H: Mean scores for internal locus of control will increase most when data is presented using a high number of supporting, non-data graphical elements, and least when information is not presented in graph form.

The results of the study were statistically non-significant; a description of the findings follows.

Participants were undergraduate students from social science classes from a mid-sized midwestern university. Additional demographic data was not collected about the sample. A total of 105 respondents completed the pretest; 91 participants completed both the pre and the posttest.

The reliability of the instrument used in the pre and posttest was tested using Cronbach's alpha. Cronbach's alpha indicated that the index used in this study—the Environmental Action Internal Control Index (EAICI)—has strong reliability based on analyzing scores for the pretest of this study (α=0.95); this is similar to previous tests of reliability on the index (see Smith-Sebasto 1995). Further analysis was conducted to determine whether there would be a measurable difference if any item from the index were deleted. The test indicated that reliability could not be increased through further deletion of any one item from the index. Therefore, the following data were based on responses from the EAICI in its entirety.

The data met the assumptions for conducting an ANCOVA as there was not a statistically significant difference between groups on the pretest scores (p=.16) and a test of between-subjects

effects was not significant (p= .63)—meeting the assumption for the homogeneity of regression assumption.

The purpose of this research question was to examine the possibility of a significant difference in internal locus of control scores (calculated using the Environmental Action Internal Control Index) based on graphical presentation of data, while controlling for participants' pretest scores using the same measure. A one-way analysis of covariance was conducted using graphical presentation type (minimized data-ink ratio and maximized data-ink ratio) as the independent variable, posttest scores on the EAICI as the dependent variable, and pretest scores on the EAICI as the covariate. A significant relationship was found between the dependent variable (posttest scores on the EAICI) and the covariate (pretest scores on the EAICI): F (2, 88) = 192.90, p < .001, η^2 = 0.69. There was not a significant difference found between graphical presentation type: F (2, 88) = 2.15, p=.12, η^2 = 0.05. The following tables display the findings for means and standard deviations and the results of the ANCOVA.

Table 1. Means and standard deviations

Group	Mean	Standard Deviation	N
Control	106.33	20.614	33
Minimized data-ink ratio	104.69	17.789	29
Maximized data-ink ratio	108.14	21.469	29
Total	106.38	19.871	91

Table 2. Tests of between-subjects effects

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	24543.713[a]	3	8181.238	64.754	.000	.691
Intercept	33.431	1	33.431	.265	.608	.003
Pretest score	24371.164	1	24371.164	192.897	.000*	.689
Group	543.920	2	271.960	2.153	.122	.047
Error	10991.825	87	126.343			
Total	1065445.000	91				
Corrected Total	35535.538	90				

a. R Squared = .691 (Adjusted R Squared =.680)
* $p < .05$

Although the results did not support the hypothesis, important implications of the data exist. The following section offers a discussion about these implications as well as comparisons to previous findings related to locus of control and data visualization theories.

DISCUSSION

The results did not support the hypothesis that exposure to a maximized data-ink ratio graph would increase scores of internal loci of control more than when data was not presented in graph form. The findings, therefore, are inconsistent with newer developments in locus of control theory suggesting its malleability and do not support the practice of manipulating visualizations as a means of encouraging changes in loci (Galvin et al. 2018; Legerski et al. 2006; Ryon and Gleason 2014). This section discusses support for and divergence from the two main guiding theories, limitations of the study, —including aspects of design and sample population — and suggestions for future research.

Recent research suggesting that locus of control may exist more like a state than a permanent trait (Legerski et al. 2006; Ryon and Gleason 2014) informed this study's attempt to manipulate internal locus of control. Research specifically attempting to manipulate locus of control to encourage pro-environmental behaviors is still nascent; other means of manipulation offer possibilities to be explored (Ahn et al. 2014). It may be that internal locus of control is more susceptible to change through methods other than exposure to environmental data via graphs.

Ziemkiewicz et al.'s 2013 study addressing the relationship between visual representations and locus of control served as inspiration for this project's hypothesis. Their findings suggest that, "a useful guideline for adaptation would be to increase the amount of explicit structures for users that might have a more external locus of control", noting that a rejection of Tufte's largely-accepted guidelines might ultimately be helpful to those with an external locus of control (2013:13). Their research also indicates that those with internal LOC may prefer their own mental models, meaning such individuals would likely do better with visual

representations that followed Tufte's guidelines. While their study does support the externalization theory of visualization, it does not make claims regarding how visualizations might be used to alter one's locus of control. Further, it should be noted that the index used for this project specifically measured internal locus of control within the domain of environmental action (on a continuum), while Ziemkiewicz et al.'s (2013) study used a different scale measuring generalized expectancies where participants were categorized as "external LOC users," "internal LOC users," and "average LOC users." Since these studies conceptualize locus of control differently (i.e., generalized versus domain-specific) the implications of each study are different. It may be the case that locus of control, as measured within a particular domain, is more or less pervious to change compared to generalized measures, or that different types of manipulations are more or less efficacious depending on their format and application to a particular domain.

Limitations in this study stem partially from sampling issues. Using a convenience sample may have introduced a selection bias. Since having a higher internal locus of control, by definition, is characterized by a greater sense of control of one's outcomes, it may be the case that those who elected to participate did so, in part, due to a relatively higher starting internal locus of control than their non-participating peers, although this clearly cannot be verified. Another potential limitation of this study may relate to the design of the study itself. Although the manipulations were inspired by suggestions in previous research (Ziemkiewicz et al. 2013), they might not have been extreme enough to cause measurable changes in locus of control. In addition, the study analyzed the responses of a relatively low number of participants (n=91), following attrition from the initial recruitment and the break between the pre and posttest. The restriction of the study to college students is not a limitation in this study since the index was

originally developed for distribution to undergraduate students (Smith-Sebasto and Fortner 1994).

This project hypothesized that graphical presentation type would influence one's ability to comprehend data. The following discusses the relationship between presentation style and comprehension and offers cause for considering how different approaches to imparting knowledge might improve this study's model for manipulating internal locus of control.

This study was based on the principle that information cannot mediate behavior in the absence of comprehension, and that comprehension could be enhanced by visual presentation style—specifically through graphs with minimized data-ink ratios. Although this study did not directly test comprehension, it was designed assuming a relationship between presentation style and comprehension. In a 2015 thesis, Kevin McGurgan conducted an experiment specifically testing the question of whether data-ink maximization improved performance in graph comprehension tasks. The results of McGurgan's study suggested that data-ink maximization does not improve performance and encouraged future studies to consider the "subjective issue of graph aesthetics" in relation to data-ink ratio and emphasized the importance of considering the audience of the graphical information (McGurgan 2012: iv). McGurgan's study tested the merit of allegiance to Tufte's guidelines, whereas this study hypothesized the influence of their rejection. Suggestions for future research, therefore, include a greater development of the understanding of the relationship between knowledge and locus of control by way of application of different epistemological approaches. The following considers how a conception of knowledge as a social relation, as opposed to a simple accumulation of facts or receipt of information, may be more effective in models aimed at manipulating internal locus of control (see Bell and Ashwood 2016:320).

Although effective communication strategies about the state of the environment remain crucial, it is unlikely that the simple sharing of information will result in increasing internal loci of control—and resulting pro-environmental behaviors—without greater consideration given to an audience's capacity to receive and integrate the information as meaningful (and actionable) knowledge. Literature supports this line of reasoning. Daubenmire et al. (2017) used the FOCUSSS (Families, Organizations, and Communities Understanding Science, Sustainability, and Service) design framework, a research project incorporating projects across both informal and formal learning environments (e.g., chemistry classrooms, the home, and museums) as a way of empowering urban high school students and their families to engage in sustainable living choices. Participation in the program correlated with increased self-efficacy and the adoption of positive changes in pro-environmental behavior (Daubenmire et al. 2017). Daubenmire et al.'s research project was constructed using the theory of Situated Cognition and Knowledge Building, a "social constructivist pedagogical theory" (2017:61). In another study, Ahn et al. (2014) examined differences between print and video messages about tree-cutting and paper use against communication via immersive visual environments (IVEs). IVEs allowed participants to hear, see and feel stimuli related to tree-cutting as if they were experiencing them in the physical world; results indicated greater success with the use of IVEs than print or video messages, as participants assigned to the IVE condition reported greater internal environmental locus of control and pro-environmental behaviors a week following the experiences (2014:235). The commonality between these two studies exists in their focus not in the transfer of knowledge by simple information sharing, but in the capacity for experientially gained knowledge (e.g., through physical stimuli and within the context of daily routines) to encourage the adoption of pro-environmental behaviors. In brief, it seems that information actually *does* play a central role

in the adoption of pro-environmental behaviors, but it is most effective when it is linked concretely to one's everyday life experiences.

Implications of study for policymakers, activists, and educators

As discussed in the previous section, it appears that the simple dissemination of information without regard to individual differences may be ineffective in shifting locus of control. Indeed, the lack of statistically significant findings in this study lend support to the conceptualization of locus of control as more of a permanent trait than an alterable state. It may be the case that, at least within the environmental domain, locus of control is unlikely to be influenced significantly. It may also be the case that locus of control did not change significantly in this study due to the weakness of the experimental manipulation. Implications exist for policymakers, educators, and activists.

Even if locus of control cannot be markedly shifted toward internality, policymakers maintain a significant amount of authority and capacity to effect change. Individuals who might not choose to participate in pro-environmental behaviors based on their own disposition or sense of duty might change their behaviors if policy changes administered by 'powerful others' require them to engage in more positive environmental behaviors. Creating policy that incurs positive incentives or negative consequences for behaviors that affect the environment is one way in which policy makers can address environmental concerns within their communities.

Since it is possible that locus of control did not alter considerably in this study due to the weakness of the intervention, activists may consider means of crafting and utilizing more direct visualizations. Visualizations based on local data or clear quantifications of personal impact, for instance, may have a greater capacity to influence locus of control than those used within this study, which utilized more global, abstract data. Additionally, since those with an external locus

of control may be more willing to adapt their thinking to novel visualizations than those with internal loci (Ziemkiewicz et al. 2013), activists might explore the efficacy of less commonly used visualizations than the bar graphs used in this study.

Locus of control theory claims that early experiences serve as antecedents to one's development of locus of control (Galvin et al. 2018); therefore environmental educators may consider paying particular attention to the education of young people who are in the process of developing expectancies as an alternative to focusing efforts on changing already-developed loci. Offering early environmental education experiences linking personal efforts to outcomes may lead young people to develop an internal locus of control in their early years. Continued educational efforts following early education would offer students exposure to current environmental realities and best practices, creating space for necessary dialogue—a valuable exercise for students, even if it fails to result in shifts in loci.

CONCLUSION

The findings of this study did not support the hypothesis that data-ink ratio impacts internal locus of control scores. However, there still exists a substantial body of research that has produced valid and reliable situation-specific measures that can be used to further test for ways of manipulating locus of control. Data visualization theory and guidelines should continue to be studied and refined based on their capacity to accurately transmit messaging. Models that recognize knowledge as a social relation, either implicitly or explicitly, show promise in previous studies and should be considered as an avenue for future research studies aimed at encouraging greater internality in locus of control within the context of environmental behaviors.

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APPENDIX A. RESEARCH COMPLIANCE FORM

NDSU NORTH DAKOTA STATE UNIVERSITY

February 21, 2019

Dr. Pamela Emanuelson
Sociology

Re: IRB Determination of Exempt Human Subjects Research:
Protocol #HS19155, "Locus of control and environmental data visualization"

Co-investigator(s) and research team: Briana Wilhelmi
Date of Exempt Determination: 2/21/2019 Expiration Date: 2/20/2022
Study site(s): NDSU
Sponsor: n/a

The above referenced human subjects research project has been determined exempt (category # 3(B)) in accordance with federal regulations (Code of Federal Regulations, Title 45, Part 46, Protection of Human Subjects). This determination is based on the revised protocol submission (received 2/15/2019).

Please also note the following:
• If you wish to continue the research after the expiration, submit a request for recertification several weeks prior to the expiration.
• The study must be conducted as described in the approved protocol. Changes to this protocol must be approved prior to initiating, unless the changes are necessary to eliminate an immediate hazard to subjects.
• Notify the IRB promptly of any adverse events, complaints, or unanticipated problems involving risks to subjects or others related to this project.
• Report any significant new findings that may affect the risks and benefits to the participants and the IRB.

Research records may be subject to a random or directed audit at any time to verify compliance with IRB standard operating procedures.

Thank you for your cooperation with NDSU IRB procedures. Best wishes for a successful study.
Sincerely,

Kristy Shirley

Kristy Shirley, CIP, Research Compliance Administrator

For more information regarding IRB Office submissions and guidelines, please consult http://www.ndsu.edu/research/integrity_compliance/irb/. This Institution has an approved FederalWide Assurance with the Department of Health and Human Services: FWA00002439.

APPENDIX B. PRETEST

Pretest

Start of Block: Informed Consent

Q1 **Informed Consent**

PI: Dr. Pamela Emanuelson, 701-231-5887, pamela.emanuelson@ndsu.edu
Co-investigator: Briana Wilhelmi, briana.r.wilhelmi.1@ndus.edu

The Department of Sociology and Anthropology invites you to participate in an experimental study. The purpose of this study is to examine the relationship between data presentation and one's sense of control over their environment. After the project is completed, the results will be analyzed, and conclusions will be shared in a thesis.

Please examine the following information before deciding whether you wish to participate. If you have questions regarding the content of this form or have questions at any time during the study, please direct them to the co-investigator or PI listed above.

The study will take place online through two Qualtrics surveys. The first survey, which immediately follows if you give your consent, is estimated to take approximately 10 minutes and the second survey should last no more than 15 minutes. You will have 48 hours to complete this first survey. A week after this deadline, you will receive the second survey, which you will also have 48 hours to complete. During the experiment, you will be asked to complete an index regarding your beliefs about the impact of your actions on the environment and will be asked about the clarity of environmentally-relevant data.

Please note that all interaction occurs online. Throughout the study you will be referred to by a label to protect your privacy.

This research has no more than minimal risk, but also carries benefits. Through participation in this study, you will learn about current environmental data. Furthermore, participants will be compensated with extra credit, receiving half of the possible points through completion of the first survey and the remainder of the possible points through completion of the second survey. **You must complete the first survey to receive the second.** You may contact your instructor for non-research alternatives to earn extra credit.

Your participation is completely voluntary, and you may opt out of the study at any time.

You have rights as a participant in research. If you have any questions about your rights, or complaints about this research, you may talk to the researcher or contact the NDSU Human Research Protection Program by:
Telephone: 701.231.8995 or toll-free 1.855.800.6717
Email: ndsu.irb@ndsu.edu
Mail: NDSU HRPP Office, NDSU Dept. 4000, PO Box 6050, Fargo, ND 58108-6050.

The role of the Human Research Protection Program is to see that your rights are protected in

this research; more information about your rights can be found at: www.ndsu.edu/irb .
If you have questions about the study, please contact Briana Wilhelmi (briana.r.wilhelmi.1@ndus.edu) or the PI, Dr. Pamela Emanuelson (701-231-5887 or pamela.emanuelson@ndsu.edu).

Do you give your consent to participate in this study?

- ○ Yes (1)
- ○ No (2)

End of Block: Informed Consent

Start of Block: Course information

Q2 Please provide course information in the following questions to receive extra credit.

Q3 Course name (e.g., SOC 110)

_____

Q4 Instructor name

_____

End of Block: Course information

Start of Block: Pretest

Q5 The Environmental Control Index: Instructions
Please read the partial statement in bold letters below followed by the action described after each

number. Then, carefully fill the choice on the answer sheet which best indicates how strongly you agree or disagree with the whole statement.

Please respond to every statement with only one choice.
Key:
1=Strongly Disagree; 2=Disagree; 3=Unsure; 4=Agree; 5=Strongly Agree

---

Q6 My individual actions would improve the quality of the environment if I were to...
learn about the recycling facilities in my area.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q7 My individual actions would improve the quality of the environment if I were to...
attend a community meeting that involves concern over a local environmental issue.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q8 My individual actions would improve the quality of the environment if I were to...
buy resource conservation devices, such as low-flow faucet aerators for my sinks and low-flow shower heads.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q9 My individual actions would improve the quality of the environment if I were to...
buy products packaged in containers that either can be reused or recycled or are made of recycled materials.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q10 My individual actions would improve the quality of the environment if I were to...
report someone who violates a law or laws that protect our natural resources (e.g., illegal fishing, hunting, or trapping or illegal tree cutting) to the proper authorities.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q11 My individual actions would improve the quality of the environment if I were to...
report someone who tampers with the anti-pollution devices on a car to the proper authorities.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q12 My individual actions would improve the quality of the environment if I were to...
reduce the amount of my household trash by reusing or recycling items to the fullest extent possible.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q13 My individual actions would improve the quality of the environment if I were to...
set my home appliances, such as the refrigerator, dishwasher, water heater, etc. to 'energy saver' levels.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q14 My individual actions would improve the quality of the environment if I were to... take my old tires to a recycling center.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q15 My individual actions would improve the quality of the environment if I were to... carpool instead of driving alone.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q16 My individual actions would improve the quality of the environment if I were to... open windows for ventilation rather than using a fan or air conditioner.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q17 My individual actions would improve the quality of the environment if I were to... convince someone to boycott a store that sells products that damage the environment.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q18 My individual actions would improve the quality of the environment if I were to... convince someone to sign a petition regarding an environmental issue.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q19 My individual actions would improve the quality of the environment if I were to... convince someone to learn about the recycling facilities in his/her area.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q20 My individual actions would improve the quality of the environment if I were to... convince someone to have a home 'energy audit' to find the heat leaks in her/his house or apartment.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q21 My individual actions would improve the quality of the environment if I were to... convince someone to obtain a copy of the League of Conservation Voters' *Environmental Scorecard.*

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q22 My individual actions would improve the quality of the environment if I were to... convince someone to buy household cleaning and/or laundry products that don't harm the environment.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q23 My individual actions would improve the quality of the environment if I were to... convince someone to buy fruits and vegetables loose rather than in plastic bags.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q24 My individual actions would improve the quality of the environment if I were to... convince someone to buy products packaged in containers that either can be reused or recycled or are made of recycled materials.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q25 My individual actions would improve the quality of the environment if I were to... convince someone to report someone who violated a law or laws that protect our natural resources (e.g., illegal fishing, hunting, or trapping or illegal tree cutting) to the proper authorities.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q26 My individual actions would improve the quality of the environment if I were to... convince someone to reuse envelopes by putting a label over the old address.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q27 My individual actions would improve the quality of the environment if I were to... convince someone to set her/his household appliances, such as the refrigerator, dishwasher, water heater, etc. to 'energy saver' levels.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q28 My individual actions would improve the quality of the environment if I were to... convince someone to keep her/his car tires properly inflated.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q29 My individual actions would improve the quality of the environment if I were to... convince someone to take old tires to a recycling center.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q30 My individual actions would improve the quality of the environment if I were to... convince someone to conserve water by not running the water while brushing her/his teeth or shaving and/or installing a water saving device in the tank of her/his toilet(s).

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q31 My individual actions would improve the quality of the environment if I were to... convince someone to avoid idling her/his car unnecessarily.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q32 My individual actions would improve the quality of the environment if I were to... convince someone to reduce the amount he/she drives her/his car by carpooling instead of driving alone and/or driving only when necessary.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q33 My individual actions would improve the quality of the environment if I were to... convince someone to reduce the amount of her/his household trash by reusing or recycling items to the fullest extent possible.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

End of Block: Pretest

APPENDIX C. POSTTEST A

PosttestA

Start of Block: Introduction

Q1
This is the second of two surveys in which you have consented to participate. If you have any questions or concerns about either or both of these surveys, you may contact the co-PI, Briana Wilhelmi (briana.r.wilhelmi.1@ndsu.edu) or the PI, Dr. Pamela Emanuelson (pamela.emanuelson@ndsu.edu; 701-231-5887).

End of Block: Introduction

Start of Block: Course information

Q2 Please provide course information in the following questions to receive extra credit.

Q3 Course name (e.g., SOC 110)

_____

Q4 Instructor name

_____

End of Block: Course information

Start of Block: Instructions

Q5 The following section contains 10 pieces of descriptive text regarding environmentally relevant data. Please read each piece of text, answer the question regarding the clarity of the information on a one-to-five Likert scale, and write one sentence describing your impression of the data where prompted to do so.

End of Block: Instructions

Start of Block: Global temperatures

Q6 Global surface temperatures have steadily risen since 1880. Since 1976, the global temperature has always been warmer than the twentieth century average. 2016 was the warmest year on record, 2015 the second warmest, and 2017 the third warmest. The coolest years on record were 1908 and 1911, which were both -0.43 below the twentieth-century average. Please rate the clarity of the above statement in the one-to-five scale below.

- ○ 1= Very unclear (1)
- ○ 2= Unclear (2)
- ○ 3= Unsure (3)
- ○ 4= Clear (4)
- ○ 5= Very Clear (5)

Q7 Please write a one-sentence reaction to the data.

_____

End of Block: Global temperatures

Start of Block: Arctic sea ice

Q8 Arctic sea ice levels have been generally declining from 1979 to 2017. The highest level of sea ice in that time frame is on record as 7,862,303 km. The lowest level of sea ice in that time frame is on record as 3,404,543 km.
Please rate the clarity of the above statement in the one-to-five scale below.

- 1= Very unclear (1)
- 2= Unclear (2)
- 3= Unsure (3)
- 4= Clear (4)
- 5= Very clear (5)

Q9 Please write a one-sentence reaction to the data.

_____

End of Block: Arctic sea ice

Start of Block: Carbon dioxide

Q10 CO2 levels have continually risen from 2005 to 2018. The lowest amount of CO2 recorded in that time frame was in 2005 at 378.93 parts per million. The highest amount was recorded in

2018 at 409.33 parts per million. Please rate the clarity of the above statement in the one-to-five scale below.

- ○ 1= Very unclear (1)
- ○ 2= Unclear (2)
- ○ 3= Unsure (3)
- ○ 4= Clear (4)
- ○ 5= Very clear (5)

Q11 Please write a one-sentence reaction to the data.

_____

End of Block: Carbon dioxide

Start of Block: Methane emissions

Q12 Methane emissions rose in the time period 1970-2012. The lowest amount of methane emitted in that time from was 5,145,430 kt of CO2 equivalent in 1971. The highest amount of methane emitted in that time frame was 8,014,067 kt of CO2 equivalent in 2012.

Please rate the clarity of the above statement in the one-to-five scale below.

- ○ 1= Very unclear (1)
- ○ 2= Unclear (2)
- ○ 3= Unsure (3)
- ○ 4= Clear (4)
- ○ 5= Very clear (5)

Q13 Please write a one-sentence reaction to the data.

_____

End of Block: Methane emissions

Start of Block: Plastics

Q14 The amount of plastics generated in the Municipal Waste Stream (MWS) increased from 1960 to 2015. The lowest amount of plastics generated in the MWS in that time period was in 1960 at 390 thousand tons. The highest amount of plastics generated in that time period was in 2015 at 34,500 thousand tons.
Please rate the clarity of the above statement in the one-to-five scale below.

- 1= Very unclear (1)
- 2= Unclear (2)
- 3=Unsure (3)
- 4= Clear (4)
- 5=Very clear (5)

Q15 Please write a one-sentence reaction to the data.

_____

End of Block: Plastics

Start of Block: Aluminum

Q16 The amount of aluminum generated in the Municipal Waste Stream (MWS) has steadily increased from 1960-2015. The lowest amount of aluminum generated in that time period in the

MWS was 340 thousand tons in 1960. The highest amount of aluminum generated in that time period was 3,610 thousand tons in 2015.
Please rate the clarity of the above statement in the one-to-five scale below.

- ○ 1= Very unclear (1)
- ○ 2= Unclear (2)
- ○ 3= Unsure (3)
- ○ 4= Clear (4)
- ○ 5= Very clear (5)

Q17 Please write a one-sentence reaction to the data.

_____

End of Block: Aluminum

Start of Block: Containers and packaging

Q18 The weight of containers and packaging generated in the Municipal Waste Stream (MWS) steadily increased from 1960-2000, leveling out somewhat in the time period 2000-2015. The lowest weight of containers and packaging generated in the time period 1960-2015 in the MWS was 27,370 thousand tons in 1960. The highest weight of containers and packaging generated in

that time period was 77,920 thousand tons in 2015.
Please rate the clarity of the above data in the one-to-five scale below.

- ○ 1= Very unclear (1)
- ○ 2= Unclear (2)
- ○ 3= Unsure (3)
- ○ 4= Clear (4)
- ○ 5= Very Clear (5)

Q19 Please write a one-sentence reaction to the data.

_____

End of Block: Containers and packaging

Start of Block: Rubber tires

Q20 The weight of rubber tires generated in the Municipal Waste Stream (MWS) steadily increased from 1960-2015. The lowest weight of tires generated in that time period in the MWS was 1,120 thousand tons in 1960. The highest weight of tires generated in that time period was 5,840 thousand tons in 2015.
Please rate the clarity of the above statement in the one-to-five scale below.

- ○ 1= Very unclear (1)
- ○ 2= Unclear (2)
- ○ 3= Unsure (3)
- ○ 4= Clear (4)
- ○ 5= Very clear (5)

Q21 Please write a one-sentence reaction to the data,

_____

End of Block: Rubber tires

Start of Block: Forest area

Q22 The world forest area has steadily decreased from 1990-2015. The highest percent of world forest area in that time period was 31.801 percent in 1990. The lowest percent of world forest area in that time period was 30.825 percent in 2015.
Please rate the clarity of the above statement in the one-to-five scale below.

- 1= Very unclear (1)
- 2= Unclear (2)
- 3= Unsure (3)
- 4= Clear (4)
- 5= Very clear (5)

Q23 Please write a one-sentence reaction to the data.

_____

End of Block: Forest area

Start of Block: Freshwater resources

Q24 The renewable freshwater resources per capita has steadily decreased from 1962-2014. The highest amount of renewable freshwater resources per capita in that time period was 13,401.910 cubic meters. The lowest amount of renewable freshwater resources per capita in that time period

was 5,920.508 cubic meters in 2014.
Please rate the clarity of the above statement in the one-to-five scale below.

- 1= Very unclear (1)
- 2= Unclear (2)
- 3= Unsure (3)
- 4= Clear (4)
- 5= Very clear (5)

Q25 Please write a one-sentence reaction to the data.

_____

End of Block: Freshwater resources

Start of Block: Post-test

Q26 The Environmental Control Index: Instructions
Please read the partial statement in bold letters below followed by the action described after each number. Then, carefully fill the choice on the answer sheet which best indicates how strongly you agree or disagree with the whole statement.

Please respond to every statement with only one choice.
Key:
1=Strongly Disagree; 2=Disagree; 3=Unsure; 4=Agree; 5=Strongly Agree

---

Q27 My individual actions would improve the quality of the environment if I were to... learn about the recycling facilities in my area.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q28 My individual actions would improve the quality of the environment if I were to... attend a community meeting that involves concern over a local environmental issue.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q29 My individual actions would improve the quality of the environment if I were to...
buy resource conservation devices, such as low-flow faucet aerators for my sinks and low-flow shower heads.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q30 My individual actions would improve the quality of the environment if I were to...
buy products packaged in containers that either can be reused or recycled or are made of recycled materials.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q31 My individual actions would improve the quality of the environment if I were to...
report someone who violates a law or laws that protect our natural resources (e.g., illegal fishing, hunting, or trapping or illegal tree cutting) to the proper authorities.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q32 My individual actions would improve the quality of the environment if I were to...
report someone who tampers with the anti-pollution devices on a car to the proper authorities.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q33 My individual actions would improve the quality of the environment if I were to...
reduce the amount of my household trash by reusing or recycling items to the fullest extent possible.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q34 My individual actions would improve the quality of the environment if I were to...
set my home appliances, such as the refrigerator, dishwasher, water heater, etc. to 'energy saver' levels.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q35 My individual actions would improve the quality of the environment if I were to... take my old tires to a recycling center.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q36 My individual actions would improve the quality of the environment if I were to... carpool instead of driving alone.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q37 My individual actions would improve the quality of the environment if I were to... open windows for ventilation rather than using a fan or air conditioner.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q38 My individual actions would improve the quality of the environment if I were to... convince someone to boycott a store that sells products that damage the environment.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q39 My individual actions would improve the quality of the environment if I were to... convince someone to sign a petition regarding an environmental issue.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q40 My individual actions would improve the quality of the environment if I were to... convince someone to learn about the recycling facilities in his/her area.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q41 My individual actions would improve the quality of the environment if I were to... convince someone to have a home 'energy audit' to find the heat leaks in her/his house or apartment.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q42 My individual actions would improve the quality of the environment if I were to... convince someone to obtain a copy of the League of Conservation Voters' *Environmental Scorecard.*

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q43 My individual actions would improve the quality of the environment if I were to... convince someone to buy household cleaning and/or laundry products that don't harm the environment.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q44 My individual actions would improve the quality of the environment if I were to... convince someone to buy fruits and vegetables loose rather than in plastic bags.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q45 My individual actions would improve the quality of the environment if I were to... convince someone to buy products packaged in containers that either can be reused or recycled or are made of recycled materials.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q46 My individual actions would improve the quality of the environment if I were to... convince someone to report someone who violated a law or laws that protect our natural resources (e.g., illegal fishing, hunting, or trapping or illegal tree cutting) to the proper authorities.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q47 My individual actions would improve the quality of the environment if I were to... convince someone to reuse envelopes by putting a label over the old address.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q48 My individual actions would improve the quality of the environment if I were to... convince someone to set her/his household appliances, such as the refrigerator, dishwasher, water heater, etc. to 'energy saver' levels.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q49 My individual actions would improve the quality of the environment if I were to... convince someone to keep her/his car tires properly inflated.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q50 My individual actions would improve the quality of the environment if I were to... convince someone to take old tires to a recycling center.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q51 My individual actions would improve the quality of the environment if I were to... convince someone to conserve water by not running the water while brushing her/his teeth or shaving and/or installing a water saving device in the tank of her/his toilet(s).

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q52 My individual actions would improve the quality of the environment if I were to... convince someone to avoid idling her/his car unnecessarily.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q53 My individual actions would improve the quality of the environment if I were to... convince someone to reduce the amount he/she drives her/his car by carpooling instead of driving alone and/or driving only when necessary.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q54 My individual actions would improve the quality of the environment if I were to... convince someone to reduce the amount of her/his household trash by reusing or recycling items to the fullest extent possible.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

End of Block: Post-test

APPENDIX D. POSTTEST B

Posttest B

Start of Block: Introduction

Q1
This is the second of two surveys in which you have consented to participate. If you have any questions or concerns about either or both of these surveys, you may contact the co-PI, Briana Wilhelmi (briana.r.wilhelmi.1@ndsu.edu) or the PI, Dr. Pamela Emanuelson (pamela.emanuelson@ndsu.edu; 701-231-5887).

End of Block: Introduction

Start of Block: Course information

Q2 Please provide course information in the following questions to receive extra credit.

Q3 Course name (e.g., SOC 110)

_____

Q4 Instructor name

_____

End of Block: Course information

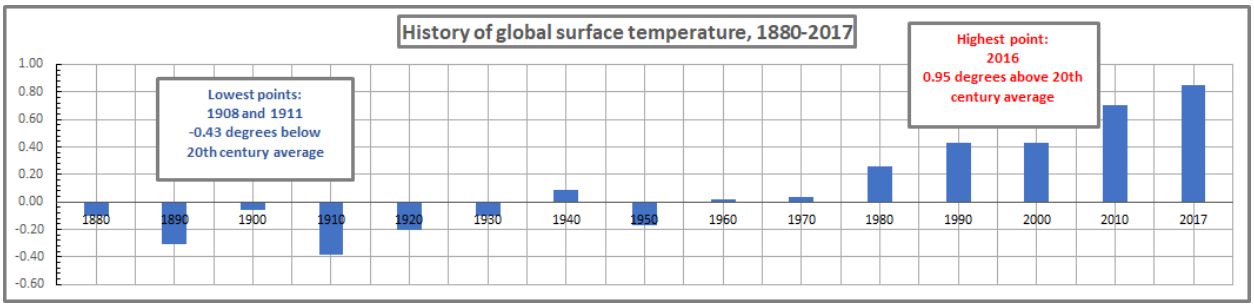
Start of Block: Instructions

Q5 The following section contains 10 graphs regarding environmentally relevant data. Please view each graph, answer the question regarding the clarity of the information on a one-to-five Likert scale, and write one sentence describing your impression of the data where prompted to do so.

End of Block: Instructions

Start of Block: Global temperatures

Q6



Q7 Please rate the clarity of the graph on the one-to-five scale below.

- 1= Very unclear (1)
- 2= Unclear (2)
- 3= Unsure (3)
- 4= Clear (4)
- 5= Very clear (5)

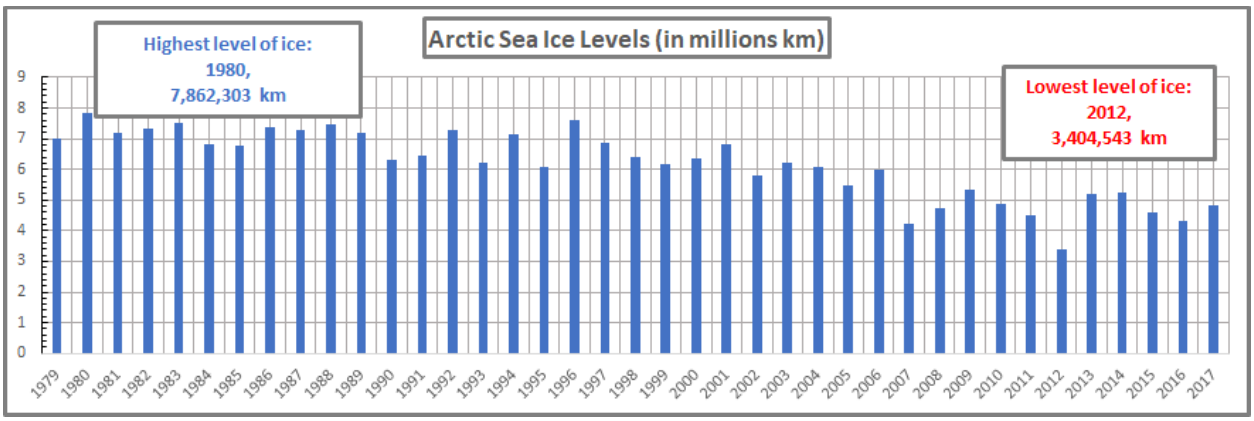
Q8 Please write a one-sentence reaction to the graph.

_____

End of Block: Global temperatures

Start of Block: Arctic ice

Q9



Q10 Please rate the clarity of the graph on the one-to-five scale below.

- 1= Very unclear (1)
- 2= Unclear (2)
- 3= Unsure (3)
- 4= Clear (4)
- 5= Very clear (5)

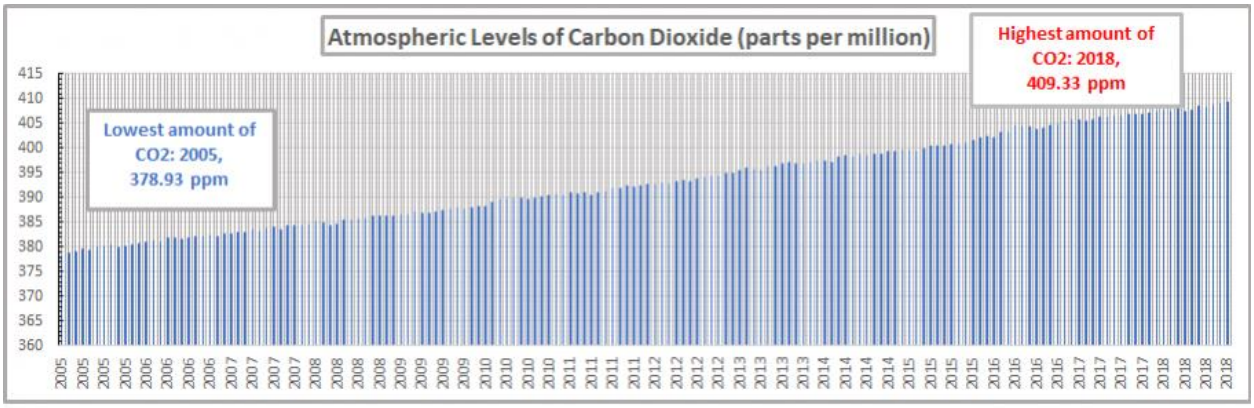
Q11 Please write a one-sentence reaction to the graph.

_____

End of Block: Arctic ice

Start of Block: Carbon dioxide

Q12



Q13 Please rate the clarity of the graph on the one-to-five scale below.

- 1= Very unclear (1)
- 2= Unclear (2)
- 3= Unsure (3)
- 4= Clear (4)
- 5= Very clear (5)

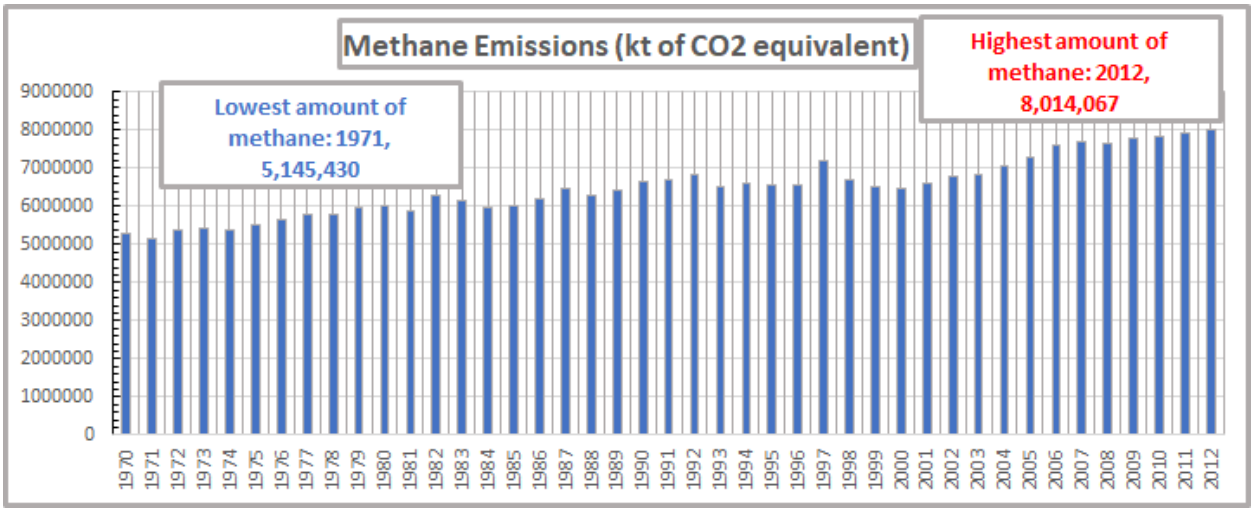
Q14 Please write a one-sentence reaction to the graph.

_____

End of Block: Carbon dioxide

Start of Block: Methane emissions

Q15



Q16 Please rate the clarity of the graph on the one-to-five scale below.

- 1= Very unclear (1)
- 2= Unclear (2)
- 3= Unsure (3)
- 4= Clear (4)
- 5= Very clear (5)

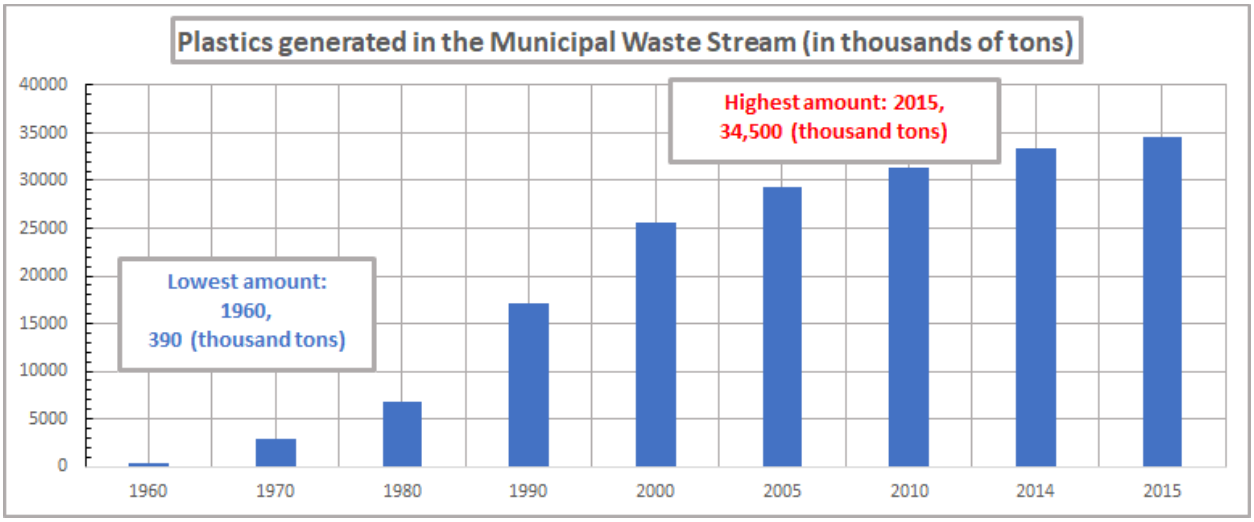
Q17 Please write a one-sentence reaction to the graph.

_____

End of Block: Methane emissions

Start of Block: Plastics

Q18



Q19 Please rate the clarity of the graph on the one-to-five scale below.

- 1= Very unclear (1)
- 2= Unclear (2)
- 3= Unsure (3)
- 4= Clear (4)
- 5= Very clear (5)

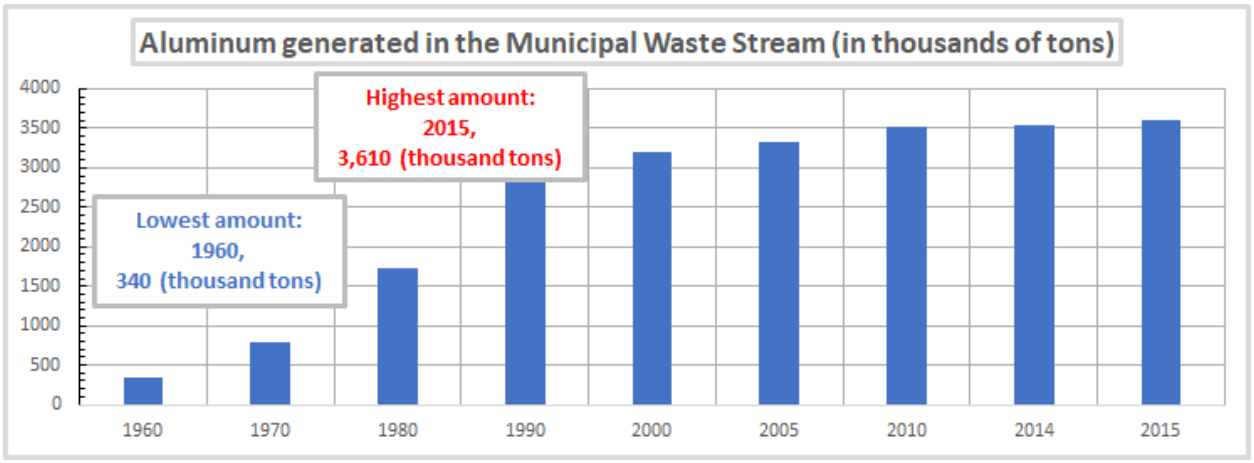
Q20 Please write a one-sentence reaction to the graph.

_____

End of Block: Plastics

Start of Block: Aluminum

Q21



Q22 Please rate the clarity of the graph on the one-to-five scale below.

- 1= Very unclear (1)
- 2= Unclear (2)
- 3= Unsure (3)
- 4= Clear (4)
- 5= Very clear (5)

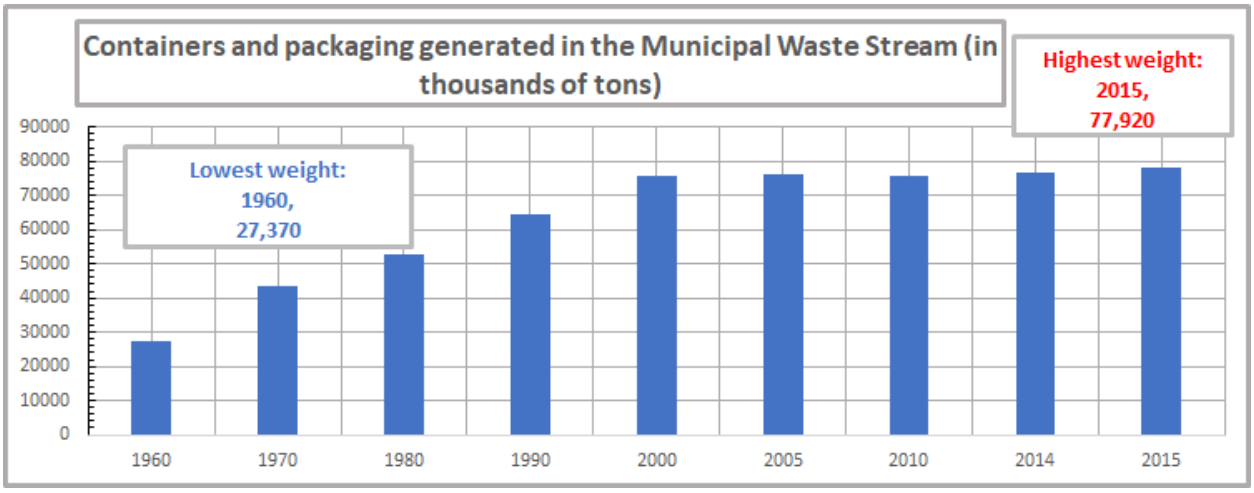
Q23 Please write a one-sentence reaction to the graph.

_____

End of Block: Aluminum

Start of Block: Containers and packaging

Q24



Q25 Please rate the clarity of the graph on the one-to-five scale below.

- 1= Very unclear (1)
- 2= Unclear (2)
- 3= Unsure (3)
- 4= Clear (4)
- 5= Very clear (5)

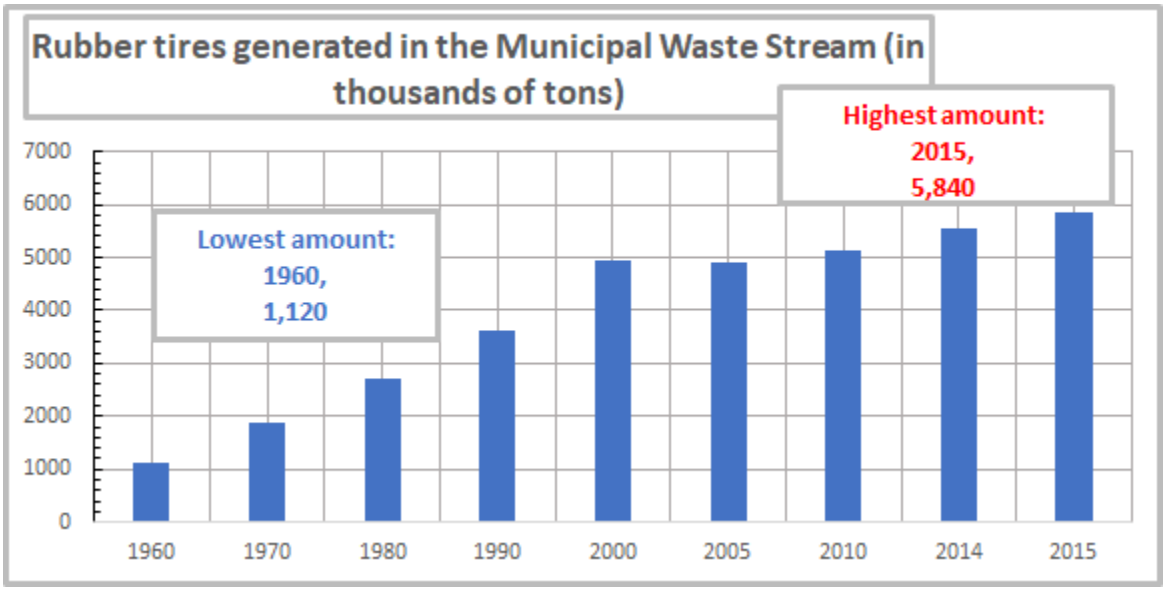
Q26 Please write a one-sentence reaction to the graph.

_____

End of Block: Containers and packaging

Start of Block: Rubber tires

Q27



Q28 Please rate the clarity of the graph on the one-to-five scale below.

- ○ 1= Very unclear (1)
- ○ 2= Unclear (2)
- ○ 3= Unsure (3)
- ○ 4= Clear (4)
- ○ 5= Very clear (5)

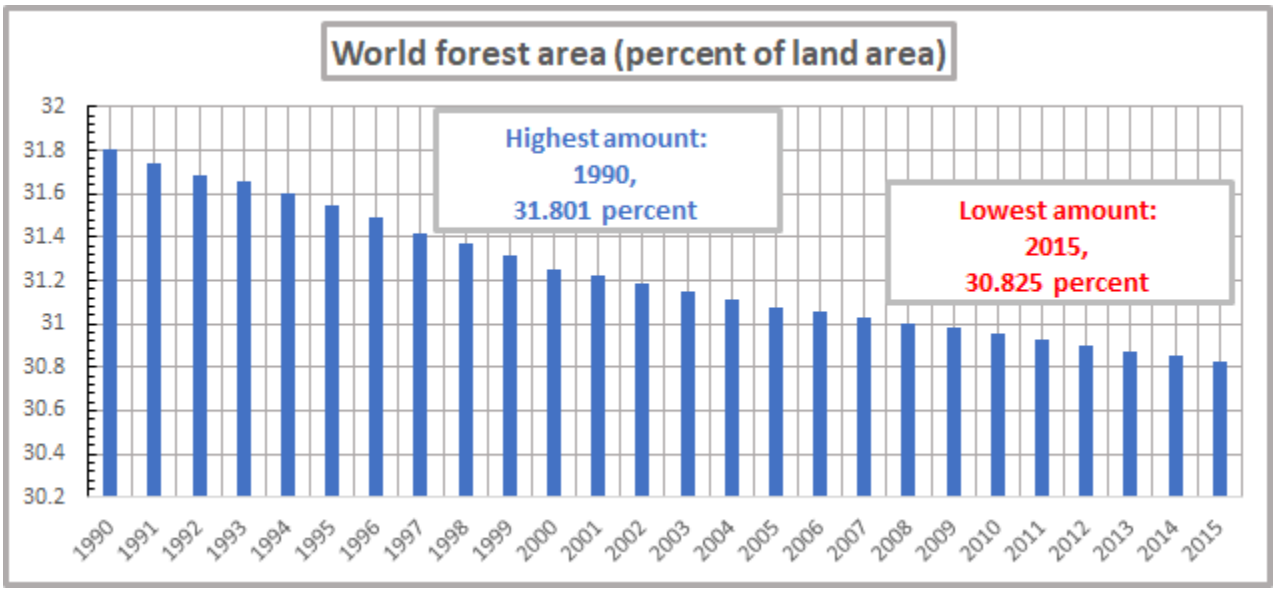
Q29 Please write a one-sentence reaction to the graph.

_____

End of Block: Rubber tires

Start of Block: Forest

Q30



Q31 Please rate the clarity of the graph on the one-to-five scale below.

- 1= Very unclear (1)
- 2= Unclear (2)
- 3= Unsure (3)
- 4= Clear (4)
- 5= Very clear (5)

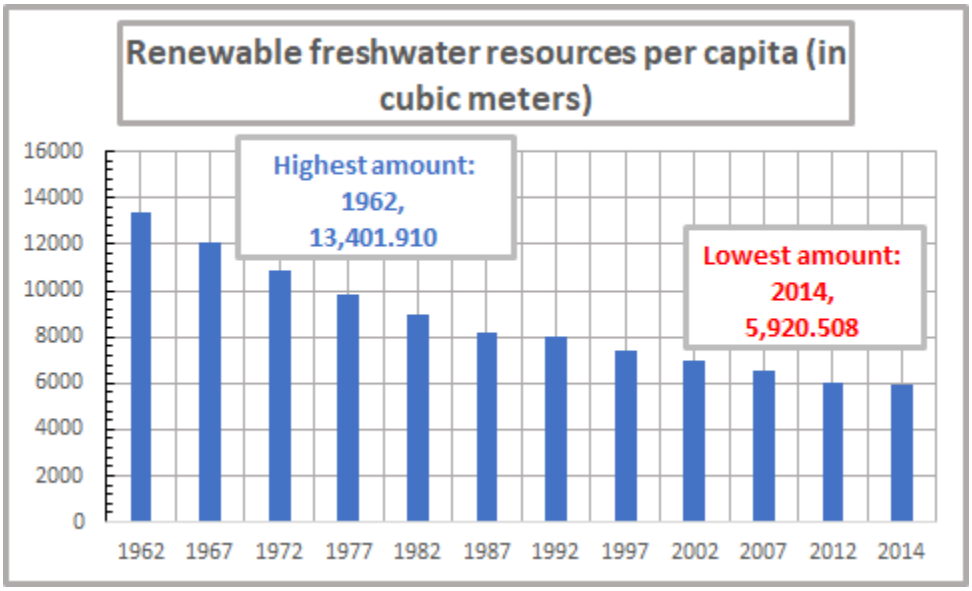
Q32 Please write a one-sentence reaction to the graph.

_____

End of Block: Forest

Start of Block: Freshwater

Q33



Q34 Please rate the clarity of the graph on the one-to-five scale below.

- 1= Very unclear (1)
- 2= Unclear (2)
- 3= Unsure (3)
- 4= Clear (4)
- 5= Very clear (5)

Q35 Please write a one-sentence reaction to the graph.

_____

End of Block: Freshwater

Start of Block: Pretest

Q36 The Environmental Control Index: Instructions
Please read the partial statement in bold letters below followed by the action described after each number. Then, carefully fill the choice on the answer sheet which best indicates how strongly you agree or disagree with the whole statement.

Please respond to every statement with only one choice.
Key:
1=Strongly Disagree; 2=Disagree; 3=Unsure; 4=Agree; 5=Strongly Agree

Q37 My individual actions would improve the quality of the environment if I were to...
learn about the recycling facilities in my area.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q38 My individual actions would improve the quality of the environment if I were to...
attend a community meeting that involves concern over a local environmental issue.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q39 My individual actions would improve the quality of the environment if I were to...
buy resource conservation devices, such as low-flow faucet aerators for my sinks and low-flow shower heads.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q40 My individual actions would improve the quality of the environment if I were to...
buy products packaged in containers that either can be reused or recycled or are made of recycled materials.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q41 My individual actions would improve the quality of the environment if I were to...
report someone who violates a law or laws that protect our natural resources (e.g., illegal fishing, hunting, or trapping or illegal tree cutting) to the proper authorities.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q42 My individual actions would improve the quality of the environment if I were to... report someone who tampers with the anti-pollution devices on a car to the proper authorities.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q43 My individual actions would improve the quality of the environment if I were to... reduce the amount of my household trash by reusing or recycling items to the fullest extent possible.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q44 My individual actions would improve the quality of the environment if I were to...
set my home appliances, such as the refrigerator, dishwasher, water heater, etc. to 'energy saver' levels.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q45 My individual actions would improve the quality of the environment if I were to...
take my old tires to a recycling center.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q46 My individual actions would improve the quality of the environment if I were to... carpool instead of driving alone.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q47 My individual actions would improve the quality of the environment if I were to... open windows for ventilation rather than using a fan or air conditioner.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q48 My individual actions would improve the quality of the environment if I were to... convince someone to boycott a store that sells products that damage the environment.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q49 My individual actions would improve the quality of the environment if I were to... convince someone to sign a petition regarding an environmental issue.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q50 My individual actions would improve the quality of the environment if I were to... convince someone to learn about the recycling facilities in his/her area.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q51 My individual actions would improve the quality of the environment if I were to... convince someone to have a home 'energy audit' to find the heat leaks in her/his house or apartment.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q52 My individual actions would improve the quality of the environment if I were to... convince someone to obtain a copy of the League of Conservation Voters' *Environmental Scorecard.*

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q53 My individual actions would improve the quality of the environment if I were to... convince someone to buy household cleaning and/or laundry products that don't harm the environment.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q54 My individual actions would improve the quality of the environment if I were to... convince someone to buy fruits and vegetables loose rather than in plastic bags.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q55 My individual actions would improve the quality of the environment if I were to... convince someone to buy products packaged in containers that either can be reused or recycled or are made of recycled materials.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q56 My individual actions would improve the quality of the environment if I were to... convince someone to report someone who violated a law or laws that protect our natural

resources (e.g., illegal fishing, hunting, or trapping or illegal tree cutting) to the proper authorities.

- ○ 1. Strongly Disagree (1)
- ○ 2. Disagree (2)
- ○ 3. Unsure (3)
- ○ 4. Agree (4)
- ○ 5. Strongly Agree (5)

Q57 My individual actions would improve the quality of the environment if I were to... convince someone to reuse envelopes by putting a label over the old address.

- ○ 1. Strongly Disagree (1)
- ○ 2. Disagree (2)
- ○ 3. Unsure (3)
- ○ 4. Agree (4)
- ○ 5. Strongly Agree (5)

Q58 My individual actions would improve the quality of the environment if I were to... convince someone to set her/his household appliances, such as the refrigerator, dishwasher, water heater, etc. to 'energy saver' levels.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q59 My individual actions would improve the quality of the environment if I were to... convince someone to keep her/his car tires properly inflated.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q60 My individual actions would improve the quality of the environment if I were to... convince someone to take old tires to a recycling center.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q61 My individual actions would improve the quality of the environment if I were to... convince someone to conserve water by not running the water while brushing her/his teeth or shaving and/or installing a water saving device in the tank of her/his toilet(s).

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q62 My individual actions would improve the quality of the environment if I were to... convince someone to avoid idling her/his car unnecessarily.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q63 My individual actions would improve the quality of the environment if I were to... convince someone to reduce the amount he/she drives her/his car by carpooling instead of driving alone and/or driving only when necessary.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q64 My individual actions would improve the quality of the environment if I were to... convince someone to reduce the amount of her/his household trash by reusing or recycling items to the fullest extent possible.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

End of Block: Pretest

APPENDIX E. POSTTEST C

Posttest C

Start of Block: Introduction

Q1
This is the second of two surveys in which you have consented to participate. If you have any questions or concerns about either or both of these surveys, you may contact the co-PI, Briana Wilhelmi (briana.r.wilhelmi.1@ndsu.edu) or the PI, Dr. Pamela Emanuelson (pamela.emanuelson@ndsu.edu; 701-231-5887).

End of Block: Introduction

Start of Block: Course information

Q2 Please provide course information in the following questions to receive extra credit.

Q3 Course name (e.g., SOC 110)

_____

Q4 Instructor name

_____

End of Block: Course information

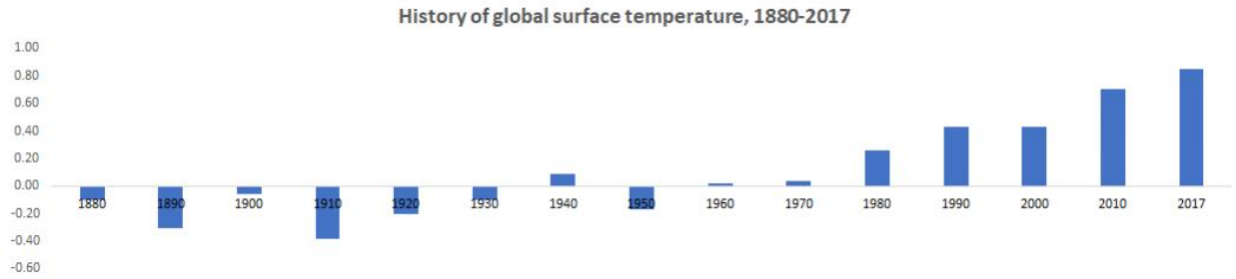
Start of Block: Instructions

Q5 The following section contains 10 graphs regarding environmentally relevant data. Please view each graph, answer the question regarding the clarity of the information on a one-to-five Likert scale, and write one sentence describing your impression of the data where prompted to do so.

End of Block: Instructions

Start of Block: Global temperatures

Q6



Q7 Please rate the clarity of the graph on the one-to-five scale below.

- 1= Very unclear (1)
- 2= Unclear (2)
- 3= Unsure (3)
- 4= Clear (4)
- 5= Very clear (5)

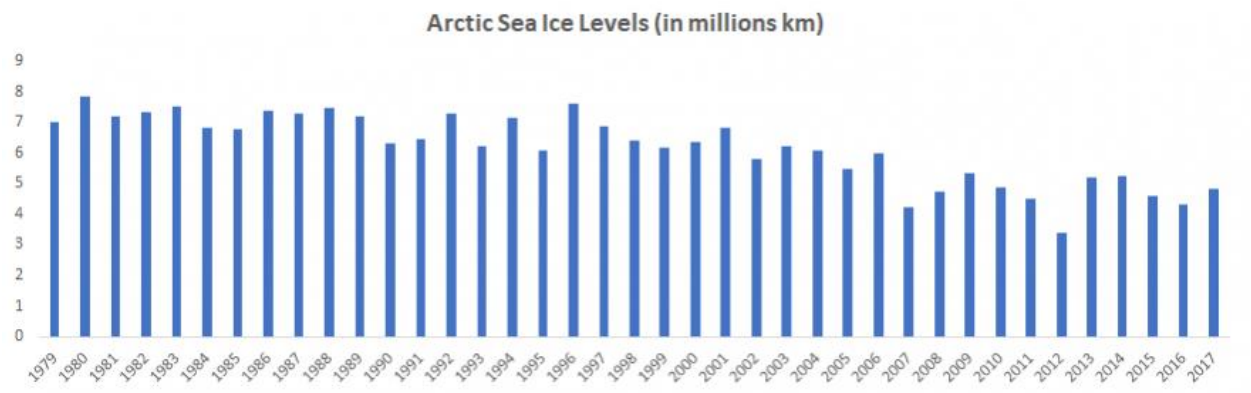
Q8 Please write a one-sentence reaction to the graph.

_____

End of Block: Global temperatures

Start of Block: Arctic ice

Q9



Q10 Please rate the clarity of the graph on the one-to-five scale below.

- 1= Very unclear (1)
- 2= Unclear (2)
- 3= Unsure (3)
- 4= Clear (4)
- 5= Very clear (5)

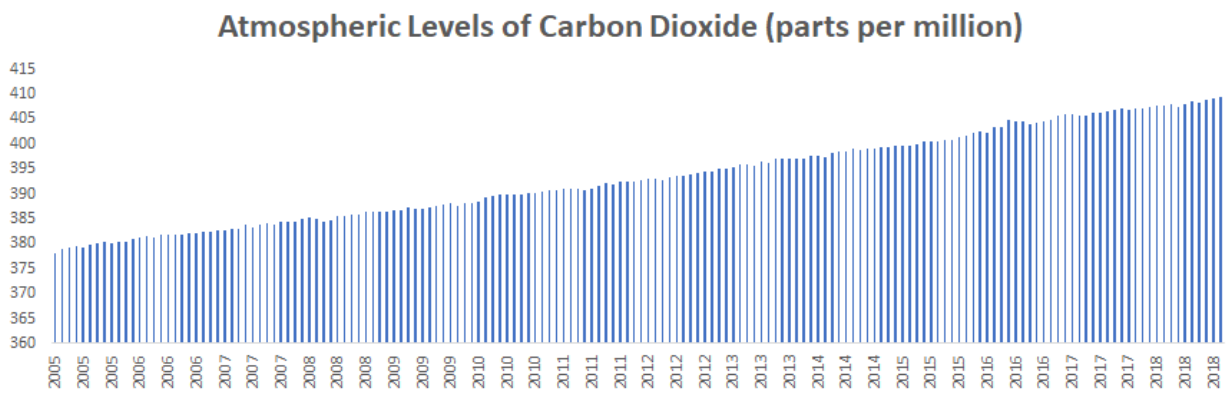
Q11 Please write a one-sentence reaction to the graph.

_____

End of Block: Arctic ice

Start of Block: Carbon dioxide

Q12



Q13 Please rate the clarity of the graph on the one-to-five scale below.

- 1= Very unclear (1)
- 2= Unclear (2)
- 3= Unsure (3)
- 4= Clear (4)
- 5= Very clear (5)

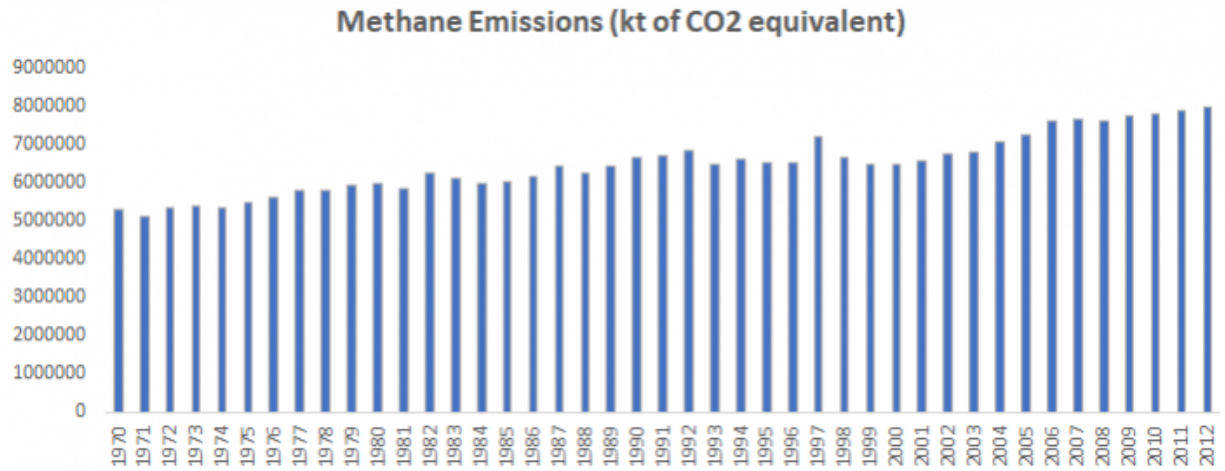
Q14 Please write a one-sentence reaction to the graph.

_____

End of Block: Carbon dioxide

Start of Block: Methane emissions

Q15



Q16 Please rate the clarity of the graph on the one-to-five scale below.

- 1= Very unclear (1)
- 2= Unclear (2)
- 3= Unsure (3)
- 4= Clear (4)
- 5= Very clear (5)

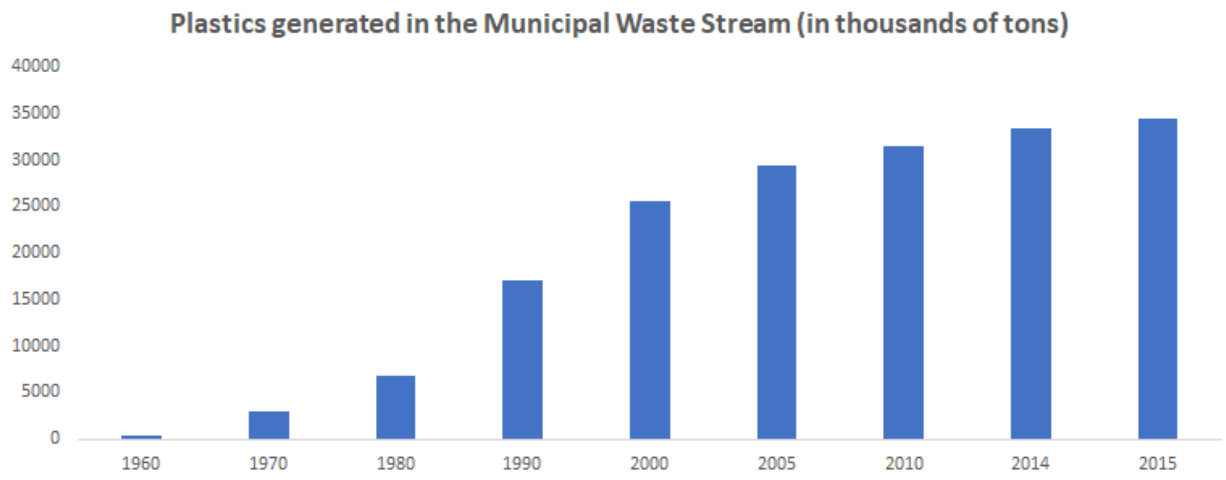
Q17 Please write a one-sentence reaction to the graph.

_____

End of Block: Methane emissions

Start of Block: Plastics

Q18



Q19 Please rate the clarity of the graph on the one-to-five scale below.

- 1= Very unclear (1)
- 2= Unclear (2)
- 3= Unsure (3)
- 4= Clear (4)
- 5= Very clear (5)

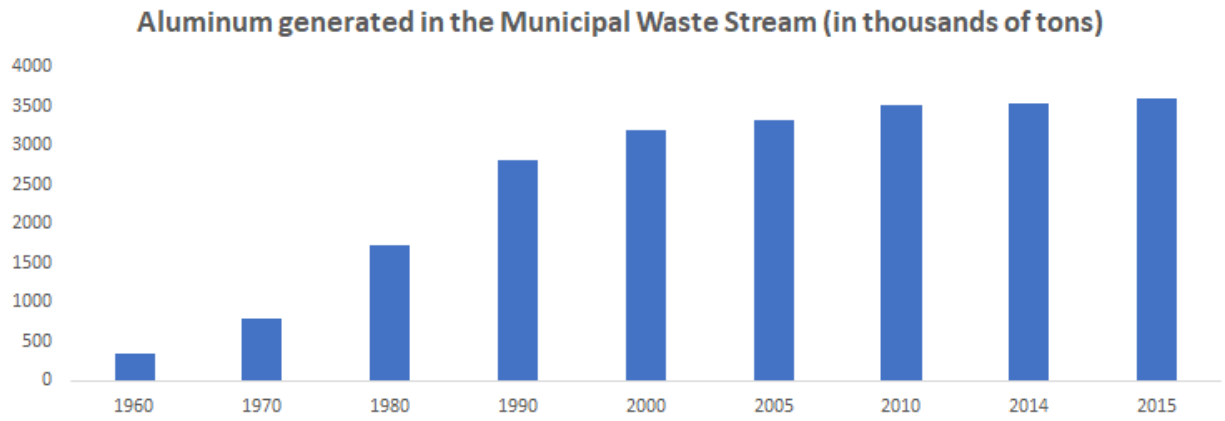
Q20 Please write a one-sentence reaction to the graph.

_____

End of Block: Plastics

Start of Block: Aluminum

Q21



Q22 Please rate the clarity of the graph on the one-to-five scale below.

- 1= Very unclear (1)
- 2= Unclear (2)
- 3= Unsure (3)
- 4= Clear (4)
- 5= Very clear (5)

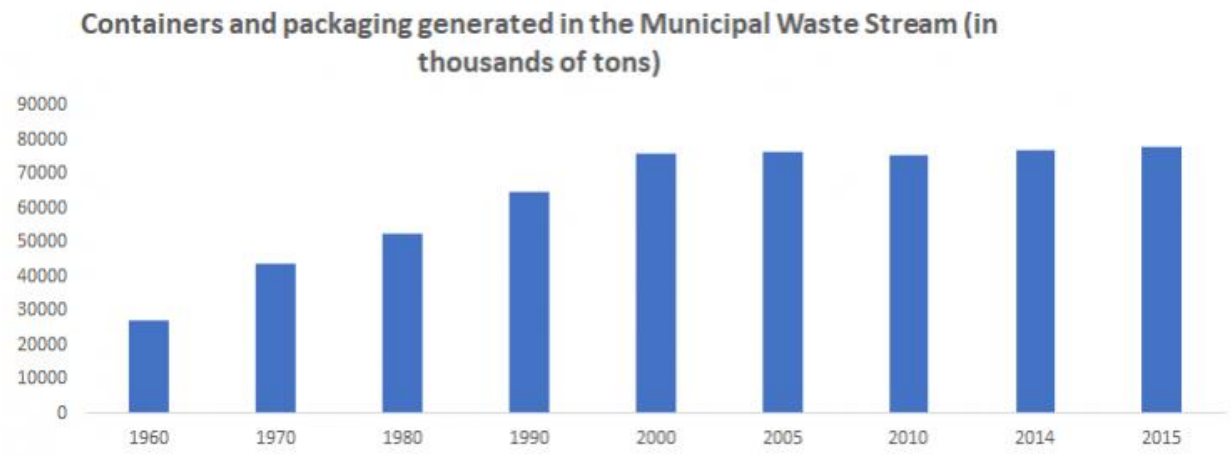
Q23 Please write a one-sentence reaction to the graph.

_____

End of Block: Aluminum

Start of Block: Containers and packaging

Q24



Q25 Please rate the clarity of the graph on the one-to-five scale below.

- 1= Very unclear (1)
- 2= Unclear (2)
- 3= Unsure (3)
- 4= Clear (4)
- 5= Very clear (5)

Q26 Please write a one-sentence reaction to the graph.

_____

End of Block: Containers and packaging

Start of Block: Rubber tires

Q27

Q28 Please rate the clarity of the graph on the one-to-five scale below.

- 1= Very unclear (1)
- 2= Unclear (2)
- 3= Unsure (3)
- 4= Clear (4)
- 5= Very clear (5)

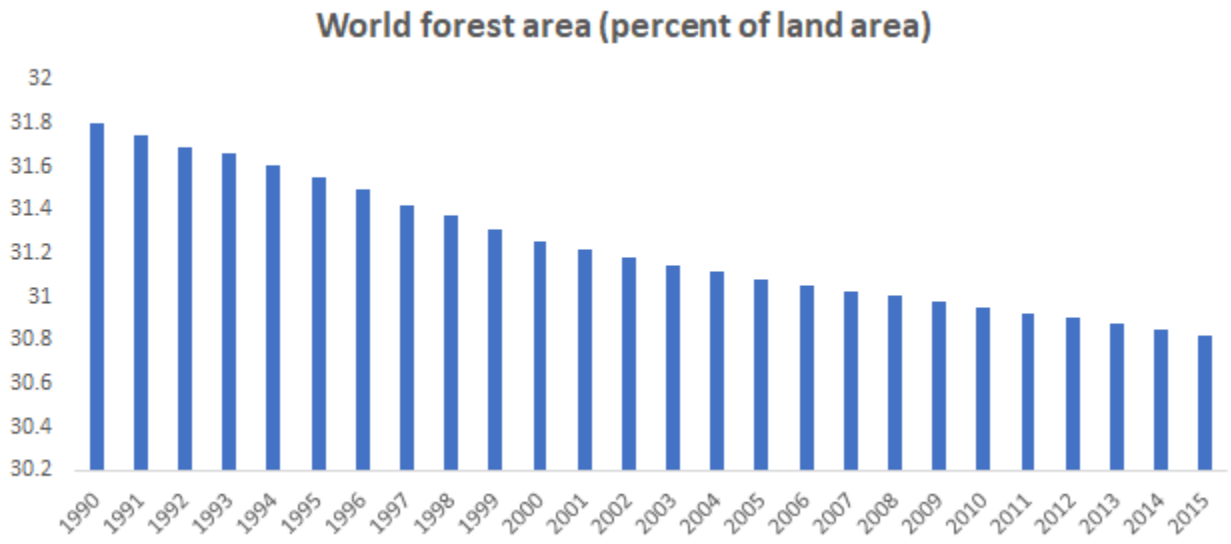
Q29 Please write a one-sentence reaction to the graph.

_____

End of Block: Rubber tires

Start of Block: Forest

Q30



Q31 Please rate the clarity of the graph on the one-to-five scale below.

- ○ 1= Very unclear (1)
- ○ 2= Unclear (2)
- ○ 3= Unsure (3)
- ○ 4= Clear (4)
- ○ 5= Very clear (5)

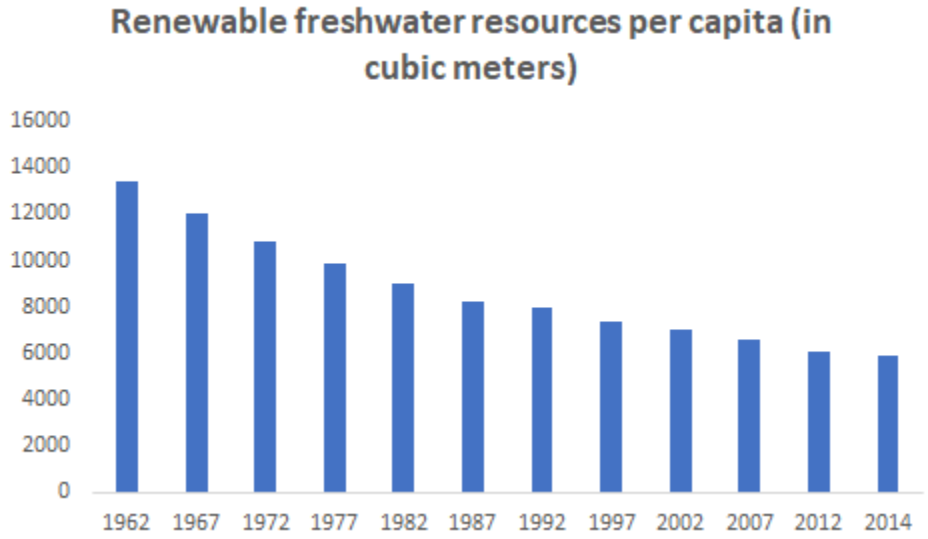
Q32 Please write a one-sentence reaction to the graph.

_____

End of Block: Forest

Start of Block: Freshwater

Q33



Q34 Please rate the clarity of the graph on the one-to-five scale below.

- 1= Very unclear (1)
- 2= Unclear (2)
- 3= Unsure (3)
- 4= Clear (4)
- 5= Very clear (5)

Q35 Please write a one-sentence reaction to the graph.

_____

End of Block: Freshwater

Start of Block: Pretest

Q36 The Environmental Control Index: Instructions
Please read the partial statement in bold letters below followed by the action described after each number. Then, carefully fill the choice on the answer sheet which best indicates how strongly you agree or disagree with the whole statement.

Please respond to every statement with only one choice.
Key:
1=Strongly Disagree; 2=Disagree; 3=Unsure; 4=Agree; 5=Strongly Agree

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Q37 My individual actions would improve the quality of the environment if I were to...
learn about the recycling facilities in my area.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q38 My individual actions would improve the quality of the environment if I were to...
attend a community meeting that involves concern over a local environmental issue.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q39 My individual actions would improve the quality of the environment if I were to...
buy resource conservation devices, such as low-flow faucet aerators for my sinks and low-flow shower heads.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q40 My individual actions would improve the quality of the environment if I were to...
buy products packaged in containers that either can be reused or recycled or are made of recycled materials.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q41 My individual actions would improve the quality of the environment if I were to...
report someone who violates a law or laws that protect our natural resources (e.g., illegal fishing, hunting, or trapping or illegal tree cutting) to the proper authorities.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q42 My individual actions would improve the quality of the environment if I were to... report someone who tampers with the anti-pollution devices on a car to the proper authorities.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q43 My individual actions would improve the quality of the environment if I were to... reduce the amount of my household trash by reusing or recycling items to the fullest extent possible.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q44 My individual actions would improve the quality of the environment if I were to...
set my home appliances, such as the refrigerator, dishwasher, water heater, etc. to 'energy saver' levels.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q45 My individual actions would improve the quality of the environment if I were to...
take my old tires to a recycling center.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q46 My individual actions would improve the quality of the environment if I were to... carpool instead of driving alone.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q47 My individual actions would improve the quality of the environment if I were to... open windows for ventilation rather than using a fan or air conditioner.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q48 My individual actions would improve the quality of the environment if I were to... convince someone to boycott a store that sells products that damage the environment.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q49 My individual actions would improve the quality of the environment if I were to... convince someone to sign a petition regarding an environmental issue.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q50 My individual actions would improve the quality of the environment if I were to... convince someone to learn about the recycling facilities in his/her area.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q51 My individual actions would improve the quality of the environment if I were to... convince someone to have a home 'energy audit' to find the heat leaks in her/his house or apartment.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q52 My individual actions would improve the quality of the environment if I were to... convince someone to obtain a copy of the League of Conservation Voters' *Environmental Scorecard.*

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q53 My individual actions would improve the quality of the environment if I were to... convince someone to buy household cleaning and/or laundry products that don't harm the environment.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q54 My individual actions would improve the quality of the environment if I were to... convince someone to buy fruits and vegetables loose rather than in plastic bags.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q55 My individual actions would improve the quality of the environment if I were to... convince someone to buy products packaged in containers that either can be reused or recycled or are made of recycled materials.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q56 My individual actions would improve the quality of the environment if I were to... convince someone to report someone who violated a law or laws that protect our natural

resources (e.g., illegal fishing, hunting, or trapping or illegal tree cutting) to the proper authorities.

- ○ 1. Strongly Disagree (1)
- ○ 2. Disagree (2)
- ○ 3. Unsure (3)
- ○ 4. Agree (4)
- ○ 5. Strongly Agree (5)

Q57 My individual actions would improve the quality of the environment if I were to... convince someone to reuse envelopes by putting a label over the old address.

- ○ 1. Strongly Disagree (1)
- ○ 2. Disagree (2)
- ○ 3. Unsure (3)
- ○ 4. Agree (4)
- ○ 5. Strongly Agree (5)

Q58 My individual actions would improve the quality of the environment if I were to... convince someone to set her/his household appliances, such as the refrigerator, dishwasher, water heater, etc. to 'energy saver' levels.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q59 My individual actions would improve the quality of the environment if I were to... convince someone to keep her/his car tires properly inflated.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q60 My individual actions would improve the quality of the environment if I were to... convince someone to take old tires to a recycling center.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q61 My individual actions would improve the quality of the environment if I were to... convince someone to conserve water by not running the water while brushing her/his teeth or shaving and/or installing a water saving device in the tank of her/his toilet(s).

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q62 My individual actions would improve the quality of the environment if I were to... convince someone to avoid idling her/his car unnecessarily.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q63 My individual actions would improve the quality of the environment if I were to... convince someone to reduce the amount he/she drives her/his car by carpooling instead of driving alone and/or driving only when necessary.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

Q64 My individual actions would improve the quality of the environment if I were to... convince someone to reduce the amount of her/his household trash by reusing or recycling items to the fullest extent possible.

- 1. Strongly Disagree (1)
- 2. Disagree (2)
- 3. Unsure (3)
- 4. Agree (4)
- 5. Strongly Agree (5)

End of Block: Pretest