2017

What’s In Your Body Of Water? Reducing The Psychological Distance Of Pharmaceutical Pollution Through Metaphor In Risk Communication

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WHAT’S IN YOUR BODY OF WATER? REDUCING THE
PSYCHOLOGICAL DISTANCE OF PHARMACEUTICAL POLLUTION THROUGH
METAPHOR IN RISK COMMUNICATION

A Thesis Presented

by

Alexandra Z. Millarhouse

to

The Faculty of the Graduate College

of

The University of Vermont

In Partial Fulfillment of the Requirements
for the Degree of Master of Science
Specializing in Natural Resources

October, 2017

Defense Date: May 31, 2017
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ABSTRACT

Aquatic pharmaceutical pollution poses ecotoxicological risks to the environment and human health. Consumer attitudes and behavior represent a significant source of pharmaceutical compounds found in water. Thus, understanding public perceptions of aquatic pharmaceutical pollution and developing effective risk communication techniques are critical to engaging society in the type of widespread change necessary for addressing the presence of pharmaceuticals in water. This mixed-methods study applies conceptual metaphor theory in conjunction with construal level theory of psychological distance to assess how metaphoric framing affects perceptions of aquatic pharmaceutical contamination across four principal dimensions of psychological distance (geographic, social and temporal distance and uncertainty). Additionally, this study assesses the direct impact of metaphor use on concern and willingness to act, which are positively associated with perceived psychological distance. Data were collected from a convenience sample (n = 20) of university students in Burlington, Vermont using cognitive interviewing. Results indicate that pharmaceutical pollution was initially perceived as geographically distant, socially distant, temporally both proximate and distant and certain (versus uncertain). Our findings suggest people perceive distances in various ways, suggesting a need for validated questions to consistently measure psychological distance. Participants preferred the metaphorically-framed visual intervention to the non-metaphor visual intervention. Further, participants’ perception of pharmaceutical pollution changed to being more geographically and socially close after viewing the metaphoric visual only. Previous research indicates perceived psychological closeness leads to increased motivation and preparedness to act. Theoretical and practical implications of metaphor use in risk communications are discussed.

Keywords: pharmaceutical pollution, psychological distance, cognitive interview, environmental communication, risk perception
CITATION

Material from this thesis has been submitted for publication to the Journal of Risk Analysis on May 10, 2017 in the following form:

ACKNOWLEDGEMENTS

Countless individuals and experiences have contributed to this thesis and to my development as a researcher. First and foremost, I’d like to thank my committee members, Adrian, Christine and Meredith for the time and energy they invested in guiding me through this process. I could not have asked for a more wonderful or supportive team and I am forever grateful to each of them.

I would also like to thank our research participants, Carolyn Goodwin Kueffner, RSEN R Student Services Specialist, for her support and friendship, Alan Howard, Director of the Statistical Counseling Clinic at the University of Vermont, for his invaluable assistance with statistical analysis and Jon Portman, Creative Director and Founding Partner at Oxbow Creative, for his graphic design input.

Funding support for this research was generously provided by the Gund Institute for Environment, the Vermont Water Resources and Lake Studies Center, a USGS Water Resources Research Institute and the Rubenstein Graduate Student Association. This study was also supported in part by the University of Vermont Rubenstein School of Environment and Natural Resources. Additionally, I’ve been lucky enough to work with and for some incredible people including Zac Ispa-Landa, Matt Kolan, Kate Baldwin, Shari Halik, Elissa Schuett, Michael McDonald and Brian Hsiang.

Last but certainly not least, I would like to thank my family and friends for all the laughter, adventures and heart-felt connection that has kept me going and focused on what matters. I would not be the person I am today without each of you. Most of all, thank you, Nathaniel Millar-House, I love you always and can’t wait to see where life takes us next.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACKNOWLEDGEMENTS</td>
<td>iii</td>
</tr>
<tr>
<td>LIST OF TABLES</td>
<td>vi</td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
<td>vii</td>
</tr>
<tr>
<td>CHAPTER 1: LITERATURE REVIEW</td>
<td>1</td>
</tr>
<tr>
<td>Introduction</td>
<td>1</td>
</tr>
<tr>
<td>Pharmaceuticals in the Environment</td>
<td>4</td>
</tr>
<tr>
<td>Ecotoxicity</td>
<td>6</td>
</tr>
<tr>
<td>Sources and origins</td>
<td>8</td>
</tr>
<tr>
<td>Current disposal practices</td>
<td>11</td>
</tr>
<tr>
<td>Drug take-back programs</td>
<td>13</td>
</tr>
<tr>
<td>Theoretical Approach</td>
<td>17</td>
</tr>
<tr>
<td>Construal level theory and psychological distance</td>
<td>19</td>
</tr>
<tr>
<td>Conceptual metaphor theory</td>
<td>25</td>
</tr>
<tr>
<td>CHAPTER 2: RESEARCHER IDENTITY AND APPROACH</td>
<td>29</td>
</tr>
<tr>
<td>CHAPTER 3: JOURNAL ARTICLE</td>
<td>33</td>
</tr>
<tr>
<td>Abstract</td>
<td>33</td>
</tr>
<tr>
<td>Introduction</td>
<td>34</td>
</tr>
<tr>
<td>Pharmaceuticals in the environment</td>
<td>35</td>
</tr>
<tr>
<td>Theoretical Grounding and Approaches</td>
<td>37</td>
</tr>
<tr>
<td>Construal level theory and psychological distance</td>
<td>39</td>
</tr>
<tr>
<td>Conceptual metaphor theory</td>
<td>41</td>
</tr>
<tr>
<td>Methods</td>
<td>43</td>
</tr>
<tr>
<td>Sampling procedure</td>
<td>44</td>
</tr>
<tr>
<td>Materials</td>
<td>46</td>
</tr>
<tr>
<td>Results</td>
<td>47</td>
</tr>
</tbody>
</table>
Initial perceptions of psychological distance, concern and willingness to act ................................................................. 48
Effect of metaphor on psychological distance, concern and willingness to act on pharmaceuticals in the environment .......... 50
Discussion ............................................................................................................................................................................. 54
Baseline results indicate varying levels of perceived distance across dimensions ................................................................ 54
Metaphor use may reduce perceived distance of the environmental issue ......................................................................... 55
Methods discussion .................................................................................................................................................................. 58
Conclusion ............................................................................................................................................................................. 59
Acknowledgements .................................................................................................................................................................. 61
References .............................................................................................................................................................................. 62
Supplemental Material ............................................................................................................................................................. 68

CHAPTER 4: SUPPLEMENTAL MATERIAL ............................................................................................................................... 70
Expanded Results and Discussion ............................................................................................................................................. 70
Background knowledge and current purchasing, use and disposal behavior ........................................................................ 70
New Ecological Paradigm Scale Descriptive Results ............................................................................................................. 74
Development of Visual Treatments ........................................................................................................................................ 75
Metaphor development and presentation ................................................................................................................................ 76
Visual Treatments .................................................................................................................................................................... 79
Visual framed through “nature as body” metaphor .................................................................................................................. 79
Visual framed without “nature as body” metaphor .................................................................................................................. 80
Survey Instrument .................................................................................................................................................................... 81

CHAPTER 5: CONCLUSION ............................................................................................................................................................. 97
Future Research Directions ......................................................................................................................................................... 99
REFERENCES ........................................................................................................................................................................... 101
LIST OF TABLES

Table I. Survey procedure. ................................................................. 44

Table II. Combined baseline results for treatment groups A and B for psychological distance, concern and willingness to act (n = 20). ....................... 48

Table III. Statistical results using Wilcoxon signed ranks test, a nonparametric method for analyzing differences and magnitude of difference between paired data that assumes a null hypothesis of zero difference (McDonald, 2014; Whitley & Ball, 2002). Significant results (p < 0.100) are bolded for emphasis. ................................................................. 52

Table IV. Demographic characteristics of respondents (n = 20), all of whom are currently enrolled students at the University of Vermont (UVM) and the UVM student population. ......................................................... 68

Table V. Current drug purchasing, use and disposal behaviors among the sample population (n = 20) and University of Vermont students (n = 359), adapted from Vatovec, Phillips, Van Wagoner, Scott, and Furlong (2016). ............... 72

Table VI. New ecological paradigm scale descriptive survey results (n = 20). ............. 74
## LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Figure 1.</strong> A simplified representation of the interplay between theoretical foundations and study objectives.</td>
<td>39</td>
</tr>
<tr>
<td><strong>Figure 2.</strong> Change in perceived geographic and social distance for group A (n = 10) between baseline and the first treatment (the metaphoric framing manipulation).</td>
<td>51</td>
</tr>
<tr>
<td><strong>Figure 3.</strong> Observed and potential impacts of metaphor use on psychological distance, concern and willingness to act.</td>
<td>57</td>
</tr>
</tbody>
</table>
CHAPTER 1: LITERATURE REVIEW

Introduction

Pharmaceuticals are oft-cited chemicals of emerging concern because of their potential impacts on the environment and human health (Environmental Protection Agency, 2008). Pharmaceuticals have been found in over 80 percent of sampled United States surface waters (Kolpin et al., 2002), which then contaminate aquatic species and drinking water. Numerous studies have reported associations between pharmaceutical contaminants and reproductive effects in fish (Jobling et al., 2006), bivalves (Antunes, Freitas, Figueira, Gonçalves, & Nunes, 2013) and zooplankton (Flaherty & Dodson, 2005). Drinking water is the principal pathway of human exposure to medications, excluding intentional doses (Rodriguez-Mozaz & Weinberg, 2010). Some evidence suggests that prescribed synthetic chemicals and hormones may contribute to human tumor formation and that susceptibility to cancer may result from developmental exposures (Birnbaum & Fenton, 2003).

Disposal of unwanted household medications via municipal trash or household drains is a principal source of drinking and surface water contamination (via the respective pathways of landfill runoff and leachate and wastewater) (Daughton, 2007). The environmentally-preferred disposal method is through collection (“take-back”) programs where drugs are collected and incinerated. These initiatives rely on voluntary participation and are critical for the reduction of pharmaceutical pollution. While multiple take-back initiatives, such as the National Prescription Take-Back Day, are in place
around the country, many are not attracting significant participation (Schwarz, 2015). A study of American household disposal practices found that 45% of people discarded medications via the trash, 28% used the toilet or sink for disposal, 5% returned drugs to their pharmacy, another 5% dropped them off at a hazardous waste facility and, significantly, 12% chose to store leftover and unused drugs at home (Kotchen, Kallaos, Wheeler, Wong, & Zahller, 2009). In a recent study of undergraduate students at the University of Vermont (UVM), 61% reported having leftover medications, 24% knew what a National Prescription Drug Take-Back Day was and of those 2% had used the program to dispose of drugs (Vatovec et al., 2016). Given the ubiquity of the problem and the prevalence of leftover pharmaceuticals, there is an urgent need to encourage proper drug disposal as an alternative to storing medications or unsafe disposal. Thus, understanding public perceptions of aquatic pharmaceutical pollution and developing effective risk communication techniques are critical to engaging society in the type of widespread change necessary for addressing the presence of pharmaceuticals in water. In this study, we apply psychological distance to characterize perceptions, attitudes and behaviors towards aquatic pharmaceutical contamination and conceptual metaphor theory to assess the impact of metaphor use in common risk communication on relevant perceptions, attitudes and behaviors.

Applying the psychological distance model of metaphor use, recent research found that metaphor use affects attitudes and behavior (e.g. creating strong opposition to open immigration policy) when a concept is framed as psychologically distant (Jia & Smith, 2013). Psychological distance, an index of how near or far from one’s self a
concept seems through temporal, geographic, social group and uncertainty dimensions (Trope & Liberman, 2010), has implications for decision-making. When a concept is perceived as psychologically distant, people mentally represent its abstract qualities and make choices based on their values (i.e. kindness); when something is psychologically close, it is conceptualized in concrete terms and feasibility concerns (e.g. expected time commitment) guide decisions (Trope & Liberman, 2010). Conceptual metaphor theory, another component of the model, states that people rely on metaphors as a cognitive tool to make sense of abstract concepts with implications for decision-making (Lakoff & Johnson, 1980). The literature notes that more research is needed to understand if metaphor use alters the perceived distance of a concept, impacting which features (values versus feasibility concerns) guide decision makers.

The purpose of this research was (1) to advance the frameworks of psychological distance and conceptual metaphor theory to better understand how people make sense of themselves relative to their environment and (2) to develop practical risk communication methods for motivating participation in take-back initiatives, ultimately reducing pharmaceutical contamination of surface waters. To accomplish my goals, I based this research on the following objectives: (1) to assess whether and, if so, how metaphoric framing impacts the perceived distance of the environmental hazard across dimensions (temporal, geographic, social group and uncertainty), (2) to assess whether and, if so, how metaphoric framing impacts concern for the environmental hazard across dimensions and (3) to assess whether and, if so, how metaphoric framing impacts behavioral responses and the likelihood of acting.
The findings I report here will contribute to the theoretical advancement of psychological distance and metaphor theories and inform communication and community outreach strategies encouraging the proper disposal of household drugs through take-back initiatives. Pharmaceutical pollution is one of many complex, multi-scaled systems of waste with consequences for environmental and human health. Ultimately, my goal is to provide practical and theoretical knowledge to the global scientific community that advances sustainable socio-ecological systems.

**Pharmaceuticals in the Environment**

Pharmaceuticals, critical tools in modern healthcare, are defined as “chemicals used for diagnosis, treatment (cure/mitigation), alteration, or prevention of disease, health condition, or structure/function of the human body” (Spellman, 2014, p. 97). This definition includes prescription and over-the-counter (OTC) medications, as well as “residues of pharmaceuticals remaining in containers, personal protective equipment contaminated with pharmaceuticals and clean-up material from spills of pharmaceuticals” (Spellman, 2014, p. 97). The use and distribution of pharmaceutical drugs continues to increase globally in response to the needs of aging populations in developed countries and efforts to improve health in developing countries, among other drivers (Castensson, 2008). This is true in the United States, where use of prescription and over-the-counter pharmaceutical drugs continues to increase (Glassmeyer et al., 2009). Recent estimates suggest that over 20% of American adults take 5 or more prescription drugs per day.
Retail spending on pharmaceuticals, representing almost a quarter of all healthcare spending in the United States, has tripled as a percentage of the gross domestic product since 1960 (Centers for Medicare and Medicaid Services, 2014).

The increasing use of pharmaceutical drugs raises concerns about their occurrence in the environment, particularly fresh water environments (Glassmeyer et al., 2009). The quantity and quality of available water resources are considered foremost challenges to the United States in the 21st century (U.S. Government Accountability Office, 2014). A survey of national water quality by the Environmental Protection Agency (EPA) revealed that approximately 55% of rivers and streams, 69% of lakes, reservoirs and ponds, 78% of bays and estuaries, 54% of wetlands, 98% of Great Lakes shoreline and >99% of Great Lakes open water are impaired (Environmental Protection Agency, 2014). An impaired water body is classified by the EPA when it fails to meet standards set by the Clean Water Act and is no longer swimmable, drinkable or fishable (Environmental Protection Agency, 2016). As demand on the country’s water resources continues to grow along with population growth and energy production, maintaining and improving the integrity of fresh water supplies is a national priority (U.S. Government Accountability Office, 2014).

Castensson (2008, p. 489) calls proper pharmaceutical waste management “a new and highly complex frontier in environmental management.” As a chemical first and a therapeutic agent second, drug waste presents many different socio-ecological concerns. Like other commercial chemicals, pharmaceuticals flow from consumers to the environment during their life cycle (Glassmeyer et al., 2009). Unlike other chemical
products, these are ubiquitously disposed of or discharged into the environment on a continual basis (Glassmeyer et al., 2009), posing significant risks to the environment (U.S. Government Accountability Office, 2011; U.S. Senate, 2014) and prompting the EPA to list them as contaminants of emerging concern (Environmental Protection Agency, 2008).

Pharmaceuticals have been found in surface waters (Glassmeyer et al., 2005; Lara-Martín, González-Mazo, Petrovic, Barceló, & Brownawell, 2014; Lara-Martín, Renfro, Cochran, & Brownawell, 2015), ground water (Banzhaf, Krein, & Scheytt, 2011) and untreated (Focazio et al., 2008) and treated (Stackelberg et al., 2007) drinking water. Of the products and metabolites that are currently possible to analyze, many appear widespread and persistent in the aquatic environment at low concentrations (parts per billion) (Glassmeyer et al., 2009). In the first national-scale reconnaissance, pharmaceuticals were detected in over 80% of sampled United States surface waters (Kolpin et al., 2002). Drugs that might have a higher rate of removal or transformation likely also appear persistent based on the high rate of replacement via wastewater (Daughton & Ternes, 1999).

Ecotoxicity

Although detected at levels below human therapeutic doses, pharmaceuticals are designed to produce biochemical activity in target organisms at low concentrations (Boxall et al., 2012; Brain, Hanson, Solomon, & Brooks, 2008). The mechanisms of bioactivity produced by pharmaceutical products are not always well-understood.
Unknown/unintended side effects are common even for targeted users, let alone untargeted biota with different chemical receptors (Daughton & Ternes, 1999). Therefore, the fate of drugs in the environment raises concerns about their ecological and human health impacts.

Pharmaceuticals have been discovered in multiple aquatic species (Brandao, Pereira, Goncalves, & Nunes, 2014; Ramirez et al., 2009), including edible species (Antunes et al., 2013). Studies have shown exposure to certain drugs can cause fish populations to display effects of endocrine disruption including intersex, feminization of male fish preventing reproduction, histological changes in gonads (Jobling, Nolan, Tyler, Brighty, & Sumpter, 1998; Jobling et al., 2006; Rodriguez-Mozaz & Weinberg, 2010; Sumpter, 1998) and even population collapse (Kidd et al., 2007; Rodriguez-Mozaz & Weinberg, 2010).

People are also exposed to drugs in the water. Other than in intentional doses, drinking water is the principal route of human exposure to pharmaceuticals (Rodriguez-Mozaz & Weinberg, 2010). There is evidence suggesting some prescribed synthetic chemicals and hormones may contribute to tumor formation in humans and that susceptibility to cancer may be the result of developmental exposures (Birnbaum & Fenton, 2003). While more research is needed, “common sense dictates it’s not a good idea to drink somebody else’s medicine” (Pringle, 2008, p. 4).

Pharmaceutical contamination of the environment has been a topic of concern since the 1970s, but it received little attention from the public and scientific communities until the late 1990s when technological and methodological advances improved analysis
and detection capabilities (Spellman, 2014). However, effects of chronic exposure to low doses of pharmaceutical chemicals and their conjugates on humans and other biota remain relatively unknown. The manifestation of effects, though potentially devastating and irrevocable, may be subtle and build over time as to be indistinguishable from natural events (Daughton & Ternes, 1999). Additionally, new methodology may be necessary to more completely understand the complex lifecycle of these chemicals. For example, it has been demonstrated that standard tests for algae, zooplankton and fish would have underestimated the toxicity for three out of four pharmaceuticals (Henschel, Wenzel, Diedrich, & Fliedner, 1997). In the meantime, it is important to take precautionary steps to reduce the presence of pharmaceuticals in the environment by addressing the sources and routes of contamination (Ruhoy & Daughton, 2007).

Sources and origins

Most household drug waste enters the environment through wastewater (Batt, Bruce, & Aga, 2006; Glassmeyer et al., 2009) or landfills (Daughton & Ternes, 1999; Heberer, 2002). Wastewater may be untreated (i.e. “straight piping” systems) or treated (e.g. via septic leach fields, or municipal sewage treatment facilities). Untreated wastewater is discharged directly into surface waters (i.e. in overflow events, or “straight-piping” systems). It has been estimated that over a million homes in the United States discharge raw sewage into receiving waters (Daughton & Ternes, 1999). The EPA estimates 850 billion gallons of raw sewage are annually discharged directly into United States waterbodies (Tibbetts, 2005). Additionally, there is a growing problem in the
United States of aging, outdated and degraded municipal sewage treatment facilities that regularly discharge improperly treated effluent into surface waters (Tibbetts, 2005). This suggests that loadings of untreated pharmaceuticals may be even greater than expected.

Treated wastewater is the principal route that pharmaceuticals are introduced into the aquatic environment (Kotchen et al., 2009). Sewage treatment, including on-site (septic) or municipal facilities, may remove or transform chemicals through microbial degradation, dilution, oxidation, or sorption into solids (later disposed of via the land as sludge) (Ternes, Joss, & Siegrist, 2004). Most sewage treatments were developed to remove odor, particulates and pathogens from natural waste and are not equipped to treat microconstituents like pharmaceutical chemicals. As a result, no treatment method is completely efficient at removal and parent compounds may survive treatment unaltered (Ruhoy & Daughton, 2007). Even “removed” chemicals may still exist in altered states, making it impossible to accurately determine removal rates. Conjugates are difficult to identify and may be more bioactive than the unaltered products. Additionally, metabolites previously transformed through human use may be converted back into parent compounds through the treatment processes (Glassmeyer et al., 2005). After treatment, the drugs and their metabolites are dispersed continuously into receiving waters, where metabolic conjugates can once again be converted back into their free parent forms. Pharmaceuticals also enter the aquatic environment via wet-weather run-off or leachate from landfills (Holm, Ruegge, Bjerg, & Christensen, 1995), where drugs are introduced in treated sewage sludge (residual solids) and in industrial and domestic waste (Daughton & Ternes, 1999; Glassmeyer et al., 2009).
The introduction of drugs into the aquatic environment is a complex function of social elements (e.g. quantity, frequency and type of dosages, as well as human perceptions and behavior); chemical properties of parent compounds, other active ingredients and metabolites (e.g. metabolism efficiency, water solubility and inclination to sorb to solids); and infrastructure (e.g. type, location and functionality of wastewater treatment facility). Consumer behavior, including drug use and disposal, is a primary cause of pharmaceutical occurrence in the environment (Daughton, 2003a, 2003b). At the household level, the three primary pathways include (1) excretion by the dosed user as metabolites and unaltered parent compounds, (2) removal of topical drugs during bathing and (3) disposal of leftover or unwanted medications (e.g. via flushing down the drain or toilet, or household trash) (Glassmeyer et al., 2009).

When a drug is ingested, the dosed individual metabolizes the bioactive ingredients, possibly transforming them completely or partially into (in)active metabolites and other chemical products – although the parent compounds may also be excreted unaltered (Bound & Voulvoulis, 2005; Kummerer, 2009). These transformations will differ based on the metabolism of the dosed user and the pharmakinetics of the particular drug (Daughton & Ternes, 1999). Additionally, the synthetic parent compound may not be the active ingredient in a drug (Glassmeyer et al., 2005). Sewage treatment processes may later convert altered products back into the parent compounds or break down unaltered parent compounds into conjugates (Daughton & Ternes, 1999). In the United States, there are currently no regulations in place to manage the levels of pharmaceuticals in drinking water or effluent (Kotchen et al., 2009).
Current disposal practices

Leftover and unwanted household medications significantly contribute to domestic drug waste entering the environment and represent a preventable source of aquatic pharmaceutical contamination (Seehusen & Edwards, 2006). An estimated 11% of all medications become unused in the United States (Musson & Townsend, 2009). Studies of United States health consumers consistently indicate a prevalence of leftover household drugs, with a majority of survey respondents often reporting storing unused medications (Kotchen et al., 2009; Seehusen & Edwards, 2006). A recent survey of the student population at the University of Vermont (UVM) indicated that a majority purchased OTC (87%) and/or prescription (77%) drugs in the past 12 months (Vatovec et al., 2016). Of those, 50% did not use all of their OTC drugs and 27% did not use all of their prescription medications. Of the students who reported having leftover medications, 91% of those with OTC drugs and 87% with prescription medications have not yet disposed of them, confirming a prevalence of stored and unused medications (that will eventually need to be disposed of) among the local student population (Vatovec et al., 2016).

Although research exploring household disposal practices in the United States is relatively limited and is often based on a convenience sample (making results difficult to generalize), commonly cited reasons for disposal include (1) medication expiration, (2) the targeted health condition becomes resolved and medication is no longer needed and (3) house-cleaning prompts the disposal of stored drugs (Kotchen et al., 2009). When people do decide to dispose of leftover drugs, common disposal practices traditionally
include flushing them down the sink or toilet, or throwing drugs away in the trash, which leads to chemical occurrence in the environment via wastewater or runoff and leachate, respectively (Kotchen et al., 2009).

One study of American household disposal practices found that 45% of people discarded medications via the trash, 28% used the toilet or sink for disposal, 5% returned drugs to their pharmacy, another 5% dropped them off at a hazardous waste facility and significantly, 12% chose to continue storing leftover and unused drugs at home (Kotchen et al., 2009). In the UVM study, only nine percent of respondents with leftover OTC medications and 13% of respondents with leftover prescription drugs reported disposing drugs in the last 12 months (Vatovec et al., 2016). Consistent with previous studies, a majority chose to dispose of drugs by throwing them into the trash (19% of respondents with OTC drugs and 14% with prescription drugs). Unlike past studies, very few students chose to flush leftover drugs down a toilet or sink (only one percent of respondents with OTC drugs and less than one percent of respondents who disposed of prescription drugs).

Throwing medications in the trash or stockpiling drugs poses an additional risk of ingestion by unintended users, particularly children and animals, while it remains in the house, awaits pick up or sits at the landfill (Daughton, 2007). Accidental exposure to medications results in significant morbidity and mortality in the United States each year (Ruhoy & Daughton, 2007; Wu & Juurlink, 2014). Accidental medication poisoning is responsible for over 60% of poisoning deaths among children 14 years of age and younger (Nierenberg, 2012). There is also a concern about drug diversion involving people intentionally seeking discarded and stored medications for illegal use or as a
means of identity theft. In 2015, 11% of Vermont teenagers (n = 21,013) self-reported consuming a prescription pain reliever or stimulant not prescribed to them (Vermont Department of Health, 2015). Comprehensively addressing the social and ecological risks posed by leftover household drugs likely requires a broad evaluation of the United States healthcare system, “so that leftover drugs would be minimized and the need for disposal would be consequentially lessened or eliminated” (Glassmeyer et al., 2009, p. 567). In the meantime, encouraging responsible household drug disposal practices, such as participation in drug collection initiatives, is a sound first step.

**Drug take-back programs**

Pharmaceutical collection programs, such as the bi-annual National Prescription Drug Take-Back Day (NTBD), offer opportunities for consumers to safely dispose leftover medications to be incinerated, which may result in improved human and environmental health by reducing instances of diversion, accidental exposure and environmental occurrences (Stoddard, 2012). The U.S. Drug Enforcement Agency collected a cumulative 5,525,021 pounds of drugs from 2010-2015 (U.S. Drug Enforcement Agency, 2015). These initiatives rely on voluntary participation and include permanent collection programs, special collection events, consumer-paid mail-back programs and education and awareness programs (Kotchen et al., 2009).

Many safe drug collection programs are in place around the country, yet there is a general concern that such initiatives are being underutilized (Schwarz, 2015). Research shows that the percentage of people who report participating in collection initiatives is
consistently lower than those who report using other disposal practices or indefinitely storing medications (Kotchen et al., 2009; Vatovec et al., 2016). For example, in the study of UVM students, almost a quarter of all respondents knew about NTBDs, but less than 2% of people disposing of leftover medications in the last 12 months chose to dispose of their drugs this way (1% OTC, <1% prescription) (Vatovec et al., 2016). It should be noted that two local police departments offer free drug collection five days a week and host the twice-yearly NTBDs in close proximity to the University (Chittenden Solid Waste District, 2016).

Considering the number of people who report storing household drugs or disposing of them via the trash (Zero Waste Washington, 2006), the quantity of drugs collected in NTBDs and other collection programs likely represents a relatively small percentage of leftover medications (and potential reduction in loadings to the environment) (Vatovec et al., 2016). Increasing public participation in household drug collection initiatives, the environmentally-preferred disposal method, is an urgent need and opportunity.

Certain programmatic considerations may help facilitate increased participation. For example, pharmacies may be the most convenient location for drug collection programs (Zero Waste Washington, 2006). Permanent disposal programs (rather than short-term collection events) may lead to increased participation since people are likely to prefer disposing of drugs at times they consider most convenient (Kotchen et al., 2009). Additionally, people may be less likely to utilize collection programs if they are located more than five or six miles away (Seehusen & Edwards, 2006).
Individual factors (like age) may also influence how someone chooses to dispose of their leftover medications. In the study by the Washington Citizens for Resource Conservation (Zero Waste Washington, 2006), older respondents were more likely to dispose medications via sink or toilet, while younger respondents were more likely to dispose of drugs by throwing them away. Other researchers have found that drug disposal via trash was the most common choice for both older and younger respondents; however, older respondents were more than twice as likely as their younger counterparts to return leftover medications to the pharmacy (Kotchen et al., 2009).

Increasing awareness and education among the general public about proper disposal practices and the risks of improper drug disposal may support increased participation in drug collection programs (Shealy, O’Day, & Eagerton, 2014). One study found that previous counseling of proper disposal methods is highly associated with returning leftover drugs to pharmacies with collection programs, yet less than 20% of patients in this study had ever been given advice on drug disposal (Seehusen & Edwards, 2006). The authors suggest that awareness of both proper disposal practices and the environmental risks associated with improper disposal may motivate behavioral changes among health consumers and encourage participation in collection programs.

In recent years, many groups in a variety of sectors have issued disposal recommendations for people with unused and leftover medications to help minimize the potential risks to human and environmental health. For example, in 2007, the United States Fish and Wildlife Service and the American Pharmacists’ Association created the “SMARxT Disposal™” program to increase consumer awareness about the effects of
improperly disposing drugs. This effort recommends that households practice (1) not flushing drugs, (2) removing labels and mixing drugs with inedible and inert substances (e.g. kitty litter) before placing in the trash and (3) participating in available collection programs (Glassmeyer et al., 2009).

However, recent research indicates that people continue to practice unsafe drug disposal, despite being aware of the consequences of improper disposal practices. For example, in one study, 43% of respondents were aware that pharmaceutical contamination had been discovered in treated wastewater and in surface waters (Kotchen et al., 2009). While these respondents were more likely to either return medications to pharmacy or drop them off at a hazardous waste site, a majority still chose to dispose of drugs via trash (38%) or toilet/sink (~23%).

Acknowledging this disconnect, a limited number of studies have begun to explore how people perceive aquatic pharmaceutical contamination and drug disposal practices. In a study of risk perception, readily available and regularly used drugs are perceived as weaker and less threatening to the environment, compared to unfamiliar drugs (e.g. antiepileptics) (Bound, Kitsou, & Voulvoulis, 2006). A similar study found that many people believe flushing drugs down the drain or toilet is unlikely to have harmful environmental impacts, particularly when the drugs are familiar OTC medications like pain relievers (Dohle, Campbell, & Arvai, 2013). And yet, as the authors point out, common pain relievers are one of the most frequently detected classes of pharmaceutical chemicals in the aquatic environment and can have severe adverse
ecological impacts. This suggests a need for further research to better understand how people perceive, relate to and act on this complex human and environmental health issue.

This study will apply conceptual metaphor theory and psychological distance, two theoretical frameworks describing how people cognitively organize and process stimuli, to better understand public perceptions of aquatic pharmaceutical contamination. This research will also explore relationships between these two frameworks to better understand the ways in which people make sense of their world.

**Theoretical Approach**

As cognitive frameworks, psychological distance and conceptual metaphor theory share a foundation that people experience and represent stimuli either as concrete or abstract, which impacts attitudes and behaviors (Landau, Robinson, & Meier, 2014). Psychological distance, an index of how near or far a concept is from a perceiver’s immediate experience, suggests a psychologically distant concept is represented through its abstract qualities (e.g. decontextualized features) and a psychologically close concept is construed in concrete terms (e.g. specific, perceptual details). Relevant attitudes and behavior are positively associated with psychological distance and different distances (near or far) lead to different attitudes and behaviors. Conceptual metaphor theory suggests that people use metaphor as a cognitive tool to understand abstract concepts through more concrete terms (e.g. war is like a football game). Metaphor use impacts
people’s practical judgments of a target concept based on understood features of the source concept.

This observation has inspired a small but growing body of research that explores the theoretical and practical interactions between the two frameworks. However, studies have so far only investigated whether manipulating conditions of psychological distance impacts conceptual metaphor use. For example, research has shown that people are more likely to rely on metaphor when concepts are framed as psychologically distant (and abstract) versus near (and concrete) (Jia & Smith, 2013). No one has yet examined whether metaphor use effects perceived psychological distance. Additionally, given the well-established relationships between psychological distance and relevant attitudes and behavioral intentions, it is possible that metaphor use also impacts these cognitive judgements.

This present study addresses these gaps in the theoretical literature while also addressing the need to better understand public perceptions of aquatic pharmaceutical contamination. The objectives of this study are (1) to assess the effect of metaphoric framing on perceived distance of the environmental hazard across dimensions (temporal, geographic, social group and uncertainty) (2) to assess the effect of metaphoric framing on concern for the environmental hazard across dimensions and (3) to assess the effect of metaphoric framing on willingness to act. This research contributes to the theoretical advancement of psychological distance and metaphor theories and informs practical risk communication strategies encouraging participation in drug take-back initiatives.
Construal level theory and psychological distance

The concept of psychological distance is inextricable from construal level theory (Liberman & Förster, 2009; Trope & Liberman, 2010), which posits that events, objects, actions and other stimuli are mentally construed as either low-level (understood in concrete, specific terms) or high-level (conceptualized through global, abstract terms). For example, describing an object as “food” (high-level) instead of as “a hamburger” (low-level) highlights its abstract, general features (e.g. it is edible) but excludes specific characteristics (e.g. it is a hamburger not a salad). The level of construal corresponds with psychological distance (for review see Trope & Liberman, 2010).

Psychological distance is the mental distance perceived between a stimulus and the perceiver’s direct experience of their self “here and now” in the present moment (Bar-Anan, Liberman, Trope, & Algom, 2007). Psychologically close stimuli tend to be low-level construals, understood through sensory, concrete knowledge (e.g. thinking about “a hamburger” may bring to mind a sensory experience of browned ground beef layered with condiments and toppings between buns) (Bar-Anan et al., 2007). Psychologically distant stimuli are generally high-level construals understood through abstract, global terms (e.g. thinking about “food” may invite thoughts about mealtimes, hunger, etc.) (Liberman & Förster, 2009). Processing of psychological distance is automatic, chronic and independent from people’s cognitive goals and intentions (Bar-Anan et al., 2007). However, perceived distance of a stimulus is neither universal nor consistent; rather, it is relative, context specific and dependent on the individual perceiver and specific situation (Bar-Anan et al., 2007).
Psychological distance is frequently studied through four primary dimensions: uncertainty, social group, geography and time. An event is psychologically closer when it is more likely to occur (uncertainty), happens to people like oneself (social group), occurs nearby (geographic) and takes place in the present or near future/past (time) (Milfont, Abrahamse, & McCarthy, 2011). Psychologically distant events are perceived as unlikely to occur, happening to people unlike oneself, occurring far away and taking place in the distant future/past.

Research suggests that the four dimensions of distance interrelate and agree, so that the perceived target is either psychologically close or distant (Bar-Anan et al., 2007; Fiedler, Jung, Wänke, & Alexopoulos, 2012). Experimental evidence suggests that thinking about one dimension in psychologically close or distant terms impacts the cognitive processing of other dimensions (e.g. thinking about people unlike oneself may prime one to perceive a greater geographic distance). For example, people improved performance on tasks requiring abstract thought (e.g. the Gestalt Completion Test) when also focusing on a future time period (temporal distance) and likewise better complete specific and detailed tasks when processing psychologically close stimuli (Spence, Poortinga, & Pidgeon, 2012).

Construal level and psychological distance have implications for decision-making. Research has shown that when a concept is perceived as psychologically distant, people make choices based on their values (i.e. kindness); when something is represented as psychologically close, specific, contextual details like feasibility concerns (e.g. expected time commitment) and anticipated outcomes guide decisions (Trope &
Liberman, 2010). For example, if someone asked you if you wanted to join them for a coffee sometime in the next three months (temporally distant and highly uncertain), you might answer based on your values (e.g. politeness). However, if someone asked you if you wanted to join them for a coffee in fifteen minutes (temporally proximate and highly certain), you might answer based on feasibility concerns (e.g. whether you have the time in your schedule).

People may be better at predicting and making choices around psychologically distant stimuli, yet be more likely to take action if the event/concept is psychologically close (Liberman & Förster, 2009; Spence & Pidgeon, 2010; Spence et al., 2012). Additionally, the perceived distance of a target motivates people to different kinds of behaviors (Haden, Niles, Lubell, Perlman, & Jackson, 2012) and attitudes (Milfont et al., 2011).

Psychological distance and construal level theory have wide-ranging implications for understanding and motivating human thought and behavior. The framework has been applied in a variety of research contexts including tourism, social and experimental psychology, consumer behavior, corporate management, cognition, emotion, linguistics and marketing. Relevant to this study, psychological distance is also proving to be a fruitful framework for answering critical questions in environmental risk analysis and communication research.

A growing body of literature examines how psychological distance impacts public perceptions, attitudes and behavioral responses to environmental risk through the four dimensions: social (for example, Milfont et al., 2011; Niles, Lubell, & Haden, 2013;
Singh, 2015; Zhang, He, Zhu, & Cheng, 2014), temporal (for example, Arnocky, Milfont, & Nicol, 2014; Milfont, Wilson, & Diniz, 2012), geographic (for example, Milfont et al., 2011; Milfont, Evans, Sibley, Ries, & Cunningham, 2014) and uncertainty (for example, Boykoff & Boykoff, 2004; Weber, 2006).

Recent research indicates that environmental threats may be seen as distant across all dimensions, strongly affecting the perceived severity of such events (Carmi & Kimhi, 2015). People believe that environmental hazards (e.g. global warming, environmental degradation and natural disasters) are unlikely to happen, to impact them personally, or to occur in the near future. Compared with security and economic threats, people experience environmental events as more distant from themselves (Carmi & Kimhi, 2015). However, people reporting a smaller perceived distance had a stronger emotional response to the threats, which may encourage them to adopt actions that would reduce or prevent the threat (Carmi & Kimhi, 2015). The authors recommend reducing the psychological distance of an environmental threat through one or more dimension to support alignment between perceived and actual risks.

For some, water pollution may be an example of a psychologically distant environmental threat. A study by Zhang, He, Zhu, and Cheng (2014) applied psychological distance to better understand the relationship between the existing reality of degraded water resources and continued behaviors threatening the availability of clean water. The researchers manipulated three dimensions of distance (uncertainty, temporal and social) to determine the factors influencing how people assess the severity of water pollution. Their results indicate that people assessed water pollution as less severe when
social distance and uncertainty independently increased (i.e. the consequences are unlikely and/or impact people unlike them). Manipulating temporal distance (when the effects of the water pollution could be felt) alone had no impact on people’s assessment of the severity of the problem; however, it did have an impact when paired with social distance. Interestingly, when the three dimensions coexisted, manipulating uncertainty more significantly impacted the perceived severity than social and temporal distance. Their results suggest that communications promoting sustainable behavior and environmental protection should highlight the high probability and local social consequences of polluted water.

Climate change researchers were early adopters of construal level theory and psychological distance as a model for exploring public attitudes and behaviors towards climate change. Climate change, like aquatic pharmaceutical contamination, is a complex socio-ecological issue at the intersection of policy, health and science. Likewise, it is influenced by the choices of individuals (Spence & Pidgeon, 2010) and targeted behavioral interventions offer opportunities for tangible and effective reductions of pollutants at the societal-level (Gardner & Stern, 2008; Spence & Pidgeon, 2009). For example, it has been suggested that lifestyle changes alone could reduce greenhouse gas emissions in the United Kingdom by 30% (UK Energy Research Centre, 2009). Additionally, the general public in the United Kingdom reports being aware of climate change and rates it as a high priority issue; yet, people continue to practice unsustainable behaviors (Spence & Pidgeon, 2010).
To address this discrepancy, recent research on climate change risk analysis has applied psychological distance to characterize public perceptions of, concern for and willingness to act on climate change risk (Spence & Pidgeon, 2010). Rabinovich, Morton, Postmes, and Verplanken (2009) suggest that in the context of climate change processing specific goals through an abstract mindset, or abstract goals through a specific mindset, may promote action (Spence et al., 2012). Experimental research by Spence et al. (2012) demonstrated that the perceived closeness of climate change impacts is related to increased concern about climate change. Therefore, risk communications promoting concern should focus on making impacts appear psychologically close across dimensions (e.g. relevant to individuals’ social group, locality and lifetime) (Spence et al., 2012). To promote action, risk communications should highlight the big-picture, global impacts of climate change (e.g. effects to distant countries) (Spence & Pidgeon, 2010).

Research also suggests that perceiving climate change risk as close versus distant may promote different behavior. For example, exploring the effects of psychological distance on farmers’ intentions to adopt different types of behaviors (adaptation versus mitigation practices), Haden et al. (2012) found that psychologically distant concerns impact farmers’ likelihood of adopting climate change mitigation practices (i.e. buying fuel efficient farm equipment) with abstract implications; while the intention to adopt climate change adaptation practices is influenced by feasibility concerns connected to psychological closeness (e.g. local water availability). Studying the limiting factors of climate change adaptation in agriculture, Niles, Lubell, and Brown (2015) confirmed the importance of psychologically close variables on individual farmers’ perceptions and
responses to climate change. Congruent with other experimental studies of psychological distance, these studies demonstrate that climate change related attitudes and behaviors are impacted by perceptions of psychological distance.

Environmental hazards are often perceived as psychologically distant across multiple dimensions. This distance influences how people perceive the severity of the threat, their attitudes and behaviors, concern for and willingness to act towards the problem. The literature overwhelmingly suggests that communication and outreach efforts should intentionally frame psychological distance in order to produce desired responses to the specific environmental issue. This leads to the question: what tools can communicators use to manipulate distance to achieve the desired effects?

Applying conceptual metaphor theory in conjunction with psychological distance, the present study will characterize the psychological distance of aquatic pharmaceutical contamination and explore whether metaphor use effects concern for, willingness to act and perceptions of distance across the four principle dimensions. This research will contribute to the theoretical literature and support practical efforts to develop effective communication strategies encouraging participation in drug collection programs to reduce the environmental and human health threat of improper disposal.

**Conceptual metaphor theory**

Conceptual metaphor theory states that people rely on metaphors as a cognitive tool to make sense of abstract concepts (Gibbs, 1996; Lakoff & Johnson, 1980). This theory stems from a certain philosophical tradition that asserts that people speak in
metaphors because they think in metaphors (Landau et al., 2014). Many scholars have hypothesized on the significance of this phenomenon in the human experience. Jackson (1983) argues that metaphor use (this is that) reflects an unconscious acknowledgment and understanding of the connection (versus dualism) between concepts.

Metaphors in this context are conventional, everyday metaphors used by regular people, rather than those used for stylistic effects (Morris, Sheldon, Ames, & Young, 2007). According to Geary (2011), English speakers typically use about one metaphor for every 10-25 words spoken, which equals about six metaphors per minute (Mark J. Landau et al., 2014). Metaphor use may be explicit, or implicitly conveyed (e.g. through verb phrases that render events in terms of other events) (Morris et al., 2007). For a review of conceptual metaphor theory see Landau, Meier, and Keefer (2010) and Mark J. Landau et al. (2014).

Conceptual mapping between target and source concepts using metaphor is referred to in the literature as the metaphor framing model, metaphoric transfer, metaphor use and/or metaphor effect; these terms are used interchangeably in this proposal. When this occurs, metaphoric description (“using terms from another domain to talk about an event”) primes corresponding metaphoric encoding (“using schemas from another domain to think about an event”) (Morris et al., 2007, p. 176). This requires two stages of cognitive processing, metaphor activation (when a root metaphor is triggered) and application (the root metaphor is used to connect a target concept to a source concept) (Mark J. Landau et al., 2014) and results in the perceiver transferring knowledge of a source concept in order to interpret a target concept (Jia & Smith, 2013). Typically,
source concepts are more easily comprehended and concrete experiences, whereas target concepts tend to be complex, hard to understand and more abstract (e.g. describing war using the metaphor of a football game) (Mark J. Landau et al., 2014).

Experimental evidence indicates that such metaphor use “causally impacts an individual’s memory, perception and evaluation of social and non-social objects” (Jia & Smith, 2013, p. 492). For example, the environment is often an abstract concept that must be individually and socially negotiated. Nature metaphors provide conceptual frameworks for relating to nature, suggesting guidelines for appropriate actions, intentions, values and concerns in relation to nature (Ivakhiv, 2001). Understanding an individual’s or group’s preferred nature metaphor(s) is useful for developing communication tools that frame information in ways that help or hinder public reception (Proctor & Larson, 2005).

Exposure to different metaphors produces different effects on a person’s practical judgments. For example, investigating the consequences of stock market commentators’ use of metaphors on the judgments of investors, Morris et al. (2007, p. 175) found that exposing participants to agent-metaphors that implied an “enduring internal disposition” reflected through observed price trends (e.g. “The Nasdaq climbed higher”), resulted in an increased expectation that a present price trend would persist the next day – as opposed to object-metaphors that do not imply an internal motivation (i.e. “The Nasdaq was pushed higher”) or non-metaphorical descriptions of the stock market.

A study by Thibodeau and Boroditsky (2011) showed that people were more likely to favor law enforcement action after reading a description of a city’s crime
problem metaphorically framed as a beast; whereas those who read about crime framed as a viral disease were more likely to support crime-reduction strategies that addressed the root causes of the problem.

Metaphoric transfer also can be triggered nonlinguistically. For example, Williams and Bargh (2008) showed that interpersonal warmth is influenced by the experience of physical warmth (e.g. when holding a cup of warm coffee, versus a cold cup, people were more likely to rate a target person as friendlier). In the United States, risk may be assessed metaphorically using “traffic light” colors: “green for safe, yellow for caution and red for danger” (Severtson & Vatovec, 2012, p. 7).

Importantly, certain conditions are necessary in order for a metaphor to be activated and useful as a conceptual tool. For example, a metaphor needs to be culturally and contextually relevant (Landau et al., 2010). It also needs to be accessible to the individual perceiver and aligned with their unique epistemological and ontological perspectives. Mark J. Landau et al. (2014) note that critical elements of metaphor activation may include political predispositions, personality characteristics, values, cultural orientation and whether the applied metaphor triggers a “hot topic” (e.g. social welfare for a politically conservative individual). Steen, Reijnierse, and Burgers (2014) suggest that reinforcing the metaphor through additional supportive textual/contextual references increases metaphoric transfer. Recent research also indicates that certain conditions of psychological distance may also be required for metaphoric activation (Jia & Smith, 2013).
CHAPTER 2: RESEARCHER IDENTITY AND APPROACH

This mixed-methods study relies heavily on qualitative research principles. Whereas quantitative research studies are judged on the basis of validity, qualitative research is often weighed on the scales of trustworthiness, credibility and authenticity (Yilmaz, 2013). These criteria rely on the practices of researcher transparency and reflexivity. To begin building capital in these categories, I have included a section on my identity as a researcher, describing my paradigmatic, ontological and epistemological lenses which impact my decisions as a researcher. My intention for this section of the proposal is to disclose my perspectives and to acknowledge their (known and unknown) impacts on this research study.

Paradigms are “basic belief systems or worldviews” that guide an investigator’s ontological and epistemological choices (Guba & Lincoln, 1994, p. 105). Guba and Lincoln (1994) compare, contrast and explain the assumptions of four paradigms of inquiry: positivism, postpositivism, critical theory et al. and constructivism. This article significantly informed my process of determining and discovering my identity as a qualitative researcher. I identify philosophically with the paradigm of constructivism (as defined by Guba and Lincoln (1994), which is expressed in my choices of research topic, design, goals and methodology.

Ontology refers to ways of constructing reality (Denzin & Lincoln, 1998). Identifying as a critical realist, I believe that reality is constructed intersubjectively and also exists externally and independent of our minds. For example, it is my belief that a
tree is real whether or not a consciousness is there to perceive it; however, different minds will perceive that tree differently and all perceptions are valid. I believe that people are experts of their own reality and experiences and that socially patterned insights can emerge. This is particularly important to my decisions around research methods and treatment of data. In the context of this research study, I will be asking questions only within the realm of each subject’s area of expertise (their own experiences) and considering all answers to be useful. That is, I will not ask subjects to project what may be true for other people (e.g., asking questions about why they think people throw drugs into the trash), nor will I disregard “outlier” responses.

Epistemology describes ways of knowing. I would describe myself as an interpretivist, believing we know what we know through our experiences, physical environment, social contexts, culture, social location, et al. This assumes an inextricable link between who we are (or understand ourselves to be) and what we know. In this study I will be collecting data on what people know about and how they perceive the issue of aquatic pharmaceutical contamination, as well as certain individual characteristics (e.g., demographics, political affiliation, environmental paradigm, etc.). While analyzing this data I will be looking for relationships between who the subjects are and what they know in order to determine if any patterns or themes emerge.

Methodology is composed of the tools and techniques used by an investigator in constructing knowledge. In this study I applied qualitative methodology, which is appropriate given my interests in better understanding how and why people construct meaning and relate to their environment. Methods are procedures of inquiry. This study
uses the naturalistic method of interviewing. Specifically, this research applied cognitive interviewing (Willis, 2004), a flexible, interactive and in-depth qualitative survey method (de Leeuw, Hox, & Dillman, 2008).

*Cognitive Interviewing*: Cognitive interviewing seeks to understand how respondents understand questions and the cognitive processes that are used to produce an answer (Beatty & Willis, 2007). Originally developed by cognitive psychologists as a question evaluation method, it emerged from the cognitive aspects of survey methodology movement that emphasized the importance of individuals’ thought processes as a source of survey measurement error (Miller, Chepp, Willson, & Padilla, 2014). It has since been adopted into and advanced by other disciplines as an effective method for developing theory, testing construct validity and uncovering potential misunderstandings that occur when respondents have trouble answering a question or give an inconsistent answer (Miller et al., 2014). To align with the objectives of this study, I applied cognitive interviewing methodology through an interpretivist framework and cognitive sociology approach (see Miller et al. (2014) for a detailed discussion).

Central concepts of cognitive interviewing include narrative, *Verstehen* and thick description. Narrative is a “rhetorically descriptive, sequential and analytically interpretive” tactic individuals use to build and structure meaning in order to understand experiences and circumstances (Miller et al., 2014, p. 12). *Verstehen* is a concept that emphasizes the role of respondents as experts on their own lives, experiences and perceptions; therefore, all interpretations and answers are taken at face value and considered valid and useful to analysis (Miller et al., 2014). Thick description is a
technique that “gives the context of an experience, states the intentions and meanings that organized the experience and reveals the experiences as a process” (Denzin, 1994, p. 505). These concepts and techniques enable the researcher to explore underlying patterns and processes that influence how people perceive and respond to questions (de Leeuw et al., 2008; Severtson & Vatovec, 2012).

Cognitive interviewing supports my research goals of characterizing the psychological distance of aquatic pharmaceutical contamination and developing the theoretical relationship between psychological distance and metaphor use.
CHAPTER 3: JOURNAL ARTICLE


Abstract

Aquatic pharmaceutical pollution poses ecotoxicological risks to the environment and human health. Consumer attitudes and behavior represent a significant source of pharmaceutical compounds found in water. Thus, understanding public perceptions of aquatic pharmaceutical pollution and developing effective risk communication techniques are critical to engaging society in the type of widespread change necessary for addressing the presence of pharmaceuticals in water. This mixed-methods study applies conceptual metaphor theory in conjunction with construal level theory of psychological distance to assess how metaphoric framing affects perceptions of aquatic pharmaceutical contamination across four principal dimensions of psychological distance (geographic, social and temporal distance and uncertainty). Additionally, this study assesses the direct impact of metaphor use on concern and willingness to act, which are positively associated with perceived psychological distance. Data were collected from a convenience sample (n = 20) of university students in Burlington, Vermont using cognitive interviewing. Results indicate that pharmaceutical pollution was initially perceived as geographically distant, socially distant, temporally both proximate and distant and certain (versus uncertain). Our findings suggest people perceive distances in various ways, suggesting a need for validated questions to consistently measure psychological distance. Participants preferred the metaphorically-framed visual intervention to the non-metaphor visual intervention. Further, participants’ perception of pharmaceutical pollution changed to being more geographically and socially close after viewing the metaphoric visual only. Previous research indicates perceived psychological closeness leads to increased motivation and preparedness to act. Theoretical and practical implications of metaphor use in risk communications are discussed.
**Introduction**

Pharmaceuticals are considered chemicals of emerging concern because of their ecotoxicological impacts on the environment and human health (Environmental Protection Agency, 2008). As commercial chemicals, pharmaceuticals flow from consumers to the environment during their life cycle on a continual basis (Glassmeyer et al., 2009). Consumer attitudes and behavior, such as disposal of household medications (e.g. via the trash or down the drain), significantly contribute to the volume of pharmaceutical compounds found in water. For example, Dohle et al. (2013) found that many people believe flushing drugs down the drain or toilet is unlikely to have harmful environmental impacts, particularly when the drugs are familiar over-the-counter (OTC) medications like pain relievers. And yet, as the authors point out, common pain relievers are one of the most frequently detected classes of pharmaceutical chemicals in the aquatic environment and can have severe adverse ecological impacts. Thus, understanding public perceptions of aquatic pharmaceutical pollution and developing effective risk communication techniques are critical to engaging society in the type of widespread change necessary for addressing the presence of pharmaceuticals in water. In this study, we apply psychological distance to characterize perceptions, attitudes and behaviors towards aquatic pharmaceutical contamination and conceptual metaphor theory to assess the impact of metaphor use in risk communication on relevant perceptions, attitudes and behaviors.
Pharmaceuticals in the environment

Nationally, a growing body of literature documents the presence of pharmaceutical compounds in ground water (Banzhaf et al., 2011) and surface waters (Kolpin et al., 2002; Lara-Martín et al., 2014; Lara-Martín et al., 2015). In addition, pharmaceutical compounds have been detected in multiple aquatic species (Brandao et al., 2014; Ramirez et al., 2009), including edible species (Antunes et al., 2013); and have been shown to cause reproductive and behavioral effects in fish (Jobling et al., 2006), bivalves (Antunes et al., 2013) and zooplankton (Flaherty & Dodson, 2005).

Increasingly found in the drinking water supply (Focazio et al., 2008; Padhye, Yao, Kung'u, & Huang, 2014; Stackelberg et al., 2007), more research is needed to understand the human health effects of pharmaceutical contamination of the water system. Some laboratory studies suggest developmental and chronic exposure to certain synthetic drug compounds may lead to susceptibility to cancer and contribute to tumor formation among humans (Birnbaum & Fenton, 2003).

Consumers are the primary source of pharmaceuticals in the environment and excretion, disposal and bathing off topical medications are the main consumer routes by which pharmaceuticals enter the environment (Daughton, 2007). As pharmaceutical use continues to rise, so does the volume of medications that may eventually enter the waste stream. Musson and Townsend (2009) estimate that 11% of all medications become unused in the United States. Studies of United States health consumers consistently indicate a prevalence of leftover household drugs, which are either stored indefinitely (for later disposal) or thrown away (Kotchen et al., 2009; Vatovec et al., 2016). Common
household drug disposal methods, such as via municipal trash or household drains, lead to drinking and surface water contamination through the respective pathways of landfill runoff and leachate and wastewater (Daughton, 2007). To reduce this preventable source of aquatic pharmaceutical contamination, government agencies, hospitals, pharmacies and not-for-profits are now offering drug collection ("take-back") programs as an alternative disposal method.

Although Americans are increasingly aware of aquatic pharmaceutical pollution and its consequences to human and environmental health, people continue to improperly store or dispose of medications (Bound et al., 2006) and many collection programs are not attracting significant participation. A recent study of university students indicated that in the last 12 months, a majority had purchased and used OTC and prescription drugs and had leftover medications they had not yet disposed of (Vatovec et al., 2016). Of those who disposed of leftover drugs within the last year, only 1% with leftover OTC and <1% with leftover prescription medications did so through an environmentally-preferred drug take-back program.

Promoting widespread participation in drug collection programs is a useful first step in addressing aquatic pharmaceutical pollution (Glassmeyer et al., 2009). These initiatives encourage individual action and consumer responsibility, critical foundations for the type of systems-level change proposed by Daughton (2003a, 2003b) to significantly reduce the presence of pharmaceutical chemicals in water. This study characterizes public perceptions and theoretical relationships between psychological
distance and metaphor use to inform effective risk communication techniques for drug
collection programs.

**Theoretical Grounding and Approaches**

As cognitive frameworks, psychological distance and conceptual metaphor theory
share a foundation that people experience and represent stimuli either as concrete or
abstract, which impacts attitudes and behaviors (Landau et al., 2014). Psychological
distance, an index of how near or far a concept is from a perceiver’s immediate
experience, suggests a psychologically distant concept is represented through its abstract
qualities (e.g. decontextualized features) and a psychologically close concept is construed
in concrete terms (e.g. specific, perceptual details). Relevant attitudes and behavior are
positively associated with psychological distance and different distances (near or far) lead
to different attitudes and behaviors. Conceptual metaphor theory suggests that people use
metaphor as a cognitive tool to understand abstract concepts through more concrete terms
(e.g. war is like a football game). Metaphor use impacts people’s practical judgments of a
target concept based on understood features of the source concept.

This observation has inspired a small but growing body of research that explores
the theoretical and practical interactions between the two frameworks. However, studies
have so far only investigated whether manipulating conditions of psychological distance
impacts conceptual metaphor use. For example, research has shown that people are more
likely to rely on metaphor when concepts are framed as psychologically distant (and
abstract) versus near (and concrete) (Jia & Smith, 2013). No one has yet examined whether metaphor use effects perceived psychological distance. Additionally, given the well-established relationships between psychological distance and relevant attitudes and behavioral intentions, there remains the question of whether metaphor use also directly impacts these cognitive judgements.

This present study addresses these gaps in the theoretical literature while also addressing the need to better understand public perceptions of aquatic pharmaceutical contamination. The objectives of this study are (1) to assess the effect of metaphoric framing on perceived distance of the environmental hazard across dimensions (temporal, geographic, social group and uncertainty) (2) to assess the effect of metaphoric framing on concern for the environmental hazard across dimensions and (3) to assess the effect of metaphoric framing on willingness to act (Figure 1). This research contributes to the theoretical advancement of psychological distance and metaphor theories and informs practical risk communication strategies encouraging participation in drug take-back initiatives.
(A) An interpretation of the relationships between psychological distance and relevant attitudes and behavioral intentions based on findings from research applying psychological distance to environmental issues. Adopted from Spence (2012); Niles (2015). (B) The relationships between metaphor use and psychological distance assessed in the objectives of the present study.

**Construal level theory and psychological distance**

Construal level theory (Liberman & Förster, 2009; Trope & Liberman, 2010), posits that people perceive events, objects, actions and other stimuli either as low-level (understood in specific terms) or high-level (conceptualized through global terms) constructs, which are inextricably linked to psychological distance. Within construal level theory, psychological distance is the mental distance perceived between a stimulus and the perceiver’s direct experience of their self in the present moment (Bar-Anan et al., 2007). Psychologically close stimuli tend to be low-level construals, understood through sensory and/or concrete terms (Bar-Anan et al., 2007). Psychologically distant stimuli are
generally high-level construals understood through abstract, global terms (Liberman & Förster, 2009).

Psychological distance is frequently studied through four primary dimensions: uncertainty, social group, geography and time. An event is psychologically closer when it is more likely to occur (uncertainty), happens to people like oneself (social group), occurs nearby (geographic) and takes place in the present or near future/past (time) (Milfont et al., 2011). Psychologically distant events are perceived as unlikely to occur, happening to people unlike oneself, occurring far away and taking place in the distant future/past. Experimental evidence suggests that the dimensions are positively associated, so thinking about one dimension in psychologically close or distant terms may impact the cognitive processing of other dimensions (e.g. thinking about people unlike oneself may prime one to perceive a greater geographic distance) (Bar-Anan et al., 2007).

Psychological distance and construal level theory have wide-ranging implications for understanding and motivating human thought and behavior. Research has shown that when a concept is perceived as psychologically distant people make choices based on their values (i.e. kindness); when something is represented as psychologically close, specific, contextual details like feasibility concerns (e.g. expected time commitment) and anticipated outcomes guide decisions (Trope & Liberman, 2010). Additionally, the perceived distance of a target motivates people to different kinds of behaviors (Haden et al., 2012) and attitudes (Milfont et al., 2011). For example, exploring the effects of psychological distance on farmers’ intentions to adopt different types of behaviors in response to climate change, Haden et al. (2012) found that psychologically distant
concerns impact farmers’ likelihood of adopting climate change mitigation practices (i.e. buying fuel efficient farm equipment) with abstract implications; while the intention to adopt climate change adaptation practices is influenced by feasibility concerns connected to psychological closeness (e.g. local water availability).

Congruent with other experimental studies of psychological distance, these studies demonstrate that related attitudes and behaviors are impacted by perceptions of psychological distance and suggest risk communication should intentionally and effectively frame psychological distance to produce desired responses to the specific environmental issue (Spence et al., 2012). Specifically, framing risk communications to reduce the perceived psychological distance of a target issue promotes concern and intent to act (Jones, Hine, & Marks, 2016).

**Conceptual metaphor theory**

This study assesses how framing the issue of aquatic pharmaceutical pollution through metaphor impacts psychological distance, which in turn may impact attitudes and behaviors. Conceptual metaphor theory states that people rely on metaphors as a cognitive tool to make sense of abstract concepts through more concrete terms (Gibbs, 1996; Lakoff & Johnson, 1980). Metaphors in this context are conventional, everyday metaphors used by regular people (Morris et al., 2007). According to Geary (2011), English speakers typically use about one metaphor for every 10-25 words spoken, which equals about six metaphors per minute (Landau et al., 2014).
In the metaphor framing model, metaphoric description (“using terms from another domain to talk about an event”) primes metaphoric encoding (“using schemas from another domain to think about an event”) (Morris et al., 2007, p. 176). This results in the perceiver transferring knowledge of a source concept to interpret a target concept (Jia & Smith, 2013). For a review of conceptual metaphor theory see Landau et al. (2010); Landau et al. (2014).

Typically, source concepts are more easily comprehended and concrete experiences, whereas target concepts tend to be complex, hard to understand and more abstract (Landau et al., 2014). For example, past research demonstrates that metaphorically evoking the experience of protecting one’s body from contamination impacts people’s judgements about their country’s immigration policy (Jia & Smith, 2013; Landau, Sullivan, & Greenberg, 2009). In two different studies, Americans more frequently opposed open immigration policies after being motivated to protect their own bodies from harmful (versus neutral) fictional bacteria.

Exposure to different metaphors produces different effects on a person’s practical judgments. For example, investigating the consequences of stock market commentators’ use of metaphors on the judgments of investors, Morris et al. (2007, p. 175) found that exposing participants to agent-metaphors that implied an “enduring internal disposition” reflected through observed price trends (e.g. “The Nasdaq climbed higher”), resulted in an increased expectation that a present price trend would persist the next day -- versus object-metaphors that do not imply an internal motivation (i.e. “The Nasdaq was pushed higher”), or non-metaphorical descriptions of the stock market.
Importantly, certain conditions are necessary in order for a metaphor to be activated and useful as a conceptual tool. For example, a metaphor needs to be culturally and contextually relevant (Landau et al., 2010). It also needs to be accessible to the individual perceiver and aligned with their unique epistemological and ontological perspectives. Steen et al. (2014) suggest that reinforcing the metaphor through additional supportive textual/contextual references increases metaphoric transfer. Recent research also indicates that certain conditions of psychological distance may also be required for metaphoric activation (Jia & Smith, 2013).

**Methods**

We applied a mixed-methods approach to characterize perceptions of psychological distance, concern and behavioral intentions towards aquatic pharmaceutical contamination and whether metaphor use in risk communications impacts these perceptions. The study was approved by the University of Vermont Institutional Review Board.

Data collection took place in Burlington, Vermont, between September 20 and November 7, 2016. All currently enrolled students (over the age of 18) able to meet in person on the UVM campus were eligible. The tailored design method (Dillman, 2014) was applied to all phases of the study. Volunteer participants were recruited through email announcements sent through student listservs. Confidential, individual in-person interviews were audio-recorded and lasted 55 minutes on average.
Sampling procedure

To understand whether metaphor use impacts perceptions of psychological distance, concern and behavioral intentions, the study was designed as a crossover study in which participants were randomly assigned a treatment sequence group (group A or group B), counterbalancing the order of metaphor and non-metaphor treatments to reduce potential order and performance variation effects (e.g. practice, boredom, fatigue, etc.). Each treatment group was composed of half of the total sample (n = 10; see Table I).

Table 1. Survey procedure.

<table>
<thead>
<tr>
<th>Interview Survey Treatment Order</th>
<th>Treatment Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A (n = 10)</td>
</tr>
<tr>
<td>1. Consent &amp; 2. Instructions</td>
<td>✓</td>
</tr>
<tr>
<td>3. Questions on awareness of topic</td>
<td>✓</td>
</tr>
<tr>
<td>4. Psychological distance survey</td>
<td>✓</td>
</tr>
<tr>
<td>5. 1&lt;sup&gt;st&lt;/sup&gt; Visual</td>
<td>Metaphor treatment</td>
</tr>
<tr>
<td>6. Psychological distance survey</td>
<td>✓</td>
</tr>
<tr>
<td>7. 2&lt;sup&gt;nd&lt;/sup&gt; Visual</td>
<td>Non-metaphor treatment</td>
</tr>
<tr>
<td>8. Psychological distance survey</td>
<td>✓</td>
</tr>
<tr>
<td>9. Questions on current behavior</td>
<td>✓</td>
</tr>
</tbody>
</table>
Data was collected using cognitive interviewing (Beatty & Willis, 2007; Willis, 2004), a semi-structured, interactive and in-depth qualitative survey method (de Leeuw et al., 2008), in which participants respond to a survey questionnaire while discussing aloud their thought processes and answer selections. Cognitive interviewing seeks to understand how respondents understand questions and the cognitive processes that are used to produce an answer (Beatty & Willis, 2007) and requires a small but deliberate sample (typically 15 - 40 participants).

Participants were instructed to read each survey question aloud, select an answer and discuss their thought processes with the interviewer through one of the six general but directed types of cognitive interviewing prompts outlined in Groves et al. (2011).

Between and within group results were compared using descriptive statistical analysis and qualitative analysis. A Wilcoxon signed ranks test was used to assess whether any within group changes after the first and second visual treatments were statistically significant at p < 0.100. This test assumes a null hypothesis of no change in mean response between pairs.

It should be noted that participants believed they were providing feedback on potential advertisements for drug collection programs and understood after the first treatment that we wanted to know if the visual changed how they thought about the issue.
Consequently, the crossover study design did not successfully prevent order effects and people became practiced in the survey. As a result, the second treatment had an insignificant and unclear impact on both groups and only baseline and first treatment results are reported.

Materials

Survey instrument: The survey questionnaire was composed of (1) baseline perceptions of and behavioral intentions towards aquatic pharmaceutical contamination (2) perceptions and behavioral intentions after viewing the first of two poster advertisements for safe drug disposal (3) perceptions and behavioral intentions after viewing second poster advertisement for safe drug disposal and (4) demographics (see Supplemental Materials for the full survey instrument).

Survey questions assessed perceptions of distance and levels of concern across the four primary dimensions of distance: geographic, social group, uncertainty and temporal. These questions were adapted from Spence et al. (2012) and further refined through pilot testing. For geographic, social group and temporal dimensions, questions were framed as near and far independently, recognizing people may reasonably perceive the problem as occurring at multiple distances. Questions examining behavioral intentions distinguished between feelings of preparation, a lower-level construct and motivation, a higher-level behavioral consideration.

Visual treatments: Two fictional posters were developed as potential advertisements for drug collection programs, one framing the issue through a “nature as
body” metaphor and one without this metaphor. The posters were identical in design and visual organization but differed in content (see Supplemental Materials for both visual treatments). The metaphor poster employed the root metaphor of “nature as body” to prime participants to protect their own bodies from contamination. Jackson (1983) demonstrates that personal and nature “bodies” are metaphorically linked in many cultural and religious traditions. In the English language, such metaphors can be found in ordinary speech (e.g. mouth of the river, body of water, foot of a mountain, etc.). Therefore, this root metaphor is widely accessible and culturally appropriate.

Results

Survey respondents were 45% male and 50% female (5% of respondents did not select a gender). A majority of participants (85%) presently resided in Burlington, Vermont, identified their race as White/Caucasian (80%) and ethnicity as not Hispanic or Latino/a (100%), were undergraduate-level students (90%) and out-of-state residents (65%). Based on the Fall 2016 Enrollment Report, the sample was roughly representative of the overall UVM student population in key demographic characteristics including gender, race, student level (undergraduate versus graduate) and in-state versus out-of-state residence. The sample was not representative of the UVM student population in undergraduate degree year or UVM school/college affiliation (see Supplemental Materials for full demographics).
Initial perceptions of psychological distance, concern and willingness to act

Overall, people perceive the issue of pharmaceuticals in the water as more geographically and socially distant (but agree to a lesser extent that it is also proximal) and are more concerned about distant geographic and social impacts (e.g. concern for distant people and places). People perceive the issue as certain (versus uncertain) and believe it to be temporally both distant and proximal. They are equally concerned about the issue in the near and far future. While people agree that they are motivated and prepared to participate in take-back programs, they feel more motivated than prepared, on average (Table II).

Table II. Combined baseline results for treatment groups A and B for psychological distance, concern and willingness to act (n = 20).

<table>
<thead>
<tr>
<th>Construct</th>
<th>Dimension</th>
<th>Question</th>
<th>Response Options</th>
<th>Initial Mean Response</th>
<th>% Unsure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Distance</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Geographic</td>
<td>Near</td>
<td>My local area is likely to be affected by the presence of pharmaceuticals in the water.</td>
<td>4-point scale (4) Strongly Agree – (1) Strongly Disagree</td>
<td>3.3</td>
<td>0</td>
</tr>
<tr>
<td>Geographic</td>
<td>Far</td>
<td>The presence of pharmaceuticals in the water will mostly affect areas that are far away from here.</td>
<td></td>
<td>3.1</td>
<td>5</td>
</tr>
<tr>
<td>Social</td>
<td>Near</td>
<td>People like me are likely to be affected by the presence of pharmaceuticals in the water.</td>
<td></td>
<td>3.2</td>
<td>10</td>
</tr>
<tr>
<td>Social</td>
<td>Far</td>
<td>Other people who are not like me are likely to be affected by the presence of pharmaceuticals in the water.</td>
<td>4-point scale (4) Strongly Agree – (1) Strongly Disagree</td>
<td>3.5</td>
<td>5</td>
</tr>
<tr>
<td>Uncertainty</td>
<td>Presence</td>
<td>Scientists are uncertain about the presence of pharmaceuticals in the water.</td>
<td></td>
<td>1.7</td>
<td>10</td>
</tr>
<tr>
<td>Uncertainty</td>
<td>Causes</td>
<td>Scientists are uncertain about what causes the presence of pharmaceuticals in the water.</td>
<td></td>
<td>1.8</td>
<td>0</td>
</tr>
<tr>
<td>Uncertainty</td>
<td>Problem</td>
<td>I am uncertain that the presence of pharmaceuticals in the water is really an issue.</td>
<td></td>
<td>1.8</td>
<td>0</td>
</tr>
<tr>
<td>Time Near People</td>
<td>Do you think local residents will feel the effects of pharmaceuticals in the water?</td>
<td>3.3</td>
<td>30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time Far People</td>
<td>Do you think people in other areas around the world will feel the effects from the presence of pharmaceuticals in the water?</td>
<td>3.3</td>
<td>20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time Near Environment</td>
<td>Do you think the local aquatic environment will feel the effects from the presence of pharmaceuticals in the water?</td>
<td>4.0</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time Far Environment</td>
<td>Do you think aquatic environments in other places around the world will feel the effects from the presence of pharmaceuticals in the water?</td>
<td>3.8</td>
<td>5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Geographic Near | When I think about my local area, I am concerned about the presence pharmaceuticals in the water. | 3.4 | 15 |
| Geographic Far | When I think about areas around the world, I am concerned about the presence pharmaceuticals in the water. | 3.7 | 0 |
| Social Near | When I think about people like me, I am concerned about the presence of pharmaceuticals in the water. | 3.2 | 5 |
| Social Far | When I think about other people who are different from me, I am concerned about the presence pharmaceuticals in the water. | 4-point scale (4) Strongly Agree – (1) Strongly Disagree | 3.5 | 5 |
| Uncertainty Environment | It is uncertain if the presence of pharmaceuticals in the water will have any effects on the environment. | 1.4 | 5 |
| Uncertainty People | It is uncertain if the presence of pharmaceuticals in the water will have any effects on people. | 1.8 | 5 |
| Time Near | When I think about the near future, I am concerned about the presence pharmaceuticals in the water. | 3.4 | 10 |
| Time Far | When I think about the distant future, I am concerned about the presence of pharmaceuticals in the water. | 3.4 | 10 |

| Prepared | I feel prepared to participate in a pharmaceutical take back initiative. | 4-point scale (4) Strongly Agree – (1) Strongly Disagree | 3.4 | 5 |
| Motivated | I feel motivated to participate in a pharmaceutical take back initiative. | 3.6 | 10 |
Effect of metaphor on psychological distance, concern and willingness to act on pharmaceuticals in the environment

Psychological distance: After viewing the metaphor treatment, group A participants perceived aquatic pharmaceutical contamination as geographically (p = .083) and socially (p = .034) significantly closer than their baseline, while geographic distance trended toward decreasing (Figure 2). Group A also expressed increased certainty about scientists’ knowledge of the issue and increased agreement that the effects will be temporally close, although these were not significant (Table III).

Treatment group B, who saw the non-metaphor treatment first, more strongly agreed that the issue was distant across social and temporal dimensions, compared to their baseline. Exposure to the non-metaphor treatment had no significant impact on perceptions of psychological distance and, in general, enhanced or had no effect on people’s initial (dis)agreement with the distance of each dimension.
**Concern:** Representing the issue through metaphor had no direct, statistically significant effect on treatment group A’s initial levels of concern across dimensions, although overall concern increased across dimensions and distances.

The non-metaphor treatment significantly increased treatment group B’s concern for geographically distant impacts ($p = .083$), compared with their baseline responses. In general, this treatment also increased concern across dimensions and distances, although no other change was statistically significant.

**Behavior:** Metaphor use had no direct, statistically significant impact on group A’s behavioral intentions, although people felt equally prepared and motivated to
participate in a drug collection program (versus initially being more motivated than prepared).

The non-metaphor visual also had no significant effect on group B’s behavioral intentions. People continued to feel more motivated than prepared.

Table III. Statistical results using Wilcoxon signed ranks test, a nonparametric method for analyzing differences and magnitude of difference between paired data that assumes a null hypothesis of zero difference (McDonald, 2014; Whitley & Ball, 2002). Significant results (p < 0.100) are bolded for emphasis.

<table>
<thead>
<tr>
<th>Construct</th>
<th>Variable</th>
<th>Metaphor Treatment (N = 10)</th>
<th>Non-metaphor Treatment (N = 10)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Z – Score</td>
<td>p Value*</td>
<td>Z – Score</td>
</tr>
<tr>
<td>Distance</td>
<td>Geographic</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Near</td>
<td>-.2121 (^b) .034</td>
<td>-.000 (^a) 1.000</td>
</tr>
<tr>
<td></td>
<td>Far</td>
<td>-.1633 (^b) .102</td>
<td>-.816 (^b) .414</td>
</tr>
<tr>
<td></td>
<td>Social</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Near</td>
<td>-.1732 (^a) .083</td>
<td>-.000 (^b) .317</td>
</tr>
<tr>
<td></td>
<td>Far</td>
<td>-.577 (^b) .564</td>
<td>-.447 (^b) .655</td>
</tr>
<tr>
<td>Distance</td>
<td>Uncertainty</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Presence</td>
<td>-.1342 (^b) .180</td>
<td>-.000 (^c) .317</td>
</tr>
<tr>
<td></td>
<td>Causes</td>
<td>-.1000 (^b) .317</td>
<td>-.1342 (^c) .180</td>
</tr>
<tr>
<td></td>
<td>Problem</td>
<td>-.816 (^a) .414</td>
<td>-.1633 (^c) .102</td>
</tr>
<tr>
<td>Distance</td>
<td>Time</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Near People</td>
<td>-.1000 (^b) .317</td>
<td>-.1414 (^b) .157</td>
</tr>
<tr>
<td></td>
<td>Far People</td>
<td>-.1342 (^b) .180</td>
<td>-.577 (^b) .564</td>
</tr>
<tr>
<td>Distance</td>
<td>Time</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Near Environment</td>
<td>.000 (^c) 1.000</td>
<td>.000 (^a) 1.000</td>
</tr>
<tr>
<td></td>
<td>Far Environment</td>
<td>-.1000 (^a) .317</td>
<td>.000 (^a) 1.000</td>
</tr>
<tr>
<td>Concern</td>
<td>Geographic</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Near</td>
<td>-.1000 (^a) .317</td>
<td>-.816 (^c) .414</td>
</tr>
<tr>
<td></td>
<td>Geographic Far</td>
<td>Social Near</td>
<td>Social Far</td>
</tr>
<tr>
<td>------------------</td>
<td>---------------</td>
<td>------------</td>
<td>-----------</td>
</tr>
<tr>
<td></td>
<td>.000&lt;sup&gt;c&lt;/sup&gt;</td>
<td>1.000</td>
<td>-1.000&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-1.000&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

* statistically significant p values in bold.  
<sup>a</sup> Based on negative ranks.  
<sup>b</sup> Based on positive ranks.  
<sup>c</sup> The sum of negative ranks equals the sum of positive ranks.

**Qualitative assessment of metaphor effectiveness:** All participants were asked to describe their experience of each visual treatment, allowing us to assess whether the metaphor produced the desired effect. Comparing the two potential advertisements, most people (55%) stated a preference for the metaphor visual, 15% preferred the non-metaphor visual and 30% could not be determined. While viewing the metaphor treatment, most people (55%) described thinking about exposure to their bodies and linking that to thinking about pharmaceuticals in the water. Some example responses included:
“Asking the question, ‘what’s in your body of water?’ makes you really wonder what’s in your body of water, like what’s going into your body? And then obviously having these pills in front of the lake makes you wonder again. [...] so, you’re like ‘oh drugs in my body! That’s not a good thing!” (Participant T).

“What’s in your body of water? [...] if you ask this I would probably think what is the mechanism of the medication – what is this medication going to cause in your body – what’s in your body of water...” (Participant A).

Comparatively, while viewing the non-metaphor treatment, nearly everyone described their reaction to seeing the types and/or quantity of drugs represented. Various reactions included shock, disinterest and familiarity, among others. People also often commented on the headline question, “Got Drugs?”, which is used in advertisements for the U.S. Drug Enforcement Agency’s biannual National Prescription Take-Back Day. Many remarked that in a college environment, this may not be as attention-grabbing as it could be in other community settings.

Discussion

Baseline results indicate varying levels of perceived distance across dimensions

Baseline results indicate people perceive the issue of aquatic pharmaceutical contamination at varying levels of distance depending on the dimension of distance. Importantly, people more strongly agreed that pharmaceutical pollution is a distant geographic and social issue (which does not preclude or conflict with the belief that local
areas and people will also be impacted) and expressed higher levels of concern for the issue at greater geographic and social distances. The perception that the issue is more likely to impact other places and people may be due to spatial bias (environmental problems are believed to be worse at global versus local levels (Uzzell, 2000), especially by younger and happier people (Schultz et al., 2014)) and/or spatial optimism (environmental conditions are better here than elsewhere) (Gifford et al., 2009; Milfont et al., 2011). For example, in a study assessing California farmers’ perceptions of climate change policy risks, Niles et al. (2013) found that overall farmers believe climate change poses greater risks to agriculture globally (far) than to agriculture in Yolo County, California (near).

These cognitive biases have implications for behavior. Believing environmental problems to be more severe at a global level can lead to decreased feelings of self-efficacy (feeling able to do something about the problem) and responsibility for the problem (Uzzell, 2000), which in turn discourages public engagement. Likewise, our baseline results indicate people felt more motivated (a value-driven, high-level construal) than prepared (a low-level construal motivated by feasibility concerns) to participate in pharmaceutical take-back initiatives, which may be connected to perceptions that aquatic pharmaceutical contamination is a distant issue.

**Metaphor use may reduce perceived distance of the environmental issue**

Results indicate that metaphor use resulted in shifts in perceived psychological distance from more geographically and socially far to more proximate.
Qualitative data capturing people’s responses to the metaphor-framed visual indicate the metaphor successfully provoked people to think about bodily exposure while interpreting the issue of aquatic pharmaceutical contamination. Further, the majority of respondents preferred the metaphor visual to communicate about drug take-back programs. Previous research indicates positive associations between psychological proximity and concern for and willingness to act on an issue (Haden et al., 2012; Jones et al., 2016; Niles et al., 2013). As well, others have found that more proximate issues activate preparedness to act. While metaphor use did not directly affect concern or willingness to act, recent research suggests psychological distance mediates the impact of message frame manipulations, like metaphoric framing, on concern and behavioral intentions. Jones et al. (2016) found that framing messages to manipulate (reduce) psychological distance indirectly increased concern and willingness to act, but had no direct, statistically significant effect on either construct. According to Rabinovich et al. (2009), reducing psychological distance may be especially critical when specific individual actions are needed to achieve a relatively abstract goal, like participating in a drug collection program to reduce aquatic pharmaceutical contamination, which cannot be detected through the senses. Therefore, risk communication efforts to bring this issue closer may indirectly lead to greater concern and preparedness to act at an individual level.
Figure 3. Observed and potential impacts of metaphor use on psychological distance, concern and willingness to act.

Due to our small sample size, we could not assess whether psychological distance mediated the effects of metaphor use on concern and willingness to act (Figure 3); however, we strongly recommend that future research consider this particular relationship. Additionally, different metaphors lead to different practical judgments of target concepts (Morris et al., 2007), therefore another possible direction for future research could include assessing whether and how different metaphors impact different dimensions of distance.
Methods discussion

In this study, cognitive interviewing was used to understand how people perceive the issue of aquatic pharmaceutical contamination using questions adapted from Spence et al. (2012) to measure psychological distance, concern and willingness to act. In doing so, we found people interpreted key constructs differently. For example, some people interpreted the geographic near construct, “my local area”, as the immediate area around Burlington, Vermont, while others assumed it meant their hometown located in another county, state or country. People often interpreted “near future” and “far future” as the future in general. Additionally, people commonly considered social factors when responding to questions assessing geographic distance and concern (e.g. regulations, environmental values, income, etc.) and likewise geographic features when answering questions assessing social distance and concern (e.g. proximity to water, physical location, etc.). These multiple interpretations could lead to inconsistent responses. As psychological distance becomes an increasingly popular framework for measuring perceptions, attitudes and behaviors, there is a need for standardized, validated language framing each dimension of distance that can be applied to studies across disciplines and topic areas.

We want to note that among this particular sample population it is possible that perceived psychological distance and concern for aquatic pharmaceutical contamination were impacted by (1) the proximity and visibility of Lake Champlain within Burlington, Vermont (Milfont et al., 2014) (2) prior awareness (Milfont, 2012) (3) socially desirable responding, the tendency of questionnaire respondents to self-report socially acceptable
answers (Van de Mortel, 2008) and (4) the use of visual (versus text) communications, which may suggest proximity between a communicator and audience (Amit, Wakslak, & Trope, 2013). Additionally, we know from qualitative data that answering questions about the topic in the context of a research study reduced perceived uncertainty about the issue and impacted people’s concerns for near and far future. For example, some people felt less concerned about the far future because they assume that current studies, such as the one they were participating in, will lead to future solutions.

**Conclusion**

Consumer attitudes and behaviors significantly contribute to the presence of pharmaceutical chemicals in water systems with consequences to human and environmental health. The purpose of this study was to better understand public perceptions of aquatic pharmaceutical contamination and how those perceptions can be effectively framed by risk communications promoting safe drug disposal. Applying construal level theory of psychological distance along with conceptual metaphor theory, we found that aquatic pharmaceutical contamination was initially perceived as psychologically distant and proximal depending on the dimension of distance. At baseline, people more strongly agreed the issue was geographically and socially distant and expressed higher concern for other areas and people. People believed the issue was certain (near) and equally temporally proximate and distant. People felt equally concerned about impacts in the near and far future. People felt more motivated (high-
level construal) than prepared (low-level construal) to participate in drug collection programs.

The majority of participants preferred the metaphoric framing intervention to the non-metaphoric message manipulation. Compared to baseline perceptions and the non-metaphor treatment, using metaphor to frame the issue of aquatic pharmaceutical contamination significantly reduced the perceived psychological distance of the issue, specifically across geographic and social dimensions of distance. While we did not find a direct influence of metaphor on concern or behavioral intentions, this effect is likely based on past research that the use of metaphor to reduce distance could have a positive influence on behaviors related to preparedness to act, which are driven by close constructs. Thus, additional research is needed to further explore these relationships with larger sample sizes. Finally, we found people interpret distances (near/far) and dimensions (geographic, social, temporal and uncertainty) in different ways, suggesting the need for validated questions to consistently measure psychological distance.

While other studies have explored how framing psychological distance affects metaphor use, this study is the first that we know of to assess how metaphor use impacts perceived psychological distance. Our findings contribute to a growing body of theoretical literature exploring the utility of psychological distance and conceptual metaphor theory in understanding how people process and form cognitive judgements on everyday stimuli. Additionally, results from this study have practical applications for designing risk communications that effectively promote public engagement and action on the issue of aquatic pharmaceutical contamination.
Acknowledgements

The authors thank the participants, Alan Howard, Director of the Statistical Counseling Clinic at the University of Vermont, for his assistance with statistical analysis and Jon Portman, Creative Director and Founding Partner at Oxbow Creative, for his graphic design input. Funding support for this project was generously provided by the Gund Institute for Environment, the Vermont Water Resources and Lake Studies Center, a USGS Water Resources Research Institute and the Rubenstein Graduate Student Association. This study was also supported in part by the University of Vermont Rubenstein School of Environment and Natural Resources.
References


Supplemental Material

A) Full survey questionnaire. We developed this survey to assess people’s perceptions of, attitudes towards and willingness to act on pharmaceutical pollution. Questions also assessed participants’ prior knowledge of the environmental issue, current purchasing, use and disposal practices for prescription and OTC medications and prior awareness of and participation in drug collection programs. Participants were asked to select their demographic characteristics and answer the New Ecological Paradigm Scale questionnaire.

B) Visual treatments. These fictional advertisements were designed to stylistically replicate preexisting advertisements for drug collection programs. The first uses visual imagery and text (e.g. what’s in your body of water?) to frame pharmaceutical pollution through the metaphor “nature as body”. The second advertisement was designed as the non-metaphor visual. Neither poster mentions specific information about the fictional collection program, nor the issue of pharmaceutical pollution.

C) Table IV. Demographic characteristics of respondents (n = 20), all of whom are currently enrolled students at the University of Vermont (UVM), and the UVM student population.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Respondents (n = 20)</th>
<th>UVM student population (n = 12,213)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>9 (45)</td>
<td>5212 (42.7)</td>
</tr>
<tr>
<td>Female</td>
<td>10 (50)</td>
<td>7001 (57.3)</td>
</tr>
<tr>
<td>No Answer</td>
<td>1 (5)</td>
<td>n/a b</td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White/Caucasian</td>
<td>16 (80)</td>
<td>10,858 (88.9)</td>
</tr>
<tr>
<td>Asian</td>
<td>2 (10)</td>
<td>380 (3.1)</td>
</tr>
<tr>
<td>American Indian</td>
<td>1 (5)</td>
<td>11 (&gt;1)</td>
</tr>
<tr>
<td>Other</td>
<td>1 (5)</td>
<td>n/a b</td>
</tr>
<tr>
<td>Two or more</td>
<td>2 (10)</td>
<td>339 (2.7)</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not Hispanic or Latino/Latina</td>
<td>20 (100)</td>
<td>473 (3.8)</td>
</tr>
<tr>
<td>Hispanic or Latino/a</td>
<td>0 (0)</td>
<td>440 (3.7)</td>
</tr>
<tr>
<td>Permanent Residence</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vermont</td>
<td>7 (35)</td>
<td>3711 (30.4)</td>
</tr>
<tr>
<td>Out-of-state</td>
<td>13 (65)</td>
<td>8502 (69.6)</td>
</tr>
<tr>
<td>International</td>
<td>1 (5)</td>
<td>669 (5.7)</td>
</tr>
<tr>
<td>Current Residence</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outside of Burlington</td>
<td>3 (15)</td>
<td>n/a c</td>
</tr>
<tr>
<td>In Burlington</td>
<td>17 (85)</td>
<td>n/a c</td>
</tr>
<tr>
<td>On campus</td>
<td>7 (35)</td>
<td>n/a c</td>
</tr>
<tr>
<td>Off campus</td>
<td>10 (50)</td>
<td>n/a c</td>
</tr>
<tr>
<td>Political Affiliation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Republican</td>
<td>1 (5)</td>
<td>n/a c</td>
</tr>
<tr>
<td>Democrat</td>
<td>9 (45)</td>
<td>n/a c</td>
</tr>
</tbody>
</table>
## Student Level

<table>
<thead>
<tr>
<th>Level</th>
<th>Total</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Undergraduate</td>
<td>18</td>
<td>(90)</td>
</tr>
<tr>
<td>1st year</td>
<td>1</td>
<td>(5)</td>
</tr>
<tr>
<td>2nd year</td>
<td>6</td>
<td>(30)</td>
</tr>
<tr>
<td>3rd year</td>
<td>9</td>
<td>(45)</td>
</tr>
<tr>
<td>4th year</td>
<td>2</td>
<td>(10)</td>
</tr>
<tr>
<td>Graduate</td>
<td>2</td>
<td>(10)</td>
</tr>
<tr>
<td>Master’s-level</td>
<td>1</td>
<td>(5)</td>
</tr>
<tr>
<td>Doctoral-level</td>
<td>1</td>
<td>(5)</td>
</tr>
</tbody>
</table>

## UVM School/College

<table>
<thead>
<tr>
<th>College</th>
<th>Total</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grossman School of Business</td>
<td>6</td>
<td>(30)</td>
</tr>
<tr>
<td>Rubenstein School of Environment &amp; Natural Resources</td>
<td>4</td>
<td>(20)</td>
</tr>
<tr>
<td>College of Nursing &amp; Health Sciences</td>
<td>3</td>
<td>(15)</td>
</tr>
<tr>
<td>College of Education &amp; Social Sciences</td>
<td>1</td>
<td>(5)</td>
</tr>
<tr>
<td>College of Arts &amp; Sciences</td>
<td>3</td>
<td>(15)</td>
</tr>
<tr>
<td>Graduate College</td>
<td>2</td>
<td>(10)</td>
</tr>
</tbody>
</table>

## Family Annual Income ($)

<table>
<thead>
<tr>
<th>Income Range</th>
<th>Total</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>25,000-44,999</td>
<td>4</td>
<td>(20)</td>
</tr>
<tr>
<td>45,000-64,999</td>
<td>3</td>
<td>(15)</td>
</tr>
<tr>
<td>65,000-84,999</td>
<td>2</td>
<td>(10)</td>
</tr>
<tr>
<td>85,000-99,999</td>
<td>2</td>
<td>(10)</td>
</tr>
<tr>
<td>100,000-200,000</td>
<td>5</td>
<td>(25)</td>
</tr>
<tr>
<td>&gt; 200,000</td>
<td>3</td>
<td>(15)</td>
</tr>
<tr>
<td>No Answer</td>
<td>1</td>
<td>(5)</td>
</tr>
</tbody>
</table>

*The UVM degree student population is represented. Data is from the University of Vermont Fall 2016 Enrollment Report (University of Vermont, 2016). n/a = data not available*
Chapter 4: Supplemental Material

Expanded Results and Discussion

Background Knowledge and Current Purchasing, Use and Disposal Behavior

Questions assessed whether participants had previously heard of the issue of aquatic pharmaceutical contamination and how informed they felt, as well as their current drug purchasing, use and disposal behaviors (adopted from Vatovec, 2016).

Background Knowledge: Overall, a majority of participants (65%) had previously heard of the issue of pharmaceuticals in the water (30% had never heard of the issue before and 5% were unsure). Of those who were aware of it, most cited hearing about the issue in an academic context (40%). Others heard about it from news media (10%), a doctor (5%), family members (5%), or because they had disposed of their own medication via a drain (5%). Importantly, only half of the participants in group A had previously heard of the issue (versus 80% of Group B). More than half of all respondents (55%) tended to or strongly disagreed that they felt informed about the issue; while less than half (45%) tended to or strongly agreed that they felt informed.

Current Purchasing, Use and Disposal Practices of Over-the-Counter (OTC) Medications: In the past 12 months, nearly all (95%) respondents had purchased OTC medication (5% had not), see Table V. Of those who had purchased OTC medications, 10% used all of their purchased medication(s) and had none leftover, whereas 30% were still using their medication(s) and 60% did not use all of their medication(s) and had
some leftover. The majority of people (60%) said they still had their leftover medication(s) and 20% said they gave them to a friend or family member. Respondents were asked to share if and how they disposed of medication in the last 12 months. A majority (65%) said they did not throw any OTC drugs away in the past 12 months, 25% said they threw them out in the garbage and 5% said they flushed their drugs down the toilet. No one took OTC medication(s) to a National Drug Take-Back Day.

*Current purchasing, use and disposal practices of prescription medications:* A majority of respondents (75%) said they had purchased prescription medication(s) in the past 12 months, although fewer people bought prescription medication than OTC medication. A quarter of participants did not purchase any prescription medication in the past 12 months. Unlike those who had purchased OTC medications, most people (30%) had used their prescription medication and there was none left. Twenty five percent were still using the medication(s) and 20% did not use all of their medication(s) and had some leftover. Although most people (70%) did not dispose of prescription medications in the past 12 months, of those who said they did, 10% threw them out in the garbage, 5% threw out an empty prescription medication bottle after the medicine had been used and 5% flushed their medication down the drain. No one took prescription medication(s) to a National Drug Take-Back Day.
Table V. Current drug purchasing, use and disposal behaviors among the sample population (n = 20) and University of Vermont students (n = 359), adapted from Vatovec et al. (2016).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Over-the-counter drugs</th>
<th>Prescription drugs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sample population n (%)</td>
<td>University of Vermont students n (%)</td>
</tr>
<tr>
<td>Current purchasing, use and disposal behaviors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I purchased medications in the past 12 months</td>
<td>19 (95)</td>
<td>315 (87)</td>
</tr>
<tr>
<td>I had leftover medications in the past 12 months</td>
<td>12 (60)</td>
<td>181 (50)</td>
</tr>
<tr>
<td>I still have this leftover medication</td>
<td>12 (60)</td>
<td>n/a a</td>
</tr>
<tr>
<td>Disposal of medications in the past 12 months</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I flushed them down the drain or sink</td>
<td>1 (5)</td>
<td>4 (1)</td>
</tr>
<tr>
<td>I threw them out in the garbage</td>
<td>5 (25)</td>
<td>67 (19)</td>
</tr>
<tr>
<td>Took them to a drug collection program</td>
<td>0</td>
<td>5 (1)</td>
</tr>
</tbody>
</table>

*a n/a = data not available

Drug collection programs: Most people (55%) had heard of drug collection programs in the past (45% had not heard of these programs in the past). However, only 10% had taken unneeded medications to a drug collection program (90% had not). Interestingly, when asked why they had not taken medications to a collection program, those who had heard of it said that they never had medication to throw out (35%), didn’t know when or where it was held (15%), couldn’t make it to the time or location where it was held (10%), did not feel comfortable taking drugs there (5%), or just forgot to utilize the resource (5%).

Contrasting with the results above, during earlier sections of the questionnaire assessing perceptions, attitudes and behaviors towards aquatic pharmaceutical
contamination, at least 20% of people mentioned that they take little or no medication when considering if they felt prepared to participate in a take-back program (although 95% and 75% of participants had purchased OTC and prescription medications, respectively, in the last 12 months). Additionally, at least 65% of people said they did not know what a pharmaceutical take back initiative is and were unfamiliar with the concept, while 15% had heard of the concept but were unfamiliar with this name for it. For example, one participant asked, “what is a pharmaceutical take back initiative?” Then, after receiving an explanation, they said, “Oh, I knew that… I feel like I’ve just heard of people being able to bring their meds back in, I didn’t know it had a name.” Note: in another section of the interview, most people (55%) agreed that they had heard of drug collection programs in the past.

These findings suggest that most people are aware of the issue of aquatic pharmaceutical contamination, as well as the existence of drug collection programs. Additionally, consistent with Vatovec et al. (2016), most people purchased and consumed OTC and/or prescription medications in the last 12 months and chose to store (rather than dispose of) leftover medications. These findings reinforce the importance of understanding how people perceive the issue relative to themselves and their actions, since awareness and education alone may not change individual behaviors and attitudes. It also suggests the utility of developing communications for drug collection programs that effectively target university students.
### Table VI. New ecological paradigm scale: descriptive survey results (n = 20).

<table>
<thead>
<tr>
<th>Statement</th>
<th>Construct</th>
<th>Strongly Agree</th>
<th>Mildly Agree</th>
<th>Mildly Disagree</th>
<th>Strongly Disagree</th>
<th>Unsure</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. We are approaching the limit of the number of people the Earth can support.</td>
<td>NEP</td>
<td>12</td>
<td>3</td>
<td>4</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>B. Humans have the right to modify the natural environment to suit their needs.</td>
<td>DSP</td>
<td>1</td>
<td>2</td>
<td>11</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>C. When humans interfere with nature it often produces disastrous consequences.</td>
<td>NEP</td>
<td>10</td>
<td>6</td>
<td>1</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>D. Human ingenuity will insure that we do not make the Earth unlivable.</td>
<td>DSP</td>
<td>2</td>
<td>1</td>
<td>7</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>E. Humans are seriously abusing the environment.</td>
<td>NEP</td>
<td>17</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>F. The Earth has plenty of natural resources if we just learn how to develop them.</td>
<td>DSP</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>G. Plants and animals have as much right as humans to exist.</td>
<td>NEP</td>
<td>15</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>H. The balance of nature is strong enough to cope with the impacts of modern industrial nations.</td>
<td>DSP</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>15</td>
<td>0</td>
</tr>
<tr>
<td>I. Despite our special abilities, humans are still subject to the laws of nature.</td>
<td>NEP</td>
<td>13</td>
<td>4</td>
<td>0</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>J. The so-called “ecological crisis” facing humankind has been greatly exaggerated.</td>
<td>DSP</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>16</td>
<td>0</td>
</tr>
<tr>
<td>K. The Earth is like a spaceship with very limited room and resources.</td>
<td>NEP</td>
<td>11</td>
<td>6</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>L. Humans were meant to rule over the rest of nature.</td>
<td>DSP</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>15</td>
<td>1</td>
</tr>
<tr>
<td>M. The balance of nature is very delicate and easily upset.</td>
<td>NEP</td>
<td>4</td>
<td>6</td>
<td>9</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>
Development of Visual Treatments

Visual images are a primary and powerful tool for communicating environmental issues to the public. “Nature and environmental themes are intrinsically visual and human perception and understanding of environmental affairs are deeply influenced by the visualizations created for the media” (Meisner & Takahashi, 2013, p. 255). For example, a review by O'Neill and Smith (2014) demonstrates the critical role images play in shaping cultural and political conversations about climate change.

Hansen and Cox (2015) argue that the public’s familiarity with environmental issues and affairs is largely due to the rise and availability of visual media since the 1960s. A historically significant example of this is the “Earth Rise” photo taken from Apollo 8 in 1968, the public’s first view of the entire planet Earth (O'Neill, Boykoff, Niemeyer, & Day, 2013). As a way to witness an issue, images inspire the public to take action (Dale, 1996; DeLuca, 1999; O'Neill et al., 2013). As a result, visual imagery has been used by nonprofits, governments, mass media and others to engage the public in various environmental issues and to encourage pro-environmental behaviors.

Relevant to this study, visual imagery and posters are commonly used to advertise the adverse socio-ecological impacts of improper drug disposal, as well as aquatic
pharmaceutical contamination and to promote public participation in safe drug collection programs. Given the goal of this study to aid practitioners in developing effective risk communication for drug collection programs, imagery, in addition to text, was used to assess the impact of metaphor on perceptions, attitudes and behaviors.

Two fictional posters were constructed as potential advertisements for drug collection programs, one describing the issue through “nature as body” metaphor and one without metaphor. Created using the free online infographic software, Piktochart, the posters are identically designed and visually organized but differ in content. Both visuals were modeled after actual drug collection advertisements, which typically feature a catchy phrase (e.g. “Dose of Reality”), followed by text describing the desired action (e.g. “Get the addictive drugs out of your medicine cabinet today”) set against an image or graphic. The non-metaphor poster featured the headline phrase “Got Drugs?” used in advertisements for the U.S. Drug Enforcement Agency’s bi-annual National Take Back Day. Mimicking this style, the metaphor treatment featured the phrase, “What’s in your body of water?”

**Metaphor development and presentation**

The poster containing the metaphorical description incorporates conditions necessary for metaphor activation noted previously. The metaphor is explicitly communicated through large text and implicitly reinforced through imagery, color and language choices.
We employed the root metaphor of “nature as body” while priming participants to protect their own bodies from contamination. This is both widely accessible and culturally appropriate. Jackson (1983) demonstrates that personal and nature “bodies” are metaphorically linked in many cultural and religious traditions. In the English language such metaphors can be found in ordinary speech (e.g. mouth of the river, body of water, foot of a mountain, etc.).

A considerable amount of literature is devoted to exploring embodied experiences as a basic source of knowledge, which can be expressed in body metaphors (Keefer, Landau, Sullivan, & Rothschild, 2014; Landau & Keefer, 2014; Landau et al., 2010). The body as a source concept can be called on metaphorically to influence attitudes and behaviors towards target concepts. For example, past research has demonstrated that protecting one’s body from contamination can be metaphorically connected to protecting one’s country from immigrants (Jia & Smith, 2013; Landau et al., 2009). In two different studies, Americans more frequently opposed open immigration policies after being motivated to protect their own bodies from harmful (versus neutral) fictional bacteria.

In conjunction with the “nature as body” metaphor, we proposed using color associations to provoke an emotional response of disgust to enhance participants’ motivation to simultaneously protect their bodies. It has been suggested that disgust is an emotion charged with the function of keeping one’s bodily boundaries intact to preserve internal health and integrity (Landau et al., 2014). Disgust may defend the integrity of the body by reducing contact with potentially physically harmful edible items, surfaces, or objects (Charash & McKay, 2002; Landau et al., 2014). Previous research in color
psychology indicates an association between green-yellow (associated with vomit and sickness) and the embodied experience of disgust (Kaya & Epps, 2004). Because emotional responses to colors depend on (and change with) value and saturation levels (Manav, 2007), this study applies the exact green-yellow tested by Kaya and Epps (2004). The notation of this color in the Munsell Color System is 2.5GY 8/10 and is assigned the hexadecimal code #CCD13E.
Visual Treatments

Visual framed through “nature as body” metaphor.

What's in Your Body of Water?

Dispose Drugs Safely

Medications thrown into the trash or down the drain spread through our waterbodies. Collection programs offer safe disposal of drugs you no longer need. No questions asked.
Visual framed without “nature as body” metaphor.

Got Drugs?

Dispose Drugs Safely

Medications thrown into the trash or down the drain are being detected in water. Collection programs offer safe disposal of drugs you no longer need. No questions asked.
Survey Instrument

Research on Pharmaceuticals and the Environment

“A study has found that 80% of lakes and rivers tested show evidence of pharmaceuticals in the water. These pharmaceuticals are often found because people throw medications in the trash, or flush them down the drain.”

1. In the past, have you heard about the presence of pharmaceuticals in the water?”
   Yes
   Please explain in what context:
   No
   Unsure

2. Please rate the following statement.

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Mildly Agree</th>
<th>Mildly Disagree</th>
<th>Strongly Disagree</th>
<th>Unsure</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
</tr>
</tbody>
</table>

I feel informed about this topic. 1 2 3 4 5

3. What kinds of medications do you think may be present in the water?

4. Please rate your agreement with the following statements.

   A. My local area is likely to be affected by the presence of pharmaceuticals in the water.
      1 2 3 4 5

   B. The presence of pharmaceuticals in the water will mostly affect areas that are far away from here.
      1 2 3 4 5
C. People like me are likely to be affected by the presence of pharmaceuticals in the water.

D. Other people who are not like me are likely to be affected by the presence of pharmaceuticals in the water.

E. Scientists are uncertain about the presence of pharmaceuticals in the water.

F. Scientists are uncertain about what causes the presence of pharmaceuticals in the water.

G. I am uncertain that the presence of pharmaceuticals in the water is really an issue.

H. It is uncertain if the presence of pharmaceuticals in the water will have any effects on the environment.

I. It is uncertain if the presence of pharmaceuticals in the water will have any effects on people.

J. When I think about people like me, I am concerned about the presence of pharmaceuticals in the water.

K. When I think about my local area, I am concerned about the presence of pharmaceuticals in the water.

L. When I think about the near future, I am concerned about the presence of pharmaceuticals in the water.

M. When I think about other people who are different from me, I am concerned about the
presence of pharmaceuticals in the water.

N. When I think about the distant future, I am concerned about the presence of pharmaceuticals in the water.

O. When I think about areas around the world, I am concerned about the presence of pharmaceuticals in the water.

P. How certain are you about the levels of concern you just expressed?

Q. I feel prepared to participate in a pharmaceutical take back initiative.

R. I feel motivated to participate in a pharmaceutical take back initiative.

Please rate the following statements.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Yes, already feeling the effects (1)</th>
<th>Yes, but in the near future (2)</th>
<th>Yes, but in the far future (3)</th>
<th>Maybe, I’m not sure (4)</th>
<th>No, don’t think the effects will be felt (5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>S. Do you think local residents will feel the effects of pharmaceuticals in the water?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>T. Do you think people in other areas around the world will feel the effects from the presence of pharmaceuticals in the water?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>U. Do you think the local aquatic environment will feel the effects from the presence of pharmaceuticals in the water?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>V. Do you think aquatic environments in other places</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>
around the world will feel the effects from the presence of pharmaceuticals in the water?

W. Rank the following factors from most to least important when considering participating in a take back initiative (options presented on index cards and physically arranged by respondent).

- My values
- The convenience of the program (e.g. location and hours of operation)
- My concern for society in general
- Accessibility of information for the program
- My concern for myself
- The timeframe in which pharmaceuticals are entering the environment
- The environmental impact
- The proximity of the issue for this area
- The global impact of this issue.
After viewing the first Safe Drug Disposal Advertisement:

5. Please rate your agreement with the following statements.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Agree (1)</th>
<th>Mildly Agree (2)</th>
<th>Mildly Disagree (3)</th>
<th>Strongly Disagree (4)</th>
<th>Unsure (5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. My local area is likely to be affected by the presence of pharmaceuticals in the water.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>B. The presence of pharmaceuticals in the water will mostly affect areas that are far away from here.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>C. People like me are likely to be affected by the presence of pharmaceuticals in the water.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>D. Other people who are not like me are likely to be affected by the presence of pharmaceuticals in the water.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>E. Scientists are uncertain about the presence of pharmaceuticals in the water.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>F. Scientists are uncertain about what causes the presence of pharmaceuticals in the water.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>G. I am uncertain that the presence of pharmaceuticals in the water is really an issue.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>H. It is uncertain if the presence of pharmaceuticals in the water will have any effects on the environment.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>I. It is uncertain if the presence of pharmaceuticals in the water will have any effects on people.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>J. When I think about people like me, I am concerned about the presence of pharmaceuticals in the water.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>
K. When I think about my local area, I am concerned about the presence of pharmaceuticals in the water.  
L. When I think about the near future, I am concerned about the presence of pharmaceuticals in the water.  
M. When I think about other people who are different from me, I am concerned about the presence of pharmaceuticals in the water.  
N. When I think about the distant future, I am concerned about the presence of pharmaceuticals in the water.  
O. When I think about areas around the world, I am concerned about the presence of pharmaceuticals in the water.  
P. How certain are you about the levels of concern you just expressed?  
Q. I feel prepared to participate in a pharmaceutical take back initiative.  
R. I feel motivated to participate in a pharmaceutical take back initiative.

Please rate the following statements.  

<table>
<thead>
<tr>
<th>Please rate the following statements.</th>
<th>Yes, already feeling the effects (1)</th>
<th>Yes, but in the near future (2)</th>
<th>Yes, but in the far future (3)</th>
<th>Maybe, I’m not sure (4)</th>
<th>No, don’t think the effects will be felt (5)</th>
</tr>
</thead>
</table>
S. Do you think local residents will feel the effects of pharmaceuticals in the water?  

| 1 | 2 | 3 | 4 | 5 |

T. Do you think people in other areas around the world will feel the effects from the presence of pharmaceuticals in the water?  

| 1 | 2 | 3 | 4 | 5 |

U. Do you think the local aquatic environment will feel the effects from the presence of pharmaceuticals in the water?  

| 1 | 2 | 3 | 4 | 5 |

V. Do you think aquatic environments in other places around the world will feel the effects from the presence of pharmaceuticals in the water?  

| 1 | 2 | 3 | 4 | 5 |

W. Rank the following factors from most to least important when considering participating in a take back initiative (options presented on index cards and physically arranged by respondent).

- My values
- The convenience of the program (e.g. location and hours of operation)
- My concern for society in general
- Accessibility of information for the program
- My concern for myself
- The timeframe in which pharmaceuticals are entering the environment
- The environmental impact
- The proximity of the issue for this area
- The global impact of this issue.
After viewing the second Safe Drug Disposal Advertisement:

<table>
<thead>
<tr>
<th></th>
<th>Strongly Agree (1)</th>
<th>Mildly Agree (2)</th>
<th>Mildly Disagree (3)</th>
<th>Strongly Disagree (4)</th>
<th>Unsure (5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. My local area is likely to be affected by the presence of pharmaceuticals in the water.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>B. The presence of pharmaceuticals in the water will mostly affect areas that are far away from here.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>C. People like me are likely to be affected by the presence of pharmaceuticals in the water.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>D. Other people who are not like me are likely to be affected by the presence of pharmaceuticals in the water.</td>
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<td>E. Scientists are uncertain about the presence of pharmaceuticals in the water.</td>
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<td>I. It is uncertain if the presence of pharmaceuticals in the water will have any effects on people.</td>
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<td>5</td>
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<tr>
<td>J. When I think about people like me, I am concerned about the presence of pharmaceuticals in the water.</td>
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<td>3</td>
<td>4</td>
<td>5</td>
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K. When I think about my local area, I am concerned about the presence of pharmaceuticals in the water. 1 2 3 4 5

L. When I think about the near future, I am concerned about the presence of pharmaceuticals in the water. 1 2 3 4 5

M. When I think about other people who are different from me, I am concerned about the presence of pharmaceuticals in the water. 1 2 3 4 5

N. When I think about the distant future, I am concerned about the presence of pharmaceuticals in the water. 1 2 3 4 5

O. When I think about areas around the world, I am concerned about the presence of pharmaceuticals in the water. 1 2 3 4 5

P. How certain are you about the levels of concern you just expressed? 1 2 3 4 5

Q. I feel prepared to participate in a pharmaceutical take back initiative. 1 2 3 4 5

R. I feel motivated to participate in a pharmaceutical take back initiative. 1 2 3 4 5

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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
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</table>

89
S. Do you think local residents will feel the effects of pharmaceuticals in the water?  
T. Do you think people in other areas around the world will feel the effects from the presence of pharmaceuticals in the water?  
U. Do you think the local aquatic environment will feel the effects from the presence of pharmaceuticals in the water?  
V. Do you think aquatic environments in other places around the world will feel the effects from the presence of pharmaceuticals in the water?  

W. Rank the following factors from most to least important when considering participating in a take back initiative (options presented on index cards and physically arranged by respondent).  
   My values  
   The convenience of the program (e.g. location and hours of operation)  
   My concern for society in general  
   Accessibility of information for the program  
   My concern for myself  
   The timeframe in which pharmaceuticals are entering the environment  
   The environmental impact  
   The proximity of the issue for this area  
   The global impact of this issue.
Over-the-counter medicine
Over-the-counter medicines are drugs that you can buy at a pharmacy without a prescription from your doctor, for example aspirin. *Note – you will not be asked about what pharmaceuticals you purchased or used.

7. In the past 12 months, have you purchased any over-the-counter medications?
   Yes
   No

8. Did you use all of the over-the-counter medications that you purchased in the past 12 months?
   Yes, I used all of these medications and there was none leftover.
   I am still using the medication.
   No I didn’t use it all, there was some leftover.

   a. If no, why was there some leftover? (If multiple medications, check all that apply.)
      More came in the package than I needed.
      I used it until I felt better, then stopped using it.
      It didn’t work for me so I stopped using it.
      Other (please explain):

   b. If there was some leftover, what did you do with the leftover over-the-counter medication? (If multiple medications, check all that apply.)
      I still have it.
      I threw it away.
      I gave it to a friend or family member.
      Other (please explain):

9. If you threw medication away in the past 12 months, how did you dispose of the drugs? (If multiple medications, check all that apply.)
   Flushed them (for example, down the toilet or down a sink).
   Threw them out in the garbage.
   Took them to the National Drug Take-Back Day.
   Other: ____________________________
   I didn’t throw leftover over-the-counter medication away in the past 12 months.
Prescription medicine

Prescription medications are drugs that you need a prescription from a doctor to obtain. Some examples include birth control pills, anti-depressants and antibiotics. *Note – you will not be asked about what pharmaceuticals you purchased or used.

10. In the past 12 months, have you purchased any prescription medication?
   Yes
   No

11. Did you use all of the prescription medications that you purchased in the past 12 months?
   Yes, I used all of these medications and there was none leftover.
   I am still using the medication.
   No I didn’t use it all, there was some leftover.

   a. If no, why was there some leftover? (If multiple medications, check all that apply.)
      More came in the package than I needed.
      I used it until I felt better, then stopped using it.
      It didn’t work for me so I stopped using it.
      Other (please explain):

   b. If there was some leftover, what did you do with the leftover prescription medication? (If multiple medications, check all that apply.)
      I still have it.
      I threw it away.
      I gave it to a friend or family member.
      Other (please explain ________)

12. If you threw medication away in the past 12 months, how did you dispose of the drugs? (If multiple medications, check all that apply.)
   Flushed them (for example, down the toilet or down a sink).
   Threw them out in the garbage.
   Took them to the National Drug Take-Back Day.
   Other: ________________________________
   I didn’t throw leftover prescription medication away in the past 12 months.
**Pharmaceutical waste disposal options**

13. Have you heard about drug collection programs?
   - Yes
   - No

14. Have you ever taken unneeded medications to a drug collection program?
   - Yes
   - No

15. If no, why not?
   - I’ve never heard of this.
   - I’ve heard of it, but never had medication to throw out.
   - I’ve heard of it, but I didn’t know when or where it was held.
   - I’ve heard of it, but I couldn’t make it to the time or location where it was held.
   - I’ve heard of it, but didn’t feel comfortable taking drugs there.
   - Other (please explain):
   ____________________________________________________________
16. Please rate your agreement with the following statements.

<table>
<thead>
<tr>
<th></th>
<th>Strongly Agree (1)</th>
<th>Mildly Agree (2)</th>
<th>Mildly Disagree (3)</th>
<th>Strongly Disagree (4)</th>
<th>Unsure (5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. We are approaching the limit of the number of people the Earth can support.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>B. Humans have the right to modify the natural environment to suit their needs.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>C. When humans interfere with nature it often produces disastrous consequences.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>D. Human ingenuity will insure that we do not make the Earth unlivable.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>E. Humans are seriously abusing the environment.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>F. The Earth has plenty of natural resources if we just learn how to develop them.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>G. Plants and animals have as much right as humans to exist.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>H. The balance of nature is strong enough to cope with the impacts of modern industrial nations.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>I. Despite our special abilities, humans are still subject to the laws of nature.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>J. The so-called “ecological crisis” facing humankind has been greatly exaggerated.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>K. The Earth is like a spaceship with very limited room and resources.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>L. Humans were meant to rule over the rest of nature.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>M. The balance of nature is very delicate and easily upset.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>
N. Humans will eventually learn enough about how nature works to be able to control it.

O. If things continue on their present course, we will soon experience a major ecological catastrophe.
Demographic Information

17. Please select your current status:
   - First-year undergraduate
   - Sophomore undergraduate
   - Junior undergraduate
   - Senior undergraduate
   - Master’s level graduate student (MS, MA, MPH, MBA, MEd, etc.)
   - Doctoral level graduate student (PhD, MD, DNP, etc.)
   - Other (please explain _____)

18. What is your current major and/or degree program?
   - Major:
   - Degree Program:

19. Where are you from (hometown)?
   _____________________________
   (City, State)

20. Where do you live now?
   - In Burlington
   - Outside of Burlington

21. If you live in Burlington, please select where you live:
   - On campus
   - Off campus

22. Please select your political affiliation.
   - Democrat
   - Republican
   - Independent

23. Please select your gender:
   - Male
   - Female

24. Please select your race: (check all that apply)
   - Black or African American
   - Caucasian or White
   - Asian or Pacific Islander
   - American Indian or Alaska Native
   - Other (Please describe) __________

25. Please select your ethnicity:
   - Hispanic or Latino/Latina
   - Not Hispanic or Latino/Latina

26. To the best of your ability, please select your family’s combined annual income:
   - Less than $15,000
   - $15,000 - $24,999
   - $25,000 - $44,999
   - $45,000 - $64,999
   - $65,000 - $84,999
   - $85,000 - $99,999
   - $100,000 - $200,000
   - More than $200,000

Thank you for completing this survey! For more information on how to properly dispose of unused medications, please visit
CHAPTER 5: CONCLUSION

Pharmaceutical pollution is one of the many complex socio-ecological issues that threatens human and environmental health. Consumer attitudes and behaviors, including disposal of leftover medications, significantly contribute to the presence of pharmaceutical chemicals in water systems. Encouraging responsible household drug disposal practices, such as participation in drug collection initiatives, is a sound first step towards addressing this problem.

The purpose of this study was to better understand public perceptions of aquatic pharmaceutical contamination and how those perceptions can be effectively framed by risk communications to promote safe drug disposal. Applying construal level theory of psychological distance along with conceptual metaphor theory, we found that aquatic pharmaceutical contamination was initially perceived as psychologically distant and proximal depending on the dimension of distance. At baseline, people more strongly agreed the issue was geographically and socially distant and expressed higher concern for other areas and people. People believed the issue was certain (near) and equally temporally proximate and distant. People felt equally concerned about impacts in the near and far future. People felt more motivated (high-level construal) than prepared (low-level construal) to participate in drug collection programs, consistent with the perception that the issue is psychologically distant.

We found metaphor may be a useful tool for reducing the psychological distance of aquatic pharmaceutical pollution in risk communications. Compared to baseline
perceptions and the non-metaphor treatment, using metaphor to frame the issue of aquatic pharmaceutical contamination significantly reduced the perceived psychological distance of the issue, specifically across geographic and social dimensions of distance. Reducing psychological distance is particularly important when an issue is perceived as abstract (high level construal) but requires a specific individual action (low level construal). Since baseline results indicate aquatic pharmaceutical pollution is perceived as an abstract issue by people considering taking the specific action of participating in drug collection programs, reducing the psychological distance in risk communications is important for encouraging action. Additionally, reduced psychological distance has been shown to increase concern and preparedness to act on an issue.

We did not find a direct influence of metaphor on attitudes or behavioral intentions, which is consistent with research suggesting psychological distance mediates the impact of message manipulations, like metaphoric-framing, on concern and preparedness to act. Our sample size was too small to assess whether metaphor indirectly impacted concern and preparedness to act by reducing psychological distance. Importantly, a majority of participants in both treatment groups preferred the metaphoric framing intervention to the non-metaphoric message manipulation.

While other studies have explored how framing psychological distance affects metaphor use, this study is the first that we know of to assess how metaphor use impacts perceived psychological distance. Our findings contribute to a growing body of theoretical literature exploring the utility of psychological distance and conceptual metaphor theory in understanding how people process and form cognitive judgements on
everyday stimuli. Additionally, results from this study have practical applications for designing risk communications that effectively promote public engagement and action on the issue of aquatic pharmaceutical contamination.

**Future Research Directions**

Based on our results we suggest several directions for future research. In this study, we intentionally used a small, targeted sample. To pursue a more generalizable assessment of the impact of metaphor use on psychological distance, as well as to assess whether psychological distance mediates the impact of the message manipulation on concern and preparedness to act, we recommend a much larger and randomized sample. We advise rigorous pilot testing and additional use of cognitive interviewing in the development of materials and methods for this next stage to ensure consistency with the current study.

The literature on cognitive metaphor theory suggests that different metaphors have different impacts on attitudes and behaviors. Similarly, it is well documented in the environmental communication literature that common nature metaphors – such as nature personified, nature as resource, nature as home (Ivakhiv, 2001), nature as object or mechanism (Larson, 2011) and nature as body (Jackson, 1983) – implicitly and explicitly embed conceptual frameworks in everyday discourse that guide different actions, beliefs, values and concerns towards nature (Allan, 2007; Cronon, 1995; Ivakhiv, 2001). For example, the news headline “Haitians, Battered by Hurricane, Huddle in Caves” (Ahmed,
implies nature as foe to defend oneself against (Cronon, 1995); whereas the headline, “Our Consumption of Earth’s Natural Resources Has More Than Tripled in 40 Years” (Mosbergen, 2016) communicates nature as resource, implying the Earth produces “things” for human use. Therefore, we suggest exploring how other nature metaphors may impact perceived psychological distance compared to the “nature as body” metaphor used in this study.

Finally, we recommend addressing the need for standardized, validated language framing each dimension of psychological distance that can be applied to studies across disciplines and topic areas. As psychological distance becomes an increasingly popular framework for measuring perceptions, attitudes and behaviors, it is important to take steps to ensure consistency of key constructs across studies.


University City setting. *Science of the Total Environment* (572), 906-914. doi: [http://dx.doi.org/10.1016/j.scitotenv.2016.07.199](http://dx.doi.org/10.1016/j.scitotenv.2016.07.199)


