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# Risky Business: Millennials' Protection Motivation Factors for Norovirus Outbreaks on College Campuses

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Risky Business: Millennials' Protection Motivation Factors for Norovirus Outbreaks on College Campuses

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**Abstract**

The risk and severity of hNoV transmission is obscurely recognized to foodservice millennial customers. Most commonly associated with cruise ships, consumers are not aware of its full potential to strike at other locations, especially college campuses. For the foodservice industry and the university community, it is imperative that a proactive method for increasing millennials' motivation to practice mitigation methods emerges to reduce future hNoV outbreaks on college campuses. Research has shown that students can play a major role in the spread of hNoV on college campuses. Therefore, the purpose of these studies is to examine motivations for health protective behaviors of college-aged millennials through an exploratory combination of PMT and SCT. The proposed measurement models (i.e. Modified Threat Appraisals, Coping Appraisals, Handwashing Intentions, and Social Distancing Intentions) were re-validated through EFA and CFA. The subsequent structure model demonstrated perceived susceptibility to a hNoV infection on a college campus significantly and positively impacted millennials intentions to wash their hands and socially distance themselves from those who are sick when mediated by self-efficacy handwashing, response-efficacy social distancing and self-efficacy social distancing. This information is intended to be useful to health communicators to accurately and positively influence health protective behaviors among millennials and for increasing overall health hygiene related practices on college campuses.

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## Dedication

This edition of *Risky Business: Millennials Protection Motivation Factors for Norovirus Outbreaks on College Campuses* is dedicated to my Opa, Bert Wijfjes, who passed away before I could complete my Doctoral Degree.  Thank you for being the best grandfather a guy could ask for and I hope this accomplishment makes you proud. I love you.

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## List of Abbreviations

| | |
|---|---|
| ABHS | Alcohol-based Hand Sanitizer |
| ADF | Asymptotic Distribution Free Function |
| AGE | Acute Gastroenteritis |
| CaliciNet | National Electronic Norovirus Outbreak Network |
| CDC | Centers for Disease Control and Prevention |
| CFA | Confirmatory Factor Analysis |
| EFA | Exploratory Factor Analysis |
| EIP | Emerging Infections Program |
| EPA | Environmental Protection Agency |
| ERS | Economic Research Service |
| FDA | Food and Drug Administration |
| FSIS | Food Safety and Inspection Service |
| GI | Genogroup one |
| GII | Genogroup two |
| GII.4 | Genogroup two type 4 |
| HW.I | Handwashing Intentions |
| HIE | Human Intestinal Enteroids |
| HIV | Human Immunodeficiency Virus |
| hNoV | Human Norovirus |
| IMC | Instructional Manipulation Check |
| LTCF | Long Term Care Facility |
| ML | Maximum Likelihood |

| | |
|---|---|
| MTurk | Amazon Mechanical Turk |
| NCES | National Center for Educational Statistics |
| NORS | National Outbreak Reporting System |
| NoV | Norovirus |
| PCA | Principle Component Analysis |
| PMT | Protection Motivation Theory |
| RC.HW | Response Costs Handwashing |
| RC.SD | Response Costs Social Distancing |
| RE.HW | Response-Efficacy Handwashing |
| RE.SD | Response-Efficacy Social Distancing |
| RT-PCR | Reverse-Transcription Polymerase Chain Reaction |
| SCT | Social Cognitive Theory |
| SE.HW | Self-Efficacy Handwashing |
| SE.SD | Self-Efficacy Social Distancing |
| SEV | Severity |
| SEM | Structural Equation Modeling |
| SD.I | Social Distancing Intentions |
| SUS | Susceptibility |
| U.S. | United States |
| USDA | United States Department of Agriculture |
| VLP | Virus-like Particles |
| WHO | World Health Organization |
| WLSMV | Weighted Least Squares Mean and Variance Adjusted |

# CHAPTER I

## Introduction

Human norovirus (hNoV) outbreaks have wreaked havoc throughout many institutional settings, including college campuses as evidenced by the reported outbreaks in the past decade. These outbreaks infected hundreds of students per campus infected and caused some to close for a couple of days (CDC, 2016a; Logue, 2016; Peterson, 2015; Roberts, Archer, Renner, Heidel, VandeBunte, Brennan, Croker, Reporeter, Nakagawa-Ota, & Hall, 2009; Rocha, 2015). Most campuses released press statements urging students to follow vigilant hygiene practices, while others closed off sections and aggressively sanitized. Some were successful in containing the outbreak, while others suffered for an extended period of time (Ellis, 2017; Logue, 2016). These outbreaks commonly cost students, staff and faculty multiple days of missed classes and work as symptoms typically last 24 to 72 hours (CDC, 2016a; Ellis, 2017). Currently there are no vaccinations for hNoVs in circulation, however according to Lucero, Vidal and O'Ryan (2018), a vaccine is currently being developed and is in the clinical testing phase. Therefore, current risk mitigation relies upon disease prevention behaviors.

The majority of college-aged students fall into the millennial generation (Gallup, 2013). Having been born between 1982 and 2002, this generation is one of the largest consumer groups in history and one of the most digitally immersed groups with their constant connection to the internet through social media, news applications and smart mobile devices (Hosek & Titsworth, 2016; Morreale & Staley, 2016; Howe & Strauss, 2000). The National Center for Educational Statistics (NCES) estimated that as of Fall-semester 2017 about 20.4 million students were expected to attend American universities, most of which would be a part of the millennial generation, especially the incoming freshmen class (NCES, 2017).

With college campuses being close knit communities and multitudes of students living in fraternity and sorority houses, along with dormitories and other tighter living quarters, colleges tend to be an easy environment for various bacteria, viruses and other disease causing agents to be transmitted due to the aforementioned situational factors. Thousands of students live in dormitories across campuses and on average a typical college dorm is around 12 feet by 19 feet, shared between two people (Rees, 2010). This tight space provides about 228 square feet in total and is the responsibility of the students who reside there to clean and sanitize, while residence hall common areas and communal bathrooms are cleaned daily by a janitorial staff. Many fraternity and sorority houses follow the same sanitation practices and have similar, if not smaller living quarters. This again tends to be an excellent environment for pathogen transmission. In 2016 there was a hNoV outbreak at The Ohio State University (OSU) where hundreds of students fell ill (Logue, 2016). The OSU campus in total had 58,243 individuals split between students (45,289) and non-student employees (12,954) spread out over 2.78 miles (Granger, 2017). Even outside of dorms and areas with foodservice stations, colleges can have thousands of people crammed into a small radius, providing an ideal scenario for hNoV outbreaks. Human NoVs have shown to have great survivability on hard surfaces, difficult to properly sanitize, and have an immense tendency to spread rapidly through socially tight living communities (CDC, 2016a). Making college living facilities and foodservice areas exceptionally easy targets.

Noroviruses are globally recognized as the leading cause of acute gastroenteritis (AGE) (Bert, Scaioli, Gualano, Passi, Specchia, Cadeddu, & Siliquini, 2014; Freeland, 2016; World Health Organization, 2016). Noroviruses (NoV) belong to the family *Caliciviridae*. There are 7 genogroups (GI-GVII) and these groups can be subdivided into about 41 genotypes, making identification of specific strains tricky and labor intensive. Advanced molecular techniques, such as Reverse-Transcription Polymerase Chain Reaction (RT-PCR), are required for sequence identification (Verhoef, Hewitt, Barclay, Ahmed, Lake, Hall, & Vinje, 2015). GI genogroups are more likely to be involved with foodborne outbreaks and GII genogroups are more likely to be person-borne, with an emphasis placed on GII where there are 4 strains that are responsible for most human outbreaks (Verhoef et al., 2015). CDC reports that worldwide about 685 million cases of AGE each year are attributed to hNoVs (CDC, 2016b). Human NoVs typically display symptoms 12 to 48 hours after contaminated food or water has been consumed and last about 24-72 hours (CDC, 2014; Vinjé, 2015). High rates of transmission linked to the low infectious dose (as few as 18 viral particles) allow for tremendously high infection rates for hNoVs (CDC, 2014). The median infectious dose (i.e. 50% human infectious dose) is about 1,320 to 2,800 virions (Atmar et al., 2014). Human NoVs are environmentally stable and spread rapidly, especially in closed communities such as, cruise ships, assisted living facilities, retirement homes, colleges, and prisons (Bret et al., 2014; Verhoef et al., 2015; CDC, 2016a). Human NoVs have been shown to survive from one day to multiple weeks on hard surfaces (Escudero, Rawsthorne, Gensel, & Jaykus, 2012). Human NoVs can be transmitted through multiple routes: the fecal/oral route (e.g. consumption of contaminated food and/or drink), contact with contaminated surfaces, and close personal contact with an infected person (Bert et al., 2014; CDC, 2014). Common symptoms of AGE include, vomiting, loose watery stools (diarrhea), abdominal cramping, and nausea (CDC, 2016a; Vinje, 2015). Less common symptoms include low-grade fevers, headaches and myalgia (CDC, 2016a; Sharps, Kotwal, & Cannon, 2012). Vomiting in 50% or greater of cases is a commonality all CDC investigators use as part of the requirements individuals must have in order to be considered a case (along with other symptoms specified at the time of the outbreak); this is an important factor due to how many incidents of vomiting (especially in public places) can increase the severity of transmission of hNoVs (Booth, 2014; Lively, Johnson, Wikswo, Gu, Leon, & Hall, 2018). Previous case studies have denoted that incidences of public vomiting were thought to contribute to the rapid spread of hNoVs during outbreaks (Bert et al., 2014; Isakbaeva, Widdowson, Beard, Bulens, Mullins, Monroe, Bresee, Sassanot, Cramer, & Glass 2005; Wikswo, Cortes, Hall, Vaughn, Howard, Gregoricus, & Cramer, 2011). It has been theorized through electron microscopic studies that as many $3x10^7$ hNoV particles can potentially be distributed to the surrounding environment following an emetic episode based on a bolus of 30 milliliters (ml) (Caul, 1995; Evans, Madden, Douglas, Adak, O'Brien, Djuretic, & Stanwell-Smith, 1998; Kirby, Streby, & Moe, 2016). Booth (2014) discovered that splashes and droplets produced during projectile emesis (commonly associated with hNoV infection) can travel distances greater than 3 meters (m) forward spread and 2.6 m lateral spread, with a suggested area of 7.8 $m^2$ needing to be decontaminated and sanitized. This suggested area is one-third of the typical college dorm room size. For example, if a student were to get sick and vomit in their own dorm room, the probability of their roommate getting sick is likely increased due to the area needed to be sanitized being larger than one perceives and only having limited space in which to avoid the infected area (Booth, 2014). This reiterates the risk within the tight living facilities and social interactions commonly seen on college campuses being a potentially easy starting point for an outbreak. With hNoVs ability to survive in the environment for potentially weeks, is also important to utilize proper sanitation equipment that is intended to halt the spread of hNoVs. An example of proper sanitation procedures would be sanitizing using a chlorine bleach solution with a concentration of 1,000-5,000 ppm (parts per million) for about 15 minutes on non-food contact surfaces and 200 ppm on food contact surfaces (Arthur & Gibson, 2015; Baker, Vipond, & Bloomfield, 2004, FDA, 2017).

Annually in the United States (U.S.), hNoV outbreaks cause an estimated 21 million illnesses, 56-71 thousand hospitalizations and 570-800 deaths (CDC, 2016a). Noroviruses are one of the top five reigning pathogens allocating to domestically acquired foodborne illnesses in relation to economic costs. The Economic Research Service (ERS) estimates the annual costs of illness for health care and lost productivity for the top five pathogens related to foodborne illness in billions: (1) nontyphoidal *Salmonella* $3.7, (2) *Toxoplasma gondii* $3.3, (3) *Listeria monocytogenes* $2.8, (4) Norovirus $2.3, and (5) *Campylobacter* $1.9 (ERS, 2017). Universities can also incur heavy losses in the forms of missed or cancelled classes, and university healthcare services (Logue, 2016).

Previous research on hNoV prevention and mitigation primarily concerns cruise ships and most passengers were discovered to be unaware of the prevalence and severity of hNoV infections, refused to practice the proper hygiene/handwashing practices outlined, and failed to report their illnesses (Bert et al., 2014, Liu; Pennington-Gray, & Krieger, 2016). The majority of passengers were unaware of the severity of the issue and lacked proper knowledge levels to recognize symptoms, implement preventative actions, and manage their hNoV infections (Neri, Cramer, Vaughan, Vinje, & Mainzer, 2008). Overall, it is important to increase the public's knowledge of hNoVs and proper preventative/mitigation steps, however, with past research showing an unwillingness of select populations to learn and comply with preventative mitigation messages (Bert et al., 2014; Neri et al., 2008), the question arises as to how can the message be broadcast in a way that will linger in the public's mind and cause them to take necessary preventative actions (e.g. handwashing and social distancing)? In the case of cruise ships, a study by Wikswo et al., (2011) discovered that after passengers had been alerted to an outbreak on the vessel they were on as well as the severity of hNoV illness, about 90% of them reported an increase in hand washing. Since compliance with mitigation strategies were adhered to only after an outbreak on the vessel had occurred, it stands to reason that the fear of an already present infection could have had some influence over compliance. These results could hold true for college aged millennials, but no research currently exists on the subject. Increases in news coverage of hNoV outbreaks in fast food chains (e.g. Chipotle) and college campuses has heightened the public's risk perception and increased awareness, but a lack of mitigation knowledge still abounds (Ellis, 2017; Peterson, 2016; Rocco, 2017).

Aside from keeping good hygiene practices and being conscious of other people around you if you are sick, the CDC suggests frequent handwashing and social distancing to assist in increasing barriers to foodborne illnesses (CDC, 2016). Maintaining clean hands is one of the greatest ways to keep from spreading pathogens (CDC, 2016), especially after restroom use, touching your face and before eating, drinking or smoking. Social distancing for this study is defined as increasing the physical distance between yourself and someone who is sick (CDC, 2017; Wikswo, Cortes, Hall, Vaughan, Howard, Gregoricus, & Cramer, 2011). Avoiding people or places that may cause illness and spread pathogens aids in lowering the risk of getting sick. The behavior of humans is key in preventing hNoV outbreaks. Understanding what motivates a person to behave in a specific manner will aid in the planning of an intervention (Naidoo & Wills, 2000). Millennial college students need to be aware of the impact that their personal behaviors have upon the health and safety of their fellow college students. Since there exists an established information gap between self-reported and observed health-related behaviors, the focus needs to be placed upon compliance (Clayton, Griffith, & Price, 2003).

The Protection Motivation Theory (PMT) is a useful model for investigating underlying factors that direct individuals' behavioral habits (Rogers, 1975). The PMT helps to understand the effect of fear on an individual's intention to protect themselves (i.e. protection motivation) from a communicated threat. In the past it has been used in multiple personal health contexts, such as, obesity, cardiovascular disease, myopia, prevention of coronary heart disease, intention to consume functional foods to offset memory loss, and condom usage to prevent HIV/AIDS (Cox, Koster & Russel, 2004; Milne, Orbell & Sheeran, 2002; Lwin & Saw, 2007; Lwin et al., 2010; Redd, 2012; Plotnikoff & Higginbotham, 1995).

Social Cognitive Theory (SCT) has also been noted as a valuable theory for investigating behavioral intentions (Bandura, 1977; Benight & Bandura, 2004). SCT postulates that the feeling of sufficient threat by some potential or actual event should be coupled with the belief that outcomes can be influenced by one's ability to practice certain behaviors, there are no major barriers to these actions and that they will indeed alleviate the threat (Bandura, 1977; Becker, 1974; Benight & Bandura, 2004). This theory denotes that threat alone is not an inherent property of every event, but it is a relational property that is concerned with the match between perceived coping capabilities and the potentially harmful aspects of the environment (Benight & Bandura, 2004). Potential threats can be frightening to people who have doubts they can control the threats, but seemingly worriless to those who feel certain they can overcome the threats through meaningful solutions (i.e. self and response efficacy). Therefore, self-efficacy, response, efficacy, and response costs (i.e. coping appraisals in PMT) determine in large part, the subjective perilousness of the environment or communicated threat (Bandura, 1977; Benight & Bandura, 2004). Taking this into consideration, an exploratory model where threat appraisals relationship to protection motivations will be mediated by coping appraisals will be put into place.

This study will seek to create and validate four measurement models to create a structure model based on threat appraisals mediated by coping appraisals in relation to protection motivations. A pilot study will first be conducted to verify the utility of the survey and scales to be used. Principle Component Analysis (PCA) will be utilized to understand the various loadings of items on latent constructs and reduce the dimensionality of the instrument. The scales will be adapted accordingly and then the main study and data collection will begin. Utilizing the adjusted survey, primary data collection will begin and the data will be split in half and analyzed using exploratory factor analysis (EFA) for the first portion (i.e. sample 1) and then the second half of the data (i.e. sample 2) will undergo Confirmatory Factor Analysis (CFA), which will be utilized to validate the model.

The study will then investigate the link between threat appraisals mediated by coping appraisals in relation to health behavioral intentions utilizing the PMT and SCT. This model asserts that the higher the perceived threat, the more likely a person is motivated to change behavior as long as the coping strategy is seen as effective in reducing the threat (Rogers, 1983; Courneya & Hellsten, 2001). The PMT postulates that people respond to persuasive communication via cognitive processes that fall into two categories: threat appraisals and coping appraisals (Rogers, 1983; Courneya & Hellsten, 2001; Milne, Orbell & Sheeran, 2002). Perceived severity and vulnerability combine to form threat appraisals, while response efficacy, self-efficacy, and response costs make up an individual's coping appraisals (Rogers, 1983). With the addition of SCT, the exploratory model will examine the cognitive process of threat appraisals mediated by coping appraisals in relation to behavioral intentions. Structural equation modeling will be utilized to ascertain if the structure model can be used to predict behavior intentions. This study will employ an online survey to investigate how hNoV outbreaks on college campuses influence individual's intentions to engage in protection motivations (e.g. handwashing and social distancing). The lack of preponderance of messages and information about this topic in the general media offers an opportunity to see how increasing and targeting generational segments can impact behavioral intentions. Most of the previous research concerning transmission of hNoVs has been focused on the role of foodservice employees (Bidawin, Malik, Adegbunrin, Sattar, & Farber, 2004; CDC, 2007; De Wit, Widdowson, Vennema, De Bruin, Fernandes, & Koopmans, 2007; Dippold, Lee, Selman, Monroe, & Henry, 2003; Malek, Barzilay, Kramer, Camp, Jaykus, Escudero, Derrick, White, Gerba, Higgins, Vinje, Glass, Lynch, & Widdowson, 2009; Moe, 2009). However, current research efforts have switched to explore the role of guests, passengers, patrons, students, teachers, and all individuals in general who are not actively participating in food preparation, but are around foodservice stations and/or live/work in tight knit communities (Booth, 2014; Chapman, Witkop, Escobar, Scholorman, DeMarcus, Marmer, & Crum. 2011; Chimonas et al., 2008; Fisher, Almanza, Behnke, Nelson, & Neal, 2018; Isakbaeva et al., 2005; Liu et al., 2016; Neri et al., 2008; Wikswo et al., 2011). Many of these studies have found that outbreaks occurred due to an infected passenger or patron initially and spread to other individuals through person-to-person transmission, instead of food as the primary vehicle of transmission. Therefore, the objective of this study is to examine college-aged millennials underlying factors associated with their intentions to practice protective health related behaviors in relation to hNoVs.

**Purpose Statement**

One of the most serious dilemmas facing the hospitality's foodservice industry is how to effectively communicate the risks of hNoV outbreaks. In addition, the industry is perplexed on how to motivate individuals to practice mitigation methods. This study will seek to determine if the PMT combined with SCT can effectively be used to communicate to college-aged millennials' motivational factors that will reduce the risks associated with and prevention of hNoV infection. As well as investigate the link between individual's threat and coping appraisals, and their intentions to wash hands and socially distance themselves from others.

This study aims to contribute to the existing body of knowledge by offering theoretical and practical implications in regard to risk communication and college-aged millennials' motivational factors to practice hNoV mitigation methods in a health related context.

**Problem Statement**

The risk and severity of hNoV transmission is obscurely recognized to foodservice millennial customers, most commonly associated with cruise ships, consumers are not aware of its full potential to strike at other locations, especially college campuses. For the foodservice industry and the university community, it is imperative that a proactive method for increasing millennials' motivation to practice mitigation methods emerges to potentially reduce future hNoV outbreaks on college campuses.

Furthermore, as more millennials are living and working in closer quarters than previously, it is essential that millennials comprehend a model of risk communication associated with hNoVs to reduce potential losses affiliated with the virus and ultimately preventing the spread of the virus.

# CHAPTER II

## Literature Review

### Health Related Regulatory Agencies

As of now there are three main regulatory agencies who are in charge of protecting the health of the United States. They consist of the United States Department of Agriculture's Food Safety and Inspection Service (USDA, FSIS), the Centers for Disease Control and Prevention (CDC), and the Food and Drug Administration (FDA). In 1994 the CDC's Office of Infectious Diseases came out with a framework for preventing infectious diseases and methods of sustaining the essentials and innovating for the future (CDC, 1998; 2011). This framework was comprised of three primary components concerning infectious diseases like hNoVs. The three elements were as follows: to strengthen public health fundamentals, including surveillance, laboratory detection, and epidemiological investigation of infectious diseases; to identify and implement high-impact public health interventions in the hopes of reducing infectious diseases; to develop and advance policies which would help prevent, detect, and control infectious diseases (CDC, 1998; 2011). By increasing our knowledge and understanding of the effect of infectious diseases on human health, there exists opportunity to reduce human illness and potentially save lives. One of the best ways to start gathering this information is by outbreak surveillance systems that have been put in place on both the local and national level.

In response to the CDC's strategy on preventing infectious diseases, the Emerging Infections Program (EIP) was established in 1995. This would serve as a national resource tool for surveillance, prevention and control of emerging infectious diseases (CDC, 2017). The EIP consists of a network of state health departments, local health departments, academic institutions, other federal agencies, public health and clinical laboratories, infection prevention specialists, and healthcare providers (CDC, 2017). Many years later the National Outbreak Reporting System (NORS) was established by the CDC to collect reports for all enteric disease outbreaks caused by viral, bacterial, parasitic, chemical, toxin, and unknown agents, along with foodborne and waterborne outbreaks of non-enteric diseases. Outbreaks can be transmitted by consumption of contaminated food or water, contact with environmental sources, infected persons or animals, or unknown modes of transmission. Enteric illnesses can be characterized by symptoms such as diarrhea, nausea, and/or vomiting (CDC, 2018a). Soon after in 2009 the National Electronic Norovirus Outbreak Network (CaliciNet) was established (CDC, 2018b). CaliciNet is the national surveillance network for hNoVs at the federal, state, and local public health levels. It focuses on hNoVs, which are the leading cause of AGE and foodborne disease illness in the U.S., and is most utilized for linking outbreaks to a common source, such as contaminated food or water; monitoring circulating strains, and identifying any and all newly emerging strains, such as GII.4 Sydney (CDC, 2018b). CaliciNet is named after the primary family of viruses it focuses on, *Caliciviridae*. Their databases include information on genetic sequencing of hNoV strains associated with AGE outbreaks in the U.S., and basic epidemiologic data, including, but not limited to, transmission route and outbreak settings (CDC, 2018a).

Shortly after the creation of CaliciNet, the CDC established the Norovirus Sentinel Testing and Tracking (NoroSTAT) network in 2012 (CDC, 2016). This collaboration between nine state health departments and the CDC help to establish and maintain standard practices for hNoV outbreak reporting to the CDC surveillance systems with the overarching goal of improving the timeliness, completeness, and consistency of outbreak reporting (CDC, 2016). The information from this network is utilized to promptly evaluate current hNoV outbreak activity, compare it to previous years, and assess strain-specific characteristics, including how the frequency and severity of hNoV outbreaks are impacted by new strains. By utilizing this information, the public health sector strives to deepen their understanding of hNoVs and develop interventions to prevent them from spreading.

**Basics of Epidemiology**

The World Health Organization (WHO) defines epidemiology as the study of the distribution and determinants of health related states or events in specified populations, and the application of this study to control diseases and other health problems (WHO, 2018). Epidemiology is data driven and relies on systematic and unbiased approaches to the collection, analysis, and interpretation of data or outbreak data specifically in the case of hNoVs (CDC, 2012). Epidemiologists use systematic approaches to assess the *What* (diagnosis of the health event), *Who* (person or people involved), *Where* (place), *When* (time), and *Why/How* (causes, risk factors, and modes of transmission), of various health states or events. There are two essential concepts of epidemiology, population and comparison, and five core tasks: public health surveillance, field investigation, research, evaluation, and policy development (CDC, 2012). When completing these tasks, epidemiologists are typically part of a team dedicated to protecting and promoting the public's overall health. By examining differences in disease and injury occurrence in varying populations, epidemiologists can formulate hypotheses about risk factors and causes of outbreaks. Epidemiologists will usually utilize cohort or case-control studies to evaluate these hypotheses. The knowledge of basic principles of disease occurrence and spread in population is essential for implementing effective prevention and control measures, which makes epidemiology all the more important to implement (CDC, 2012).

The traditional epidemiologic triad model maintains that infectious diseases result from the interaction of agent, host, and environment. Specifically, transmission occurs when the agent leaves its reservoir (human, animal, environmental) or host through a portal of exit (path which a pathogen leaves its host), is conveyed by a mode of transmission (direct contact, droplet spread, airborne, vehicle-borne, vector-borne), and enters through an appropriate portal of entry (path in which a pathogen enters a susceptible host and can be the same path as the exit portal) to infect a susceptible host. This is often referred to as the chain of infection (CDC, 2012). Knowledge of the portals of entry and exit and modes of transmission provides a baseline for determining suitable control measures. Control measures will typically target the segment in the infection chain that is most susceptible to the intervention. Interventions will usually be directed at controlling or eliminating agents at the source of transmission, portals of entry, and increasing host's defenses (CDC, 2012). For hNoVs, appropriate interventions might be directed at controlling or eliminating the pathogen at its source by implementing proper handwashing techniques, social distancing oneself from infected people, environmental sanitation, proper hygiene for food-handlers, and appropriate food handling/preparation procedures. This study targets the source of infection by addressing intentions of college-aged millennials to practice proper handwashing techniques and to socially distance themselves from individuals on college campuses who are sick or infected.

**Millennials and College Living**

Millennials are one of the largest generational segments and are said to represent about one-third of the total U.S. population (The Council of Economic Advisers, 2014). The majority of college aged students fall into the millennial generation (Gallup, 2013). Having been born between 1982 and 2004, this generation is one of the largest consumer groups in history and one of the most digitally immersed groups with their constant connection to the internet through social media, news applications and smart mobile devices (Hosek & Titsworth, 2016; Morreale & Staley, 2016; Howe & Strauss, 2000). The U.S. Census Bureau estimated that in 2015 there were greater than 83 million millennials existing and this number would only continue to grow (Census Bureau, 2015). In Fall-semester of 2017 it was estimated that some 20.4 million students were expected to attend American Universities, most of which would be a part of the millennial generation, especially the incoming freshmen class (NCES, 2017). By 2026 NCES (2018) projects that college enrollment will have steadily increased by 13%, indicating enrollment growth trends will continue.

Currently it is estimated that about 40% of full-time students in public universities live on campuses, while about 40% live off-campus, and 20% live with their parents (Tellefsen, 2018). At private universities the number of full-time students living in dorms increases to 64% (Tellefsen, 2018). With almost half of most college student populaces living on campus, it becomes increasing important to make sure students understand there is an increased risk of illness from pathogens associated with living in such tight quarters and the methods to combat or prevent these risks. Previous research has shown that in general younger adults (aged 18-29), who are currently healthy, have existing perceptions of *invulnerability* to adverse health conditions, which has become an obstacle to health promotion and prevention strategies (Greening, 1997; Goldberg, Halpern-Felsher, & Millstein, 2002; Wurtele & Maddux, 1987). These perceptions subsequently make accurate threat appraisals among younger populations, such as millennials, difficult. However, Abraham, Sheeran, Abrams and Spears (1996) noted that a solution may reside in the use of group or peer affiliation. Abraham et al., (1996) discovered that young adults were able to be effectively evaluated on their severity of a health threat by determining that their peers, also suffered a high risk of the adverse health event in question, human immunodeficiency virus (HIV). Further evaluation of this type of operationalization could prove to be effective in the design and implementation of health promoting interventions. With this in mind the current study took into consideration the effect of peer influence on perceptions of invulnerability and decided to put the participants into the specified communal location of a college campus where they would have potentially immense person-to-person interaction. This would not only place them into peer situations, but also increase their chances of infection by hNoVs.

The CDC (2017) notes that's college campuses are at risk for communicable disease outbreaks, such as AGE caused by hNoVs, due to the high degree of person-to-person interactions and relatively crowded dormitory settings (Jewett, Cohen, Buckley, Leino, Even, Beavers, Brown, & Marano, 2016). Human NoVs are highly contagious and are easily transmitted through person-to-person contact, ingestion of contaminated food/water, or by touching contaminated surfaces (CDC, 2016a). The tight living quarters of residence halls (dorms), sorority/fraternity houses, and the commonly crowded classroom and communal dining areas (often self-serve) give hNoVs plenty of opportunities to infect people or for food to become contaminated (CDC, 2016; Jewett et al., 2016; Logue, 2016; Rees, 2014; Rocha, 2015). With the average college dorm room being about 228 square feet and shared by two people, the amount of close personal peer interaction is increased (Rees, 2014). This tight living space denotes a multitude of human interaction between two people on a regular basis, not to mention the other individuals living in the communal residence hall. This is a prime scenario for hNoVs as person-to-person contact with an infected individual is one of the many routes of transmission (CDC, 2016a). So if one roommate were to become infected, then there is a high possibility the other would as well, which could lead to the entire floor or dorm hall becoming infected. Dorm halls, depending on their size, can house anywhere from hundreds to thousands of students.

When one student falls ill or becomes infected with a pathogen, there is a high probability the others residing in the communal dorm will as well since they commonly share cafeterias, bathing areas, and restrooms (Roberts et al., 2009; Tellefsen, 2018). The same can be said for fraternity and sorority houses. This could also be attributed to hNoVs being environmentally stable. As seen from past outbreaks, environmental contamination contributed to numerous outbreaks in other housing facilities such as long term care facilities (LTCF) and hotels (Cheesbrough, Green, Gallimore, Wright, & Brown, 2000; Wu, Fornek, Schwab, Chapin, Gibson, Schwab, Spencer, & Henning, 2005). Common areas in residence halls, such as bathrooms, showers, dining areas, and recreational areas are cleaned daily, however the dorm room itself is typically only cleaned and sanitized by the residents (Miko, Cohen, Conway, Gilman, Seward, & Larson, 2012). This leads to concerns about the quality of the cleaning and sanitation process occurring within the dorm room. Miko et al., (2012) discovered that among college students in a New York university there was a large ranging frequency between once per day to never cleaning dormitory surfaces. The researchers also discovered that much of the cleaning that would occur in the dorm rooms would happen when a roommate was sick, thus propagating the idea that a motivated or planned behavior was occurring with the intent to reduce their chance of being infected or to improve their personal health (Miko et al., 2012). The idea of social norms was also utilized by Miko et al., (2012) as it was noted that freshmen placed more importance on disinfecting the living environment to mitigate illness when compared to sophomores, juniors, or seniors. Their data demonstrated that underclassmen may wish to participate, or be perceived as participating, in socially normative behaviors like personal and environmental hygiene more so than the upperclassmen (Miko et al., 2012). For the current study, this again reiterates the idea and need of a location where peer influence is constant. Thus, college campuses will be utilized as the location of this study in the thought that communal areas present the best chances for socially normative behaviors to occur.

**Norovirus Outbreaks on College Campuses**

Over the last few years there have been numerous hNoV outbreaks disrupting a multitude of college campuses since transmission of the virus has can be expedited due to the close contact with numerous individuals, shared living spaces, and variable hygiene habits of other students (CDC, 2016a; Logue, 2016; Miko et al., 2012; Peterson, 2015; Rocha, 2015). Although hNoV outbreaks occur throughout the year, about 80% of outbreaks take place between November and April (CDC, 2016a). According to the data reported to NORS between 2008 and 2016 there were 1,082 outbreaks, 68,342 illnesses, 92 hospitalizations and 1 death attributed to hNoVs in school and college settings reported by public health agencies (NORS, 2017). Within the past few years, Michigan, Ohio, Pennsylvania, California, Toronto, Massachusetts and Wisconsin have all reported colleges hit with hNoV outbreaks (Logue, 2016; Peterson, 2015; Roberts, Archer, Renner, Heidel, VandeBunte, Brennan, Croker, Reporeter, Nakagawa-Ota, & Hall, 2009; Rocha, 2015). In 2008 during an outbreak at a California university a total case count of 478 students out of approximately 32,000 were identified with an overall attack rate of 1.5% on the campus. The mean duration of the sickness was 2.4 days resulting in numerous students seeking medical attention and 2.1% of them being hospitalized due to dehydration. All students were asked to complete a web-based survey which was used for case ascertainment and risk factor analysis. Despite the survey, on-site interviews, and involvement of the county health department, there was no single event, residence hall, or eating venue implicated as a single risk factor. This led to the belief that they all may have played a part in the outbreak (Roberts et al., 2009).

In 2008, students and staff at a college in Michigan experienced a hNoV outbreak and suffered similar results. With approximately 3,200 students enrolled, 418 fit the case definition of gastroenteritis and 33 of the 630 faculty also matched the definition (Roberts et al., 2009). The county health department in conjunction with the local college decided to close campus for up to five days. Upon examination of stool specimens utilizing RT-PCR it was found that GI.4 was responsible. Interviews with the dining staff discovered that three of the workers had bouts of vomiting and diarrhea at the main campus dining facility before being sent home and that this was the likely cause of the outbreak (Roberts et al., 2009). In the same year a large university in Wisconsin with an approximate enrollment of 42,000 was hit by a hNoV outbreak. The outbreak was thought to start in a residence hall of about 1,150 students when two students from this hall visited campus medical facilities with symptoms of AGE. An investigation by local and state health departments along with campus health services was then initiated. Over the next few days additional cases surfaced from neighboring residence halls and sorority houses. In total there were 3,480 students living in 8 residence halls, and 2,700 students living in sorority or fraternity houses who could have been potentially infected. By the end of the outbreak a total of 156 cases had been identified and 93 of them came from the initial residence hall, 29 from neighboring residence halls, 9 from a nearby sorority house, and 25 who lived off campus. These final estimates did not account for underreporting by victims, which commonly happens in outbreak scenarios (Roberts et al., 2009). During these outbreaks all of the colleges informed their students via email of the potential outbreak, posted proper hand hygiene/sanitation signs, sent emails about handwashing procedures, avoiding people who are sick, and disinfection recommendations for dormitory rooms and bathroom surfaces and objects with bleach solution. Because of the potential for widespread infection by hNoVs and rapid transmission on college campuses, efforts to prevent and control outbreaks in these settings would benefit from focusing on hand hygiene, avoidance of ill students, exclusion of ill workers and education on environmental disinfection practices (Roberts et al., 2009).

A separate outbreak in 2015 at a smaller university in California, about 50 students were confirmed to have AGE caused by hNoV. The university and county health care agency quickly investigated the cause of the outbreak, but could not completely lock down a source. They did however hypothesize a communal foodservice area as a potential source and quickly shut it down and sanitized it to hospital standards (Rocha, 2015). Then again in 2016 outbreaks struck colleges in Michigan, Ohio and Pennsylvania (Logue, 2016). Approximately 200 cases were reported in Ohio, while 29 were found in California. More than 150 over the course of one week were reported in Michigan with only one student requiring hospitalization due to dehydration. Soon after another outbreak hit a university in Michigan that struck 375 students and faculty. The outbreak was traced back to the on-campus restaurant. The outbreak resembled that of the 2015 Chipotle hNoV outbreak that sickened nearly all of the 120 infected students at a nearby university in Boston, Massachusetts (Logue, 2016; Peterson, 2015).

Another outbreak occurred more recently, but was unrelated to educational settings. However, it was at a location where there were a high population of people residing in communal housing, interacting, and consuming food/water in communal areas. In February of 2018 the Winter Olympics in Pyeongchang, South Korea was the victim of a hNoV outbreak. In total 128 people were infected, with more than 1,000 people being quarantined (News Desk, 2018). The outbreak reportedly began when 97 cases had been reported at one of the local dormitories that housed many of the local security and staff members for the Olympics (News Desk, 2018). The tightknit living quarters of a dormitory more than likely increased the transmission rate of the hNoV outbreak, further indicating how precarious this virus can be in the right environments.

These incidences further reiterate the need for mitigation behaviors involving increased hand washing practices, avoiding people who are ill, and learning/performing appropriate environmental sanitation procedures. There is an increased need to understand the psychological determinants of such behavioral changes with millennials on college campuses. This study will seek to explore the underlying constructs related to these psychological determinants by examining college-aged millennials' coping and threat appraisals toward hNoV outbreaks on campus and how these constructs impact their intention to perform these protective health behaviors.

**Norovirus**

Human NoVs, previously known as Norwalk-like viruses, are genetically diverse RNA viruses belonging to the *Caliciviridae* family (Arthur & Gibson, 2015; Lindesmith, Moe, Marionneau, Ruvoen, Jiang, Lindblad, Stewart, LePendu, & Baric, 2003). Human Caliciviruses are a leading cause of AGE across the world (Love, Jiang, Barrett, Farkas, & Kelly, 2002). Human NoVs were originally identified as winter vomiting disease by John Zahorsky in 1929 (Alder & Zickl, 1969; Zahorsky, 1929). In 1972 they were first linked to human diseases when viral particles were identified using immunoelectron microscopy in stool samples from adult volunteers who had been inoculated with stool filtrates that were obtained from individuals in the 1968 AGE outbreak in Norwalk, Ohio (Dolin, 1978; Lucero, Vidal, O'Ryan, 2017). Human NoVs are viruses with positive-sense, polyadenylated, single-stranded RNA genome of approximately 7,500 nucleotides in length, that is protected by a non-enveloped protein capsid structure (Lucero, Vidal, O'Ryan, 2017; Schwab, Estes, & Atmr, 2000; Wu, Fornek, Schwab, Chapin, Gibson, Schwab, Spencer, & Henning, 2005). The capsid structure serves to protect the virus from environmental degradation which can be caused by elevated temperatures or dehydration. The capsid structure also serves to increase the resistance to chemical disinfectants, making it difficult to properly sanitize and eliminate (Schwab et al., 2000; Wu et al., 2005).

Human NoVs have been shown to survive from one day to multiple weeks on hard surfaces (Escudero et al., 2012). They are able to withstand both freezing and heating and are resistant to many common chemical disinfectants, making them environmentally stable and difficult to properly sanitize (Hall, 2012). NoVs have been shown to have extremely high rates of transmission due to a low infectious dose of about 18 viral particles (Teunis, Moe, Liu, Miller, Lindesmith, Baric, Pendu, & Calderon, 2008). The low infectious dose coupled with the copious viral shedding by infected persons (average $10^5$ – $10^9$ viral copies per gram of feces for an average of 8 to 60 days), even among asymptotic hNoV infections leads to elevated risks of the infection spreading to others who are not yet infected (Atmar, Opekun, Gilger, Estes, Crawford, Neill, & Graham, 2008; Hall, 2012; Teunis, Sukhrie, Vennema, Bogerman, Beersma, & Koopmans, 2014). After initial infection, hNoV may remain in a person's feces for two weeks or more, which allows others to still be contaminated despite the carrier no longer being symptomatic (CDC, 2016a). Human NoVs can be transmitted through multiple routes: the fecal/oral route, contact with contaminated surfaces, and close personal contact with an infected person, and ingestion via aerosolized particles that typically occur due to vomiting (Bert et al., 2014; CDC, 2014; Hall, 2012). Human NoVs typically display symptoms about 12-48 hours after contaminated food or water has been consumed and last about 24-72 hours (CDC, 2014; Vinjé, 2015). They cause self-limiting gastroenteritis which is typically diagnosed by symptoms of vomiting, loose watery stools (diarrhea), abdominal cramping, and nausea (CDC, 2016a; Vinje, 2015).

With vomiting being a commonality among all hNoV cases, past research has shown that vomiting (especially in public places) can increase the severity of transmission of hNoVs (Booth, 2014). Previous case studies have demonstrated that incidences of public vomiting were thought to contribute to the rapid spread of hNoVs during outbreaks (Bert et al., 2014; Isakbaeva, et al., 2005; Wikswo et al., 2011). Booth (2014) took note that during projectile vomiting, infected droplets can travel an area of $7.8m^2$. This area is about one-third the size of a common college dormitory room and reestablishes the risk within tight living facilities and social interactions, commonly seen on college campuses, being a viable starting point for hNoV outbreaks. Recently hNoV and its capability to be infectious through aerosolized particles was studied (Bonifait, Charlebois, Vimont, Turgeon, Veillette, Longtin, Jean, & Duchaine, 2015). Researchers discovered that air in hospital patients' rooms may contain up to 2,000 genomic copies/$m^3$, and that approximately 60 copies of hNoVs could be deposited on the worker's mouth and be ingested by healthcare workers caring for the symptomatic patient during a 5 minute stay in the room. For some individuals, this could be sufficient quantity to cause the disease (Bonifait et al., 2015). When compared to a dorm room situation, similarities can be drawn between spending time in a dorm room with one's symptomatic roommate and a healthcare worker spending time in a hospital room with a symptomatic patient. This could mean that by being in a dorm room or shared space with symptomatic individuals, one could become infected from sharing the air, which only stands to further reiterate the need to socially distance oneself from those who are sick in an effort to help prevent the spread.

Multiple strains of hNoVs have been implicated in outbreaks of AGE in various settings, including hotels, colleges, foodservice establishments (e.g. quick service and fine dining restaurants), hospitals, long-term care facilities, cruises, and other public gathering places (CDC, 2016; Cheesbrough et al., 2000; Evans, Meldrum, Lane, Gardner, Ribeiro, Gallimore, & Westmoreland, 2002; Vinje, 2015; Wu et al., 2000). There are 7 genogroups (GI-GVII) and these groups can be subdivided into about 41 genotypes, making identification of specific strains complicated and rigorous. Advanced molecular techniques, such as RT-PCR, are required for amplicon identification which can then be used for sequence identification (Verhoef et al., 2015). Primarily GI and GII have been associated with human AGE. The GI viruses are more frequently associated with environmental outbreaks, while GII are associated with person-to-person transmission and health-care associated outbreaks (Kirby, Streby, & Moe, 2016). Within these genogroups, GII.4 has been the most predominant cause of outbreaks worldwide (CDC, 2013b; Lucero, Vidal, O'Ryan, 2017). New strains of GII.4 viruses tend to emerge every 2 to 4 years and sometimes result in increased outbreak activity (CDC, 2013b).

Globally hNoV outbreaks are estimated to be responsible for 685 million cases every year (CDC, 2016b). Most deaths from hNoVs are seen in children, elderly patients, and those who are immuno-compromised. About 50,000 children in developing countries die each year due to hNoV infections. Severe dehydration brought on by the common symptoms of vomiting and diarrhea can sometimes lead to death (CDC, 2016a). Human NoV infections are a common problem in both low and high income countries around the world and is estimated to cost about $60 billion, which can primarily be attributed toward healthcare costs and lost productivity (CDC, 2016b). In this U.S. hNoVs account for about 21 million cases of AGE, about 71 thousand hospitalizations and approximately 800 deaths per year (CDC, 2016). It has an economic burden of about $2.3 billion in the U.S. and is ranked as one of the top five pathogens for highest annual costs of illness for health care and lost productivity (ERS, 2017). In terms of colleges, heavy losses can be incurred in the forms of missed or cancelled classes, university healthcare services, sanitation services, and temporary closure of the campus (Logue, 2016, Roberts et al., 2009). The costs associated with the illness caused by hNoVs are hypothesized to lessen if the development of a vaccine is successful (Baehner, Bogaerts, & Goodwin, 2016).

Rotavirus used to be the leading cause of AGE in children under 5, but due to the increasing use of the rotavirus vaccine, hNoV is now the most common as presently there exists no vaccine for it (CDC, 2016b). However, recently there have been enormous advances in the ability to study and culture hNoVs since they have now been cultured in the lab, something that was thought not to be probable since viruses need host cells in order to replicate (Bradshaw, 2016). With the creation and growth of miniature three dimensional intestines dubbed Human Intestinal Enteroids (HIE's) (Bradshaw, 2016; Ettayebi et al., 2016) scientists can now inoculate these intestines and allow researchers to recover thousands of times more genetic material than initially added. A team at Baylor University took it a step further and added bile, and the replication of hNoV was significantly improved. New abilities to culture hNoV in the lab will lead to the ability to test for vaccines, therapeutics and other various control measures for NoVs in humans, along with managing transmission. Recently a pharmaceutical company took on the challenge of developing a vaccine for hNoV (Baehner, Bogaerts, & Goodwin, 2016). Research was not related to the recent ability to culture hNoV in the lab, as the researchers pointed out that without a reliable high-yielding cell or animal model systems, they veered toward the development of vaccines using nonreplicating recombinant capsid proteins including virus-like particles (VLPs) and sub-virus sized P particles. The vaccine based on adjuvant VLPs from GI.1

genotype and a consensus GII.4 sequence which was created from three natural GII.4 variants. As of now the early clinical trials are showing good tolerability and robust immune responses in not only adults, but also children. The researchers and company hope to be able to lessen the substantial disease burden and cost associated with hNoV infections through vaccination (Baehner, Bogaerts, & Goodwin, 2016). In lieu of a vaccine being made, the CDC states some of the best ways to prevent an infection caused by hNoV is to regularly wash hands and avoid people who are sick (CDC, 2016a).

**Norovirus Prevention Methods of Interest: Handwashing & Social Distancing**

**Handwashing.** As defined by the CDC (2016c), handwashing is carefully washing one's hands for at least 20 seconds with soap and running water. With hNoVs being environmentally stable (able to survive extended periods of time on hard surfaces), the environmental surfaces that comes into contact with ones hands becomes a potential fomite (Escudero et al., 2012; Sharps, Kotwal, & Cannon, 2012). A fomite is defined as any material capable of carrying infectious organisms (Sharps, Kotwal, & Cannon, 2012). Since one of hNoVs' paths of transmission is contact with infected environmental surfaces, the importance of washing ones hands is elevated (CDC, 2016a). In Sharps, Kotwal, and Cannon's (2012) study on the transfer of hNoVs from hands, to stainless steel, to small fruits, it was discovered that the transmission rate of hNoVs ranged from 1 to 50% for wet transfer and 2 to 11% for dry transfer of the virus. Wet surfaces had a substantially higher rate of transmission than dry surfaces, emphasizing the need for proper drying upon completion of the handwashing procedure. The CDC (2016a) recommends cleaning contaminated surfaces with soapy water, rinsing thoroughly with clean water and then wiping dry with disposable towels. Following this process one should sanitize using a chlorine bleach solution with a concentration of 1,000-5,000 ppm (parts per million) for about 15 minutes on non-food contact surfaces and 200ppm on food contact surfaces (Arthur & Gibson, 2015; Baker, Vipond, & Bloomfield, 2004; FDA, 2017). In an environmental study for monitoring enteric viruses in a pediatric primary immunodeficiency unit, researchers discovered that toilet taps (e.g. sink handles) in bathrooms were the most heavily contaminated surface with hNoV (Gallimore, Taylor, Gennery, Cant, Galloway, Iturriza-Gomara, & Gray, 2005). Similarly in a study performed on passengers abroad a cruise ship in Alaska that was hit with a hNoV outbreak, researchers discovered that women's toilets that were contaminated with vomit were positively associated with obtaining AGE from hNoV (Chimonas, Vaughan, Andre, Ames, Tarling, Beard, Widdowson, & Cramer, 2008). This again emphasizes the need for proper cleaning of environmental surfaces, especially those at a higher risk (e.g. bathroom surfaces), and proper handwashing after using the bathrooms.

The CDC (2016c) suggests that individuals wash their hands carefully with soap and water before drinking, eating, preparing or handling food, before smoking, touching ones' face and after using the toilet, changing diapers, blowing ones' nose, coughing, sneezing, touching animals, animal feed or wastes, and after touching garbage. Doing so will help reduce the spread of diseases. It is estimated that thoroughly washing with soap and running water for about 20 seconds can prevent 1 in 3 diarrhea-related sickness and 1 in 5 respiratory infections, such as a cold or the flu (CDC, 2017b). If soap and water are not available to clean ones' hands, the next best option would be to use an alcohol-based hand sanitizer (ABHS) that contains at least 70% alcohol (CDC, 2016c), but research on the effectiveness of alcohol based hand sanitizers remains controversial (Blaney, Daly, Kirkland, Tongren, Kelso & Talbot, 2011; Bloomfield, Aiello, Cookson, O'Boyle, & Larson, 2007; Liu, Yuen, Hsiao, Jaykus, & Moe, 2010; Park, Barclay, Macinga, Charbonneau, Pettigrew, & Vinje, 2010). Blaney et al., (2011) discovered that preferential use of ABHS over soap and water for daily hand hygiene could be associated with an increased risk of hNoV outbreaks in LTCF. In a study concerning hNoV cross-contamination during food handling, it was discovered that rates of transmission of hNoV from contaminated hands to food were higher than transfer of the virus from food to clean hands (Bidawid, Malik, Adegbunrin, Sattar, & Farber, 2004). This study also indicated that when hands were cleaned with soap and water, there was less of the virus transferred than when hands were cleaned with an ABHS (Bidawid et al., 2004). Similar results were seen in Lie et al., (2007) where researchers observed through RT-PCR that soap and water used for at least 20 seconds when washing hands reduced hNoV by 0.7 – 1.2 $\log_{10}$. The importance of handwashing and its ability to reduce pathogens is seen in numerous studies (Bidawin et al., 2004; Blaney et al., 2011; Liu et al., 2007; Macinga, Sattar, Jaykus, & Arbogast, 2008; Sickbert-Bennett, Weber, Gergen-Teague, Sobsey, 2005). This stands to emphasize the importance of handwashing as a preventative or protective measure against hNoVs. Another useful preventative measure as outlined by the CDC (2017) is social distancing.

**Social Distancing.** The CDC (2017) defines social distancing as increasing the physical distance between yourself and someone who is sick. This is an important preventative measure for hNoV infections since it has the ability to be passed along from person to person through close personal contact and in an aerosolized form (Bert et al., 2014; CDC, 2014). In a hNoV outbreak on a cruise ship, Chimonas et al., (2008) noted that behavioral factors among infected or the population under examination are crucial in attenuating the risk for disease transmission during hNoV outbreaks. The researchers noted that the voluntary isolation period of 48 hours was thought to help reduce symptomatic passengers from exposing other passengers to increased numbers of contaminated public surfaces, fomites, and direct contact with an infected person

(Chimonas et al., 2008). This study used a form of social distancing (e.g. voluntary isolation) in an effort to reduce the burden of the outbreak. Similarly, during a hNoV outbreak at U.S. Air Force Academy, numbers of new cases were thought to be increasing due to the close person-to-person interaction of the cadets. It was not until after the cadets were segregated into separate tents to recover that the outbreak began to taper off (Chapman, Witkop, Escobar, Schlorman, DeMarcus, Marmer, & Crum, 2011). This study again reiterated the need for social distancing among infected personnel to help alleviate the burden of the outbreak and reduce the overall spread. Similar to college students, cadets on the airbase lived in dormitories shared by multiple individuals, which was thought to facilitate the spread of hNoV (Chapman et al., 2011). The need to educate and inform college students, especially those living in communal dorms, about preventative measures regarding hNoVs is again highlighted in these studies since close personal interaction with infected or symptomatic individuals is attributed to higher risks of illness propagation.

Social distancing as a preventative measure is also important since hNoVs can be spread in an aerosolized form as well. In a study of hNoV outbreaks in eight healthcare facilities, researchers discovered that hNoV particulates from infected individuals experiencing vomiting or diarrhea could become aerosolized (Bonifait et al., 2015). Those sharing a space with these individuals were at an increased risk of infection due to the amount of particulates in the air. The researchers also went on to note that significant concentrations of human hNoV genomes were also detected in the air of corridors and nursing stations, not just the rooms where infected people were stationed. This suggests that hNov particulates could remain suspended in the air for prolonged periods of time (5 to 10 minutes at least), giving life to a new route of transmission via air (Bonifait et al., 2015). These studies again demonstrate the need for social distancing as a preventative measure against hNoV infections and how crucial it is to be compliant with social distancing measures. The question of how to motivate individuals to practice mitigation behaviors is then put into motion. As seen in previous literature (Lwin et al., 2010; Lwin & Saw, 2007; MacDonell, Chen, Yan, Li, Gong, Sun, Xiaoming, & Stanton, 2013; Milne, Orbell & Sheeran, 2002; Plotnikoff & Higgginbotham, 1995), protection motivation theory (PMT) can be a useful aid in determining motivational factors for groups of people to practice healthy or preventative behaviors.

**Protection Motivation and Social Cognitive Theory**

Protection motivation theory was first developed by Rogers in 1975 (Rogers, 1975). The PMT is a useful model for the investigation of underlying factors that influence individuals' behavior patterns. This theory put forth the notion that fear is the basis of motivation for behavior change. The theory originally only included three parts: (1) severity of the threat, (2) susceptibility to the threat, and (3) belief in the usefulness of the behavior change (Rogers, 1975). A few years later Rogers (1983) revised the model to include response efficacy as a coping appraisal. The model was revised further by Maddux and Rogers (1983) with the addition of self-efficacy theory, which was first put forth by Bandura (1977) and maintains that all processes of psychological change operate through the change of a persons' expectancies of personal efficacy. This new addition suggested that a communicated danger to the individual may be prevented by a change in behavior. The addition added self-efficacy, response-efficacy and response costs to the coping appraisals section of the model. The PMT postulates that an adaptive or maladaptive coping response is the result of two cognitive appraisal processes, threat and coping appraisals (Rogers and Prentice-Dunn, 1997). Figure 1 shows the overall model for the PMT process put forth by Rogers and Prentice-Dunn (1997). Numerous sources of information may initiate the cognitive mediating process in which the PMT focuses. These sources can be categorized as environmental or intrapersonal (Rogers & Prentice-Dunn, 1997).

Threat appraisals evaluate the maladaptive behavior and is comprised of perceived severity and susceptibility to the health threat (Rogers, 1983; Rogers & Prentice-Dunn, 1997). The severity and susceptibility of a threat will decrease the probability of selecting maladaptive responses. Perceived severity is defined as how serious an individual perceives a threat would be to his or her own life (Milne, Sheeran, & Orbell, 2000; Rogers, 1975). While perceived susceptibility is defined as how personally vulnerable an individual feels to the communicated threat (Milne, Sheeran, & Orbell, 2000; Rogers, 1983). If a threat is not perceived as severe, or if nothing can be done to address the threat, then no protection motivation response will be aroused, meaning there would be no change in behavior intentions (Lwin & Saw, 2007; Rogers, 1975).

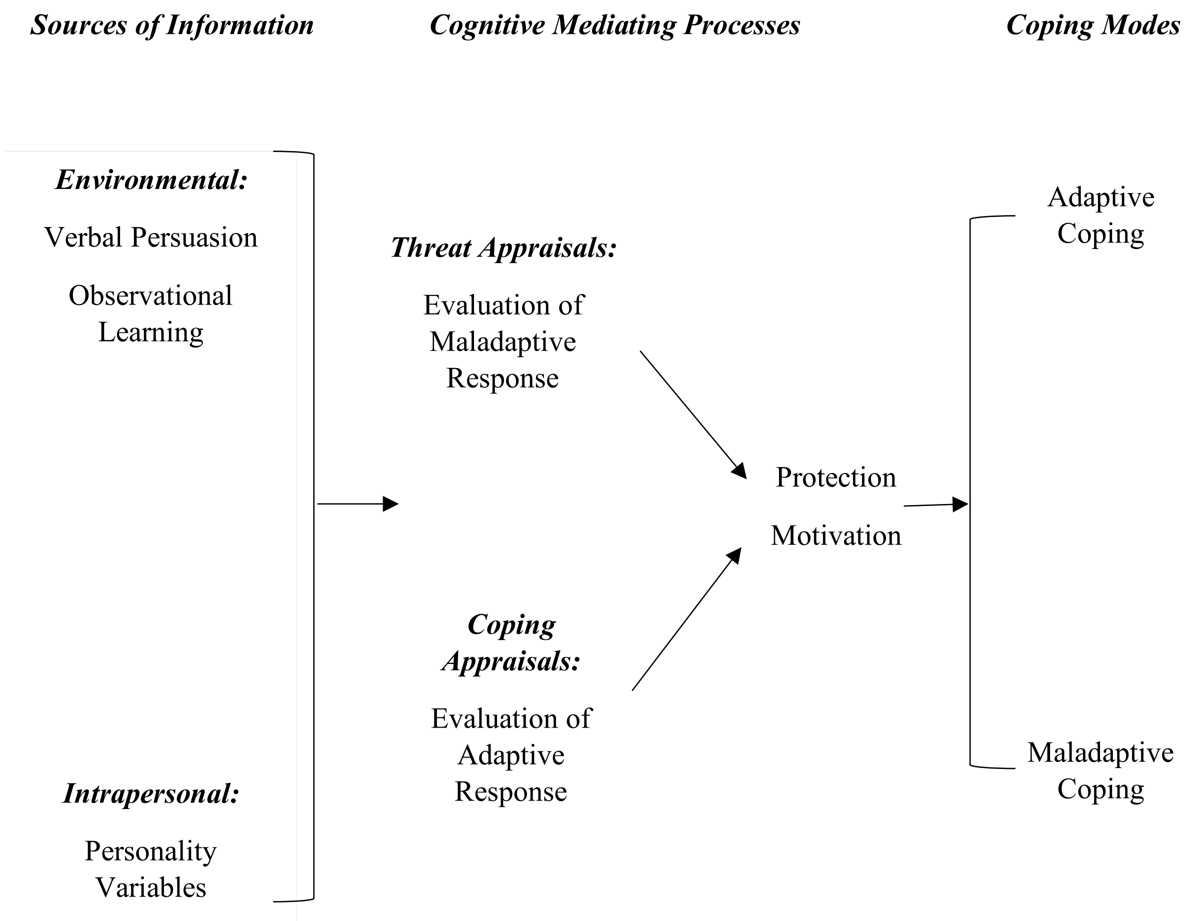


*Figure 1.* Full protection motivation theory model (adapted from Rogers and Prentice-Dunn, 1997).

Coping appraisals evaluate the adaptive response that would avert the threat and involves the belief that the recommended response would be effective in preventing the threat in question (i.e. response-efficacy). It also assesses the belief that an individual can effectively carry out the recommended preventative behavior (i.e. self-efficacy) (Maddux & Rogers, 1983). The third component to coping appraisals is response costs and they are defined as any perceived barriers to completing or accepting the adaptive coping response (Maddux & Rogers, 1983; Rogers, 1983). Self-efficacy and response efficacy have been noted to increase the probability of selecting the adaptive response, while response costs have been noted to decrease the probability of selecting the adaptive response (Boer & Seydel, 1996; Lwin & Saw, 2007; Rogers & Prentice-Dunn, 1997).

The PMT model has been applied to populations of adults, adolescents, and children in numerous health aspects including, but not limited to, HIV, myopia, obesity, and coronary heart disease and hNoVs on cruise ships (Boer & Seydel, 1996; Fisher, Almanza, Behnke, Nelson & Neal, 2018; Lwin & Saw, 2007; Lwin, Stanaland, & Chan, 2010; Milne, Sheeran, & Orbell, 2000; Plotnikoff & Higginbotham, 1995, 2002; Wong, Gaston, DeJesus, & Prapavessis, 2016). All of which found PMT to be an effective predictor of health protection behaviors. Most studies were as predicted, when perceived severity, susceptibility were high, individuals had a greater intention to practice protection motivations. Similarly, when self-efficacy and response-efficacy were high, individuals had better ratings of the corresponding protection motivations (i.e. intention to practice healthy behaviors), while response costs were a negative influence on protection motivations (Boer & Seydel, 1996; Lwin & Saw, 2007; Norman, Searle, Harvard & Vedhara, 2003; Plotnikoff & Higginbotham, 1995, 2002; Wong et al., 2016). The addition of efficacy has been shown to improve the overall predictive utility of the PMT, as research consistently demonstrates that self-efficacy expectancies are excellent predictors of intentions and behaviors (Maddux & Rogers, 1983; Rogers & Prentice-Dunn, 1996). The PMT model has been successful in explaining the underlying cognitive and psychological processes that motivate individuals to practice various health protective behaviors. As such, this study will utilize an adaptation of the PMT model which has been modified further by social cognitive theory's (SCT) explanation on self-efficacy (Bandura, 1989).

Since the addition of self-efficacy from Bandura's (1977) self-efficacy theory, later renamed social cognitive theory, threat and coping appraisal processes have typically been used as standalone mediating processes for protection motivation behaviors in health related contexts (Maddux & Rogers, 1983; Boer & Seydel, 1996; Lwin & Saw, 2007; Lwin, Stanaland, & Chan, 2010; Norman, Searle, Harvard & Vedhara, 2003; Plotnikoff & Higginbotham, 1995, 2002; Wong et al., 2016). However, taking into consideration the self-efficacy theory put forth by Bandura (1977), one should include the feeling of sufficient threat by some potential or actual event (i.e. severity and susceptibility), the belief that outcomes can be influenced by the practice of certain behaviors (i.e. self-efficacy and response efficacy), and that there are no major barriers to these actions (i.e. response costs). A number of research articles have denoted that many people fail to comply with medical advice or take health protective measures because they fail to exhibit much incentive or motivation about the health behavior; because they do not think it is likely they will contract an adverse health condition or its sequelae; because they do not believe the occurrence of the condition would seriously upset their lives; because they do not believe prevention or control of the condition is likely to occur through their own personal intervention abilities; or because they feel the effort required to mitigate or prevent the health problem exceeds their personal abilities (Becker, 1974; Becker & Janz, 1985; Becker & Rosenstock, 1984; Rosenstock, Strecher, & Becker, 1988). Bearing this in mind, Benight and Bandura (2004) noted how threat is not solely an inherent property of every event. They postulated that threat appears to be a relational property concerned with the match between perceived coping capabilities and the potentially harmful aspects of the environment. Potential threats can be frightful to people who have doubts that they can control the threats, but relatively harmless to those who feel certain they can override the threats. Therefore, self-efficacy, response-efficacy and response costs determine in large part, the subjective perilousness of the environment or communicated threat (Bandura, 1977, 1989; Benight & Bandura, 2004). Taking this into consideration, having copping appraisals (e.g. self-efficacy, response efficacy, and response costs) and threat appraisals (e.g. severity and susceptibility) as standalone cognitive processes (i.e. purely exogenous variables) within the PMT model brings into question the effectiveness of the model in predicting true human behavioral intentions in health related contexts. The combination of the PMT model with SCT will take the approach of a mediated model in which threat appraisals are mediated by coping appraisals in order to predict protection motivations. For hNoV outbreaks on college campuses, perceived severity and susceptibility for each individual during an outbreak, will be mediated by self-efficacy, response efficacy, and response costs in order to predict intentions to practice handwashing and social distancing behaviors. Figure 2 demonstrates the proposed mediation model for this study.

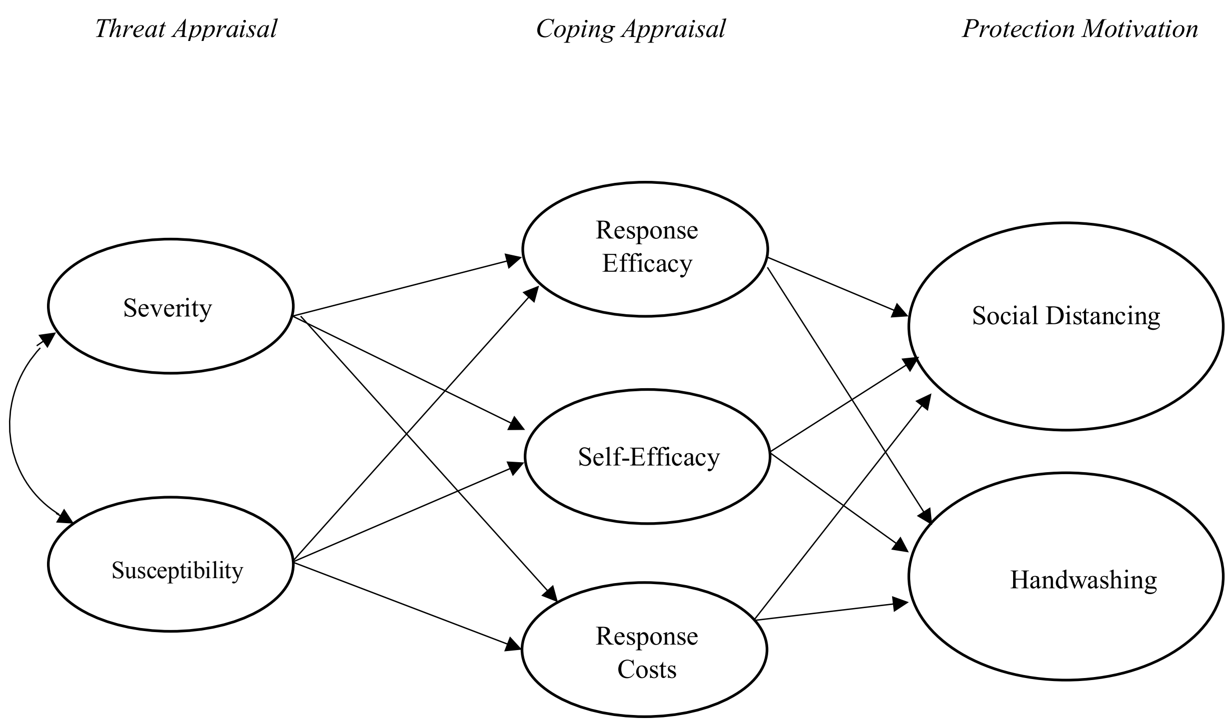


*Figure 2.* Conceptual model for protection motivation theory combined with a social cognitive theory framework for Human Norovirus prevention practices on college campuses.

## Research Questions and Hypotheses

Research has shown that students can play a major role in the spread of hNoV on college campuses. Therefore, the purpose of these studies is to examine motivations for health protective behaviors of college-aged millennials for hNoV through an exploratory combination of PMT and SCT. This information will be useful to health communicators in order to accurately and positively influence health protective behaviors among millennials and for increasing overall health hygiene related practices on college campuses.

### Research Questions

$RQ_1$: Is the instrument being used to measure perceived threat and coping appraisals in relation to behavioral intentions valid?

$RQ_2$: Will perceived threat appraisals mediated by coping appraisals will impact protection motivations?

### Hypotheses

$H_{1a}$: Perceived severity of hNoV will indirectly impact Handwashing when mediated by self-efficacy.

$H_{1b}$: Perceived severity of hNoV will indirectly impact Handwashing when mediated by response-efficacy.

$H_{1c}$: Perceived severity of hNoV will indirectly impact Handwashing when mediated by response cost.

$H_{2a}$: Perceived severity of hNoV will indirectly impact Social Distancing when mediated by self-efficacy.

$H_{2b}$: Perceived severity of hNoV will indirectly impact Social Distancing when mediated by response-efficacy.

$H_{2c}$: Perceived severity of hNoV will indirectly impact Social Distancing when mediated by response cost.

$H_{3a}$: Perceived vulnerability of hNoV will indirectly impact Handwashing when mediated by self-efficacy.

$H_{3b}$: Perceived vulnerability of hNoV will indirectly impact Handwashing when mediated by response-efficacy.

$H_{3c}$: Perceived vulnerability of hNoV will indirectly impact Handwashing when mediated by response cost.

$H_{4a}$: Perceived vulnerability of hNoV will indirectly impact Social Distancing when mediated by self-efficacy.

$H_{4b}$: Perceived vulnerability of hNoV will indirectly impact Social Distancing when mediated by response-efficacy.

$H_{4c}$: Perceived vulnerability of hNoV will indirectly impact Social Distancing when mediated by response cost.

# CHAPTER III

## Methodology

### Sampling and Participants

A pilot study was conducted with a small convenience sample of college-aged millennial students (*n* = 120) to ascertain if any items or grouping of items need to be adjusted. This sample had almost an even split between Males (*n* = 58) and Females (*n* = 62) and was primarily made up of college sophomores (*n* =55) and juniors (*n* = 35). The survey was disseminated to the sample via Qualtrics, an online survey service. Upon completion of the pilot study, the data was analyzed utilizing principle components analysis (PCA). Numerous items and constructs were removed due to cross loadings and item content and will be discussed in the subsequent sections. Following this the primary study took place utilizing a non-probability sample of college-aged millennials (*n* = 1,389) who were acquired from different universities that agreed to disseminate the online survey through email via Qualtrics to their students. Social media and an online survey website, Amazon Mechanical Turk (MTurk), were also utilized in an attempt to garner survey responses from college-aged millennials globally.

The survey in MTurk had multiple instructional manipulation checks (IMC) to help increase validity by ensuring respondents were reading the questions as well as filter questions so only those in the appropriate age range and those who were attending or had attended college would partake in the survey (Oppenheimer, Meyvis & Davidenko, 2009). These IMC are necessary for MTurk as it is a paid crowdsourcing service. Offering 35 cents per survey completed (i.e. a respondent successfully passed all IMC and completed the survey), was the recommended amount for a survey of this nature according to Chambers and Nimo (2018). These authors discussed the potential pricing for surveys used in MTurk and compared them to pricing through Survey Monkey and Qualtrics and it was discovered that MTurk is able to garner more survey responses for less money, but the caveat being, all IMC must be properly answered in order for that survey response to be valid.

College-aged millennials were the population of interest and a sample of at least 500 was to be collected in accordance with a general rule of thumb put forth by numerous researchers (Bentler & Cho, 1987; MacCallum, Peng & Lai, 2012). This rule postulates that 10 times the number of measurement items will yield a minimum sample size required for analysis (Peng & Lai, 2012). Convenience samples are an ideal way to maximize college-aged millennials participation, as most traditional students currently attending college fall into the millennial generation (Elam, Stratton, & Gibson, 2007; Howe & Strauss, 2000). However, this style of sampling can be detrimental to external validity, that is, the generalizability of the results. Generalizing the results to an entire population then must be made on a more theoretical base than statistical one. Overall 2,073 surveys were collected online through email, social media and MTurk combined. After inspection and cleaning of the data for incomplete responses, about 67% were left ($n$ = 1,389) that were used for exploratory factor analysis, confirmatory factor analysis, and structural equation modeling statistical analyses. Of the 1,389 useable surveys the average age of the participants was 25.53 (SD = 4.79). About 41.10% of the sample was Male ($n$ = 571) and 46.90% were female ($n$ = 651). The majority of the sample (32.50%) were classified as college Graduate Students ($n$ = 451), with college seniors following behind at 20.90% ($n$ = 290). The demographic information for the total sample, sample 1, and sample 2, garnered through the primary study can be seen in Table 9.

## Survey Development

An extensive literature review was conducted to develop items for each of the constructs in the PMT model. The resulting items formed the majority of the survey instrument and are discussed in the subsequent sections. The remaining questions addressed demographics such as, age, sex, race, and college classification. Table 2 displays the demographic information for the pilot study. Previous experiences with hNoV was examined along with media was also examined through a multitude of questions (e.g. "Prior to this survey, had you ever heard of Norovirus? Have you ever been diagnosed with Norovirus?). Frequency of handwashing and use of hand sanitizer were also examined (e.g. "Please use the slider to estimate how many times in a day you would normally wash your hands" "Please use the slider to estimate how many times a day you normally use hand sanitizer" and "I would use hand sanitizer instead of washing my hands if it is available"). The items concerning hand sanitizer were adapted from Baş, Ersun, and Kıvanç (2006) and modified to a 7-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree) to add more variability and stay in line with the remaining survey items. The start of the survey contained a short introduction, which gave some background information on hNoVs concerning the illness it causes (self-limiting gastroenteritis), symptoms, transmission, and susceptible locations which were adapted from the CDC's (2014) clinical overview of hNoVs.

> "*Norovirus is a highly contagious virus (some symptoms include: vomiting, diarrhea, nausea) that accounts for about 21 million cases of self-limiting gastroenteritis in the U.S., about 70 thousand hospitalizations, and about 800 deaths per year. Norovirus can sometimes be referred to as the "stomach flu". Symptoms usually last anywhere from 24 to 72 hours. It is easily spread from touching contaminated surfaces, person-to-person contact, and consumption of contaminated food or water. College campuses have close living quarters (dorms, fraternity/sorority houses), classrooms, and shared dining areas have the potential to increase infection rates.*"

Participants were then instructed to read each statement within the context of being on a college campus. A subheading "While on a college campus…" was provided at the top of each page before the statements were presented.

For the survey that went through MTurk, validation questions were added in the form of IMCs (Oppenheimer, Meyvis & Davidenko, 2009). Questions such as "Please select strongly agree from the answer choices below", "Please leave this question blank and continue on to the next question" and "Please select strongly disagree from the answer choices below", were used as validation checks to see if participants were actually reading the questions. The question regarding selection of strongly agree was a logic question and would exit the survey and not provide a code for participants to be paid if they answered it incorrectly. Prior to implementing the pilot and primary study with the instrument, trained experts reviewed the survey items for quality control purposes. They examined items for grammatical errors, readability, conciseness, and clarity. Any items identified by the trained experts that required adjustment were immediately rectified.

**Measures**

The latent constructs that were used to measure intention to practice the protection motivations (e.g. handwashing and social distancing) are the only purely endogenous variables in the proposed model (Figure 2), similar to the original model. Threat appraisals consisted of severity and vulnerability and were the only two purely exogenous variables within the proposed model. While coping appraisals are made up of response efficacy, self-efficacy, and response costs. These constructs served a dual role as both exogenous and endogenous variables, based on the addition of social cognitive theory (SCT) to protection motivation theory (PMT). In line with SCT the efficacy related variables are thought to mediate the relationship between perceived threats and behavioral intentions (Figure 2), instead of acting as purely exogenous variables as seen in other PMT models (Hodgkins & Orbell, 1998; Lwin & Saw, 2007; Rogers & Prentice-Dunn, 1997), the newly adapted model will treat them in a stronger psychological sense, as seen in SCT. For efficacy to have a stronger meaning and motivate behavior change, there must be a corresponding threat or stimulus that enables one to be cognizant of both self and response efficacy (Benight & Bandura, 2004). Five items for each construct were adapted and created from previous literature to fit the context of hNoV outbreaks (CDC, 2017; Fisher, Almanza, Behnke, Nelson & Neal, 2018; Lwin & Saw, 2007; Lwin, Stanaland, & Chan, 2010; Milne, Sheeran, & Orbell, 2000). Table 1 demonstrates the initial items and their respective construct.

Table 1
*Initial Items used in Principle Components Analysis*

| **Construct** | **Item** |
|---|---|
| Severity[1] (SEV) | Norovirus would make me very sick |
| | Norovirus would cause me to be hospitalized |
| | Norovirus would cause me to miss class/work |
| | Norovirus would affect my overall attitude regarding the semester |
| | Norovirus is too minor to impact my daily life |
| Susceptibility[1] (SUS) | My chances of contracting Norovirus are quite small |
| | It is possible that I will get Norovirus |
| | The chance of my peers getting Norovirus is rather large |
| | It is possible that I get Norovirus from a person rather than food |
| | It is possible that I am infected by Norovirus unknowingly |
| Response-Efficacy Handwashing[2] (RE.HW) | I think handwashing would be one of the best ways to prevent an illness caused by Norovirus |
| | Regular handwashing would reduce my chances of contracting Norovirus |
| | Following advice about proper handwashing would help me not get sick from Norovirus |
| | Using hand soap reassures me that I am safe from Norovirus |
| | Handwashing would impact whether or not I get sick from Norovirus |

Table 1
*Continued*

| Construct | Item |
|---|---|
| Self-Efficacy Handwashing[2] (SE.HW) | I would know how to wash my hands effectively to reduce my risk of Norovirus |
| | I would be able to wash my hands when I want too. |
| | I would be capable of successfully following proper handwashing information |
| | I would have no difficulty practicing proper handwashing procedures |
| | I would know how to properly wash my hands to reduce my risk of Norovirus infection |
| Response Cost Handwashing[3] (RC.HW) | I would wash my hands every time I should, even if it takes a lot of time |
| | I would wash my hands every time I should, even if the sink is far away |
| | I would not use a restroom with broken sinks, even if the next usable restroom is far away |
| | I would wash my hands after opening doors, even if it is inconvenient |
| | I would still wash my hands with water, even if the soap dispenser was empty |
| Response-Efficacy Social Distancing[2] (RE.SD) | I think avoiding people who are sick would be one of the best ways to prevent an infection from Norovirus |
| | Avoiding people who are sick would have an impact on whether or not I am infected by Norovirus |
| | Avoiding people who are sick would reduce my chances of a Norovirus infection |
| | Actively avoiding people who appear sick would help keep me free from Norovirus infection |
| | If I follow Norovirus prevention media I would not get sick from Norovirus |
| Self-Efficacy Social Distancing[2] (SE.SD) | I would know how to effectively avoid people who are sick |
| | I would be able to avoid people who are sick when I want too |
| | I would be capable of successfully following Norovirus avoidance media |
| | I would have no difficulty avoiding people who are sick |
| | I would be confident in my ability to avoid people who are sick |

Table 1
*Continued*

| Construct | Item |
|---|---|
| Response Costs Social Distancing[3] | I would avoid people who are sick, even if it meant missing class or work |
| | It would take too much effort to avoid people who are sick |
| | It would take too much time to avoid people who are sick |
| | I would avoid sitting close to anyone who is sick, even if it is inconvenient |
| | It is not convenient to always avoid people who are sick |
| Intentions Handwashing[4] | I would wash my hands to protect myself from a Norovirus infection |
| | I would wash my hands before eating |
| | I would wash my hands after eating |
| | I would wash my hands after using the restroom |
| | I would wash my hands after opening doors |
| Intentions Social Distancing[5] | I would intentionally avoid people who are sick to protect myself from a Norovirus infection |
| | I would **not** sit next to someone who is actively sick in the classroom |
| | I would leave a public restroom if there is someone actively sick in one of the stalls |
| | I would avoid going to a self-service dining hall because it might get me sick with Norovirus |
| | I would order food to my room to avoid eating around others in the dining hall |

*Note*. [1]Lwin & Saw, (2007); Lwin, Stanaland, & Chan, (2010); [2]Lwin, Stanaland, & Chan, 2010; [3]Lwin & Saw, (2007); [4]Fisher, Almanza, Behnke, Nelson, & Neal, (2018); Lwin, Stanaland, & Chan, (2010); Milne, Sheeran, & Orbell, (2000); [5]Lwin, Stanaland, & Chan, (2010); Milne, Sheeran, & Orbell, (2000).

**Protection Motivation.** Protection motivation is most accurately measured utilizing behavioral intentions (Rogers & Prentice-Dunn, 1997). They are typically assessed by the development of an intention to adapt a protective behavior (Hodgkins & Orbell, 1998), in the case of hNoV, handwashing and social distancing. Protection motivation was thus operationalized as an individuals' behavioral intention for the practice of handwashing and/or social distancing habits. Handwashing for this study is defined as washing your hands carefully with soap and water for at least 20 seconds (CDC, 2016c). Social distancing for this study was defined as increasing the physical distance between yourself and someone who is sick (CDC, 2017; Wikswo et al, 2011). Each of these protection motivation constructs were measured utilizing items adapted from previous PMT health related studies concerning myopia, HIV, and coronary heart disease (Lwin & Saw, 2007; Lwin, Stanaland, & Chan, 2010; Milne, Sheeran, & Orbell, 2000; Plotnikoff & Higginbotham, 1995, 2002; Wong, Gaston, DeJesus, & Prapavessis, 2016), into the context of hNoV outbreaks. Statements such as "I intend to use condoms to prevent myself from getting HIV" were adapted from Lwin, Stanaland, and Chan (2010) and modified to the context of hNoVs (e.g. "I would wash my hands to protect myself from getting a Norovirus infection"). Similarly, social distancing was assessed through a similar series of questions (e.g. "I would intentionally avoid people who are sick to protect myself from getting a Norovirus infection"). These items were measured on a 7-point Likert scale, ranging from 1 (strongly disagree) to 7 (strongly agree). Higher scores indicated greater levels of protection motivation.

**Perceived Severity.** Items in the perceived severity scale were utilized to assess the individuals' belief in the severity of the threat (Rogers & Prentice-Dunn, 1997; Taylor & May, 1996). Defined as how serious an individual perceives a threat would be to his or her own life (Milne, Sheeran, & Orbell, 2000; Rogers, 1975). The five items in this scale were adapted from Lwin and Saw, (2007) and Lwin, Stanaland, and Chan (2010) (e.g. "HIV is a serious problem" and "Myopia may increase the risk of developing eye diseases") and were adapted to the context of hNoV outbreaks (e.g. "Norovirus would make me very sick"). Responses to these items were measured on a 7-point Likert scale, ranging from 1 (strongly disagree) to 7 (strongly agree) with higher scores indicating increased levels of perceived severity.

**Perceived Susceptibility.** Five items in the perceived susceptibility construct were adapted from Lwin, Stanaland, and Chan (2010) and Lwin and Saw (2007), "It is possible that I will ever get HIV" and adapted to fit the context of hNoVs (e.g. "It is possible that I would get Norovirus"). Defined as how personally vulnerable an individual feels to the communicated threat (Milne, Sheeran, & Orbell, 2000; Rogers, 1983). Responses to these items were measured on a 7-point Likert scale, ranging from 1 (strongly disagree) to 7 (strongly agree) with higher scores indicating increased levels of perceived vulnerability.

**Response Efficacy.** In line with Fishbein and Ajzen (1975) response efficacy is operationalized by linking consequences to the recommended behavior, as well as to whether the individual regarded the consequences as likely outcomes of the recommended behavior. Defined as the perception that a certain course of action would reduce or prevent the threat (Maddux & Rogers, 1983). The items for the handwashing construct were adapted from Lwin, Stanaland, and Shaw's (2010) questionnaire concerning HIV. Statements such as "The use of condoms ensures I am protected against HIV" were adapted to fit hNoVs (e.g. "Handwashing would have an impact on whether I get sick from Norovirus), and the social distancing construct (e.g. Avoiding people who are actively sick would reduce my chances of contracting Norovirus). The responses for these items were measured on a 7-point Likert type scale ranging from 1 (strongly disagree) to 7 (strongly agree). Higher scores reflected increased perceived effectiveness of both adaptive responses respectively.

**Self-Efficacy.** Self-efficacy refers the ability or expectancy that one can perform a behavior or action (Maddux & Rogers, 1983). Statements from Lwin and Saw (2007), and Lwin, Stanaland, and Chan (2010), such as "I am able to use condoms effectively" into a context that fit hNoVs outbreaks for both handwashing (e.g. "I would be able to wash my hands when I want too"), and social distancing (e.g. "I am able to avoid people who are sick when I want too"). The responses for these items were measured on a 7-point Likert type scale ranging from 1 (strongly disagree) to 7 (strongly agree). Higher values indicated the more positive the individual's perceived self-efficacy.

**Response Costs.** The construct for response cost is defined as the perceived barriers to the practice of good protective behaviors (Lwin & Saw, 2007; Maddux & Rogers, 1983). Statements from Lwin and Saw (2007), such as "It is time consuming for me to ensure that my child practices good eye care habits" and "It is not convenient for me to take my child for regular eye checkups at the optician or optometrist" into the context of hNoVs for handwashing (e.g. "I would wash my hands every time I should, even if it takes a lot of time) and social distancing (e.g. "It is not convenient to always avoid people who are sick). The responses for these items were measured on a 7-point Likert type scale ranging from 1 (strongly disagree) to 7 (strongly agree). Higher scores indicating increased response costs.

**Procedures**

A pilot study was conducted utilizing an online survey system (Qualtircs), based on a convenience sample from the population of interest (*n* = 120). This information was utilized to provide initial insights on knowledge of hNoVs, past experiences, examine threat and coping appraisals, and protection motivations. The pilot test was used to ascertain which items from the survey would need to be removed due to poor factor loadings or cross loadings on latent constructs. The results were analyzed and the questionnaire modified accordingly to refine and minimize any potential ambiguity. Items with factor loadings less than .40 or loading heavily (> .40) on more than one factor were eliminated (Nunnally, 1978). Trained professionals screened items for clarity, readability, and face validity regarding each items relationship to the appropriate construct.

Following the pilot study and modifications to the survey based on results of the initial PCA, the primary study began. The survey was disseminated through three online outlets, social media, email, and MTurk. An additional question was put in the online survey inquiring if the participant has previously taken this survey. If they had, they were redirected to the end of the survey and thanked for their time. The MTurk survey also contained added filter questions regarding age and if the participant is currently a college student or a recent graduate, since the population of interest was college-aged millennials and added IMC questions as discussed previously discussed.

**Statistical Analyses**

**Principle Components Analysis (PCA).** Pilot data ($n$ = 120) was analyzed utilizing the Statistical Package for Social Sciences (SPSS) Version 25 software program. A PCA can be used to examine the dimensionality of a measurement instrument by finding the smallest number of interpretable factors needed to explain the correlations among a set of variables. Similar to the original studies, in which the scales were derived, a factor loading lower than .40 was used as a cut off value and any items loading heavily (>.40) on one or more factors were also removed (Lwin & Shaw, 2007; Lwin, Stanaland & Chan, 2010). In line with previous studies, varimax rotation was used during the PCA. Four PCA analyses were performed. Table 3 demonstrates the results of the PCA performed on Threat Appraisals (i.e. Perceived Severity & Susceptibility). Two items under these constructs, "Norovirus is too minor to impact my daily life" and "My chances of contracting Norovirus are quite small", were recoded after data collection and before analyses. Next Coping Appraisals (see Table 4) were examined (i.e. Self-Efficacy, Response-Efficacy, & Response Costs). Finally, participants' intentions to wash their hands and their intentions to social distance themselves were analyzed (see Tables 6 & 7, respectfully).

**Exploratory Factor Analysis (EFA).** Data were analyzed using MPlus Version 7.31 multivariate software. The total sample ($n$ = 1,389) was split in half (Sample 1, $n$ = 694 & Sample 2, $n$ = 695), and using the first half of the data, measures were tested by subjecting the remaining constructs to factor analysis utilizing EFA for categorical data with an oblique rotation since many factors were expected to be correlated based on previous research (Lwin & Saw, 2007; Lwin, Stanaland, & Chan, 2010). The goal of an EFA is to ultimately enhance the overall interpretability of the retained factors with the goal of a simple structure, where each factor explains as much variance as possible in non-overlapping sets of indicators. Observed variables were categorical and thus utilized Weighted Least Squares estimation was utilized. Items with low item loadings on factors (< .40) or heavy cross loadings (>.40) were removed. The items were removed one at a time and the analysis repeated until the remaining items met the previously mentioned specified cut off criteria. After this process, each latent variable was examined to see how many items remained. According to the three-indicator rule for factor analytic models, each latent variable should ideally be measured by 3 items minimum (Bollen & Davis, 2009).

The entire construct for "Response-Efficacy Handwashing" was removed due to the majority of the items cross loading heavily on other items. After the removal of this construct, all other items loaded heavily on their desired construct and had minimal cross loadings.

**Confirmatory Factor Analysis (CFA).** The second half of the data set (Sample 2, $n$ = 695) underwent CFA for categorical data to validate the scales, defined by the EFA, used in measuring the latent constructs. A CFA was used to ascertain if the model appropriately describes the relationship between the indicators and the constructs. Weighted least squares mean and variance adjusted (WLSMV) estimation was used to assess parameter estimates.

WLSMV assumes the data is categorical and makes no assumptions about the distribution of the observed variables, however it does assume a normal latent distribution underlying each observed categorical variable (Li, 2016). The WLSMV estimates parameters using a diagonal weight matrix with standard errors and mean– and variance – adjusted chi-square test statistic that use a full weight matrix.

To identify the model, the total number of parameters estimated needs to be less than or equal to the number of unique variances ($t \leq u$). Each latent variable had an assigned unit of measurement, by fixing the variance to one. Fit indices (e.g. parsimonious, absolute, and incremental) were then be examined. Acceptable fit indices and fit were examined based on examining the *t*-statistic or chi-square value, the Root Mean Square Error of Approximation (RMSEA $\leq$ .08), Comparative Fit Index (CFI $\geq$.90), and the Tucker Lewis Index (TLI $\geq$.90) also known as the Non-normed Fit Index (NNFI). If the model fit parameters have been found to be unsatisfactory then model re-specification took take place. Modifications were based on theoretical grounds from empirical research. The reliability and validity of the CFAs were then tested utilizing a non-linear structural equation modeling reliability coefficient (Green & Yang, 2009; Yang & Green, 2011) for the multidimensional components, Cronbach's alpha for single dimension, and model fit.

**Reliability and Validity Testing**. The structural portion of a full structural equation model typically involves the relationships between the latent variables only and the primary concern in working with a full model in SEM is to assess the extent to which these relations are valid and reliable. It is critically important to ensure the measurement of each latent variable is psychometrically comprehensive (Byrne, 2006). This touches on the importance of testing for the validity and reliability of the measurement models before attempting to evaluate the structure model. Therefore, the CFA constructs comprising the measurement models need to be tested for reliability and validity. The internal reliability of the multidimensional constructs (Threat Appraisals & Coping Appraisals) were assessed using a non-linear SEM reliability coefficient, which involves model parameter threshold estimations (Yang & Green, 2009) instead of the commonly used Cronbach's alpha (Ary, Jacobs & Razavieh, 2002; Crocker & Algina, 1986). The validity of these constructs was assessed utilizing model fit indices.

The original constructs used to create the items for this study utilized Cronbach alpha to validate their scales. Lwin, Stanaland, and Chan (2010), found their severity, susceptibility, response-efficacy, self-efficacy and protection motivation (i.e. intention) constructs to be reliable using this value (Severity: $\alpha = .81$; Susceptibility: $\alpha = .71$; Response-Efficacy: $\alpha = .88$; Self-Efficacy: $\alpha = .87$; Intention: $\alpha = .87$). These researchers designed their scales to target male adults in terms of condom usage to prevent HIV/AIDS. Similarly, the other study used to create the items (Lwin & Shaw, 2007), targeted parents and concerned myopia prevention for their children. These scales were also found to be reliable constructs utilizing construct reliability (CR) and variance extracted (VE) methods. The authors did not give specifics for each construct, however they did state that all their constructs met the recommended value for each CR (.70) and VE (.50). The third study (Milne, Orbell, & Sheeran, 2002) concerned combining motivational and volitional interventions to promote exercise participation and the author's also found reliability using Cronbach alpha (Intentions: $\alpha = .85$). The final study (Fisher et al., 2018), which helped create the handwashing intentions items, also utilized Cronbach alpha coefficient for their measures of handwashing ($\alpha = .92$).

Although the previous authors used Cronbach alpha, research has suggested that is not a good indicator of whether a set of items measures a single factor since the average Pearson correlation can be offset by greater numbers of items (Kline, 2016; Yang & Green, 2011). Cronbach's alpha is an informative reliability index, strictly speaking, only in settings that are rather restrictive (Novick & Lewis, 1967). Cronbach's alpha has three basic assumptions: 1. Item scores are a summation of the items true and error scores (Classical item-score assumption); 2. The same true scores underlie all items and equally contribute to all item scores. Taken into the context of factor analysis, items have equal loadings on a single underlying factor (Tau-equivalency assumption); 3. Item error scores between any pair of items are uncorrelated (Uncorrelated-error assumption) (Yang & Green, 2011). All of these assumptions are likely to be violated to a degree in actual practice, resulting in the accuracy of the reliability to be somewhat problematic.

The first assumption is typically held in discontent with psychometricians since scores on items are usually limited to small numerical values, yes or no (i.e. 0,1) or 1 through 5 for Likert-type items. Items that contain limited responses are difficult to conceptualize in terms of item sums are a simple sum of item true and error scores. There is no clear understanding of whether violation of this assumption has an impact on the accuracy of coefficient alpha, but it does affect the way the violations of the other assumptions are assessed. The essentially tau-equivalence condition requires that components measure the same underlying dimensions with the same units of measurement. Inside a latent variable modeling context, tau-equivalence measures can be considered, for most practical purposes, indicators of a single factor on which items load equally (Raykov, 2004; Yang & Green, 2011). Practically speaking, items on a scale are unlikely to be tau-equivalent. If a scale is truly unidimensional, then it would be doubtful whether a single underlying factor would contribute the same amount to every single item present. Also, scales are usually unlikely to be unidimensional (Raykov, 2004; Yang & Green, 2011). Since the behavioral measurement and noncognitive scales in latent constructs are usually based on subjective units, the requirement for their factor loadings to be the same is quite restrictive. It would be preferable in these cases to implement a bifactor model that underlies items on the scales in way that all items are strongly associated with the general factor and subsets of items are associated with group factors, resulting in an essentially unidimensional construct (Yang & Green, 2011).

The tau-equivalence condition requires equal discriminating power for all components in the test, as well as the unidimensionality of the test, represented by equal factor loadings for all components under the one-factor factor analytic model (McDonald, 1999) and the lack of uncorrelated errors. When the essentially tau-equivalent condition is not met, Cronbach's coefficient-alpha is a lower bound of reliability in the population, therefore underestimating the true reliability to some extent (Raykov, 2004). It has been demonstrated that with unidimensional tests, the underestimation of the alpha value is minimal, unless one or two loadings are substantially greater than the others. In practice it is nearly impossible to obtain the tau-equivalent assumption perfectly, in terms of both equal discrimination power for all test components and unidimensionality of each test. Underestimation of reliability becomes a greater issue in terms of multidimensional scale scores (Raykov, 2001). In the context of this study, constructs are measured utilizing multiple dimensions (e.g. Coping Appraisals: self-efficacy, response efficacy, and response costs). In this study the researchers are concerned with measuring the overall threat and coping appraisals as a summation of the scores from all dimensions, as well as measuring the threat and coping appraisal for each dimension separately. Coefficient-alpha for the total scale scores will underestimate the true reliability, because of the multidimensionality of the scales, thus a nonlinear SEM reliability coefficient will be utilized (Yang & Green, 2011) and will be discussed later on in this section.

The uncorrelated error assumption is often ignored by researchers who discuss coefficient alpha (Yang & Green, 2011). A researcher can rarely assert the thought that violations of independence are absent, and it can be troublesome, if not impossible to analyze the degree and effect of non-independence (Cronbach, 2004). This assumption is violated frequently and through a number of paths. Errors can be correlated if subsets of items on a scale are associated with different stimuli and the potential ordering of items could introduce correlated errors, especially if similarly worded items are adjacent to one another (Yang & Green, 2011). Ephemeral effects associated with taking a set of items on a single occasion may also introduce correlated errors (Green, 2003). Typically, the errors will be positively correlated and can result in coefficient alpha being inflated, but to what degree is less clear due to the lack of research on the subject of correlated errors in scales is less routinely investigated.

The violation of these three assumptions can cause Coefficient alpha to be negatively biased, relatively unbiased, and positively biased. The degree that a scale is negatively or positively biased depends on the degree that the tau-equivalency and uncorrelated errors assumptions are violated in combination (Yang & Green, 2011). Consequently, for this study, which utilizes numerous items to measure multiple scales, some of which are multidimensional, a different method of reliability estimation will occur. Since the items in this study are categorically ordered, as are most item scores since a limited number or response points are present, a linear approach to estimating reliability cannot be taken. Linear approaches like Maximum Likelihood methods are conducted on a covariance matrix among the items, but can yield incorrect fit indices, biased factor loadings, and create spurious factors (Yang & Green, 2011). To prevent this hindrance from occurring, a non-linear SEM method utilizing categorical data will be implemented in the CFA step before SEM takes place. Since the CFA models in this study will be estimated utilizing WLSMV, a non-linear SEM reliability coefficient will be used. Yang and Green (2011, p.384) stated "This estimation is hypothetically the correlation between a scale and its parallel form with zero time between administrations, although the data is obtained from a scale administered on a single occasion". This can be computed utilizing polychoric correlations (polychoric correlations estimate the correlations between normally distributed continuous item scores that are hypothesized to underlie the observed categorical item scores (Yang & Green, 2011)) and using robust weighted least estimation methods (Green & Yang, 2009). Using the fitted model's sample thresholds, factor loadings, factor correlations, and polychoric correlations to replace the parameters needed to compute the numerator and denominator of the reliability coefficient normally calculated through classical test theory (Green & Yang, 2009). This estimate can help clarify one's understanding of reliability coefficients at both population and sample level data when the underlying distribution of item scores are normal or deviate from normality (Yang & Green, 2012).

Concurrently, if the model fit parameters utilized to examine the constructs were satisfactory, the construct will be considered valid (Crocker & Algina, 1986; Thompson & Daniel, 1996). In other words, it will be measuring what is intended to be measured (i.e. the items for each latent construct accurately reflect that latent construct).

**Structural Equation Modeling.**

Following the validation of the measurement models, the newly validated structural model utilized the full data set ($n$ = 1,389) and underwent analyses through structural equation modeling (SEM) using WLSMV. The proposed structure model (Figure 3) was subjected to the absolute, incremental, and parsimonious fit measures. This analysis was conducted using MPlus multivariate software and used to ascertain if threats mediated by coping appraisals could successfully predict intentions to practice protection motivation factors. Any model re-specifications required were subsequently carried out, drawing upon information from construct correlations and the modification indices.

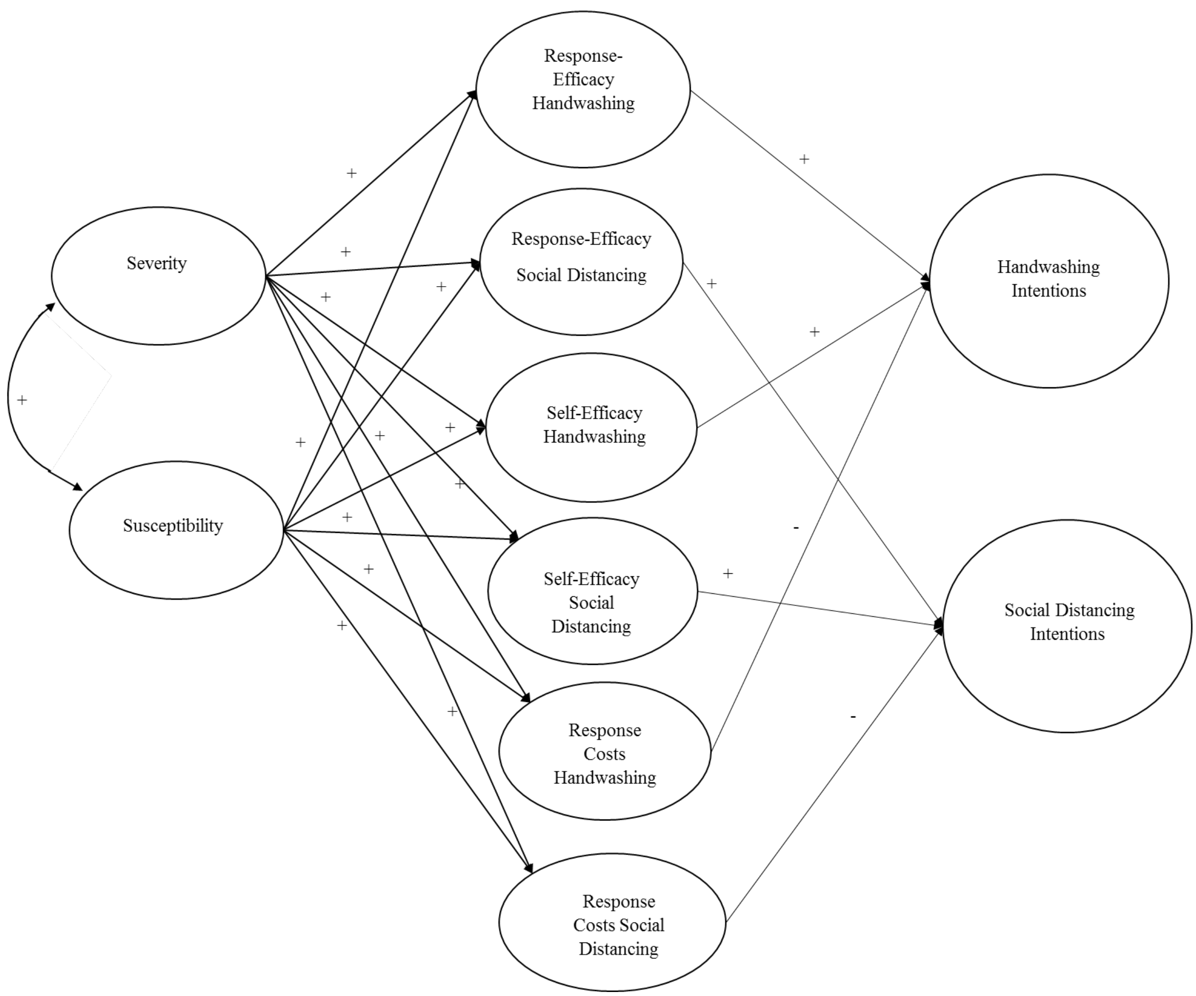


*Figure 3*. Proposed Structure Model for the combination of PMT and SCT in the context of hNoV prevention practices on college campuses.

# CHAPTER IV

## Results

### Pilot Study

The purpose of the pilot study was to ascertain if the adapted items were able to measure the latent constructs and if any items needed to be removed due to low item loadings on factors (< .40) or heavy cross loadings (>.40). A convenience sample of 120 college-aged millennials was used to complete the pilot study statistical analyses. A breakdown of the sample's demographics can be seen in Table 2.

Table 2
*Pilot Demographics: Age, Sex, College Classification, and Race*

| | | *n* | % | *M* | *SD* |
|---|---|---|---|---|---|
| Age | | 120 | --- | 20.36 | 2.00 |
| *Sex* | | | | | |
| | Male | 58 | 48.3% | | |
| | Female | 62 | 51.7% | | |
| *College Classification* | | | | | |
| | Freshmen/first-year | 19 | 15.8% | | |
| | Sophomore | 55 | 45.8% | | |
| | Junior | 35 | 29.2% | | |
| | Senior | 10 | 8.30% | | |
| | Graduate Student | 0 | 0.00% | | |
| | Other | 1 | 0.80% | | |
| *Race* | | | | | |
| | White | 101 | 84.2% | | |
| | Black or African American | 5 | 4.20% | | |
| | American Indian | 1 | 0.80% | | |
| | Asian | 7 | 5.80% | | |
| | Hispanic | 6 | 5.00% | | |

After removal of all items that had issues, (i.e. low item loadings (< .40) or loading heavily (>.40) on more than one component), 36 items remained. Table 3 contains information regarding item loadings, communalities ($h^2$), Kaiser-Meyer-Olkin (KMO) index, and the mean and standard deviation for the items designed for the Threat Appraisals components (i.e. severity and susceptibility). One item from each construct was removed. Severity lost the item "Norovirus is too minor to impact my daily life" due to loadings of above .40 on both factors. The analysis was performed again without this item and Susceptibility subsequently had an item loading above .40 on both factors, "It is possible that I am infected by Norovirus unknowingly". This item was removed and the final results can be seen in Table 3.

Table 3
*Principle Component Analysis Item Loadings between Severity and Susceptibility*

| | **Factor Loadings** | | | | |
|---|---|---|---|---|---|
| **Items** | SEV | SUS | *M* | *SD* | $h^2$ |
| *Severity (SEV)* | | | | | |
| Norovirus would make me very sick | 0.78 | 0.19 | 6.01 | 1.21 | 0.643 |
| Norovirus would cause me to be hospitalized | 0.76 | 0.05 | 5.1 | 1.28 | 0.583 |
| Norovirus would cause me to miss class/work | 0.78 | 0.23 | 6.24 | 1.03 | 0.667 |
| Norovirus would affect my overall attitude regarding the semester | 0.63 | 0.25 | 5.38 | 1.37 | 0.461 |
| *Susceptibility (SUS)* | | | | | |
| My chances of contracting Norovirus are quite small | 0.15 | 0.78 | 4.44 | 1.41 | 0.637 |
| It is possible that I will get Norovirus | 0.27 | 0.56 | 5.13 | 1.05 | 0.401 |
| The chance of my peers getting Norovirus is rather large | 0.24 | 0.81 | 4.77 | 1.36 | 0.717 |
| It is possible that I get Norovirus from a person rather than food | 0.38 | 0.58 | 5.22 | 1.37 | 0.496 |

| | **Factor Correlations** | |
|---|---|---|
| **Factor** | SEV | SUS |
| SEV | 1.00 | 0.79 |
| SUS | -0.62 | 1.00 |
| **KMO** 0.786 | | |

Table 4 contains the item loadings, mean and standard deviation for the Coping Appraisals construct (i.e. self-efficacy and response-efficacy for both handwashing and social distancing), Handwashing Intentions, and Social Distancing Intentions. The items that were thought to measure Response Costs had high cross loadings with two or more components to the point of only 2 items loading well together and nothing else. The items that cross loaded were removed and after a re-examination of the literature it was decided to remove the Response Cost constructs all together as one of the model studies used to create the scale prioritized monetary and time costs (Lwin & Saw, 2007) and this study did not. Also, with only two items loading appropriately, this construct failed to the three-indicator rule for factor analytic models (Bollen & Davis, 2009).

Table 4
*Principle Components Analysis Item Loadings between Coping Appraisal Constructs*

| | **Factor Loadings** | | | | | | |
|---|---|---|---|---|---|---|---|
| **Items** | SE.HW | RE.HW | RE.SD | SE.SD | *M* | *SD* | $h^2$ |
| *Self-Efficacy Handwashing (SE.HW)* | | | | | | | |
| I would know how to wash my hands effectively to reduce my risk of Norovirus | 0.61 | 0.03 | 0.38 | 0.13 | 5.64 | 1.10 | 0.53 |
| I would be able to wash my hands when I want too | 0.67 | 0.10 | 0.13 | 0.29 | 5.77 | 1.02 | 0.57 |
| I would be capable of successfully following proper handwashing information | 0.82 | 0.15 | 0.12 | 0.15 | 6.07 | 0.90 | 0.73 |
| I would have no difficulty practicing proper handwashing procedures | 0.75 | 0.16 | 0.06 | 0.01 | 5.90 | 0.13 | 0.59 |
| I would know how to properly wash my hands to reduce my risk of Norovirus infection | 0.75 | 0.15 | 0.28 | 0.05 | 5.88 | 1.12 | 0.66 |

Table 4
*Continued*

| | Factor Loadings | | | | | | |
|---|---|---|---|---|---|---|---|
| | SE.HW | RE.HW | RE.SD | SE.SD | *M* | *SD* | $h^2$ |
| *Response-Efficacy Handwashing (RE. HW)* | | | | | | | |
| I think handwashing would be one of the best ways to prevent an illness caused by Norovirus | 0.20 | 0.64 | 0.34 | -0.09 | 5.91 | 1.00 | 0.56 |
| Following advice about proper handwashing would help me not get sick from Norovirus | 0.28 | 0.48 | 0.26 | 0.27 | 5.93 | 1.04 | 0.45 |
| Using hand soap reassures me that I am safe from Norovirus | -0.04 | 0.83 | 0.03 | 0.18 | 4.53 | 1.48 | 0.73 |
| Handwashing would impact whether or not I get sick from Norovirus | 0.28 | 0.66 | 0.17 | 0.07 | 5.23 | 1.08 | 0.56 |
| *Response-Efficacy Social Distancing (RE.SD)* | | | | | | | |
| I think avoiding people who are sick would be one of the best ways to prevent an infection from Norovirus | 0.28 | 0.16 | 0.80 | 0.11 | 5.58 | 1.17 | 0.75 |
| Avoiding people who are sick would have an impact on whether or not I am infected by Norovirus | 0.23 | 0.28 | 0.74 | 0.08 | 5.70 | 1.08 | 0.70 |
| Avoiding people who are sick would reduce my chances of a Norovirus infection | 0.06 | 0.08 | 0.80 | 0.15 | 5.80 | 0.99 | 0.68 |
| Actively avoiding people who appear sick would help keep me free from Norovirus infection | 0.26 | 0.21 | 0.69 | 0.33 | 5.37 | 1.08 | 0.71 |
| *Self-Efficacy Social Distancing (SE.SD)* | | | | | | | |
| I would know how to effectively avoid people who are sick | 0.09 | 0.29 | 0.31 | 0.68 | 5.18 | 1.24 | 0.65 |
| I would be able to avoid people who are sick when I want too | 0.16 | 0.01 | 0.13 | 0.84 | 5.18 | 1.19 | 0.74 |
| I would have no difficulty avoiding people who are sick | 0.06 | 0.07 | 0.08 | 0.80 | 5.08 | 1.27 | 0.66 |
| I would be confident in my ability to avoid people who are sick | 0.15 | 0.05 | 0.08 | 0.84 | 5.12 | 1.17 | 0.74 |

Table 4
*Continued*

| | Factor Correlations | | | |
|---|---|---|---|---|
| **Factor** | SE.HW | RE.HW | RE.SD | SE.SD |
| SE.HW | 1.00 | | | |
| RE.HW | 0.560 | 1.00 | | |
| RE.SD | -0.397 | 0.878 | 1.00 | |
| SE.SD | -0.721 | -0.118 | 0.457 | 1.00 |
| **KMO** | 0.851 | | | |

The Coping Appraisal construct lost 3 items total after the removal of Response Costs. Two of the items came from the social distancing aspect. The item "If I follow Norovirus prevention media I would not get sick from Norovirus" was removed from the Response-Efficacy construct since it was loading on more than one component at a level greater than .40. The analysis was performed again and this time the item "I would be capable of successfully following Norovirus avoidance media" was removed from the Self-Efficacy construct (see Table 7) since it was loading above .50 on two separate components. The analysis was performed again and only one item was shown to be of concern, "Regular handwashing would reduce my chances of contracting Norovirus". This item had loadings of above .40 on two separate components and was removed. The analysis was performed again and all items showed acceptable loadings for only a single component.

Tables 5 and 6 demonstrate the loadings for Handwashing intentions and Social Distancing intentions components respectively. All items were found to be loading satisfactorily and were thus kept for the primary study.

Table 5

*Principle Components Analysis: Item Loadings for Handwashing Intentions*

| **Item** | **Factor** HWI | *M* | *SD* | $h^2$ |
|---|---|---|---|---|
| I would wash my hands to protect myself from a Norovirus infection | 0.68 | 5.74 | 1.17 | 0.46 |
| I would wash my hands before eating | 0.78 | 5.76 | 1.21 | 0.61 |
| I would wash my hands after eating | 0.67 | 5.03 | 1.45 | 0.44 |
| I would wash my hands after using the restroom | 0.79 | 6.1 | 1.10 | 0.63 |
| I would wash my hands after opening doors | 0.64 | 4.66 | 1.62 | 0.41 |
| **KMO** | .762 | | | |

Table 6

*Principle Components Analysis: Item Loadings for Social Distancing Intentions*

| **Item** | **Factor** SDI | *M* | *SD* | $h^2$ |
|---|---|---|---|---|
| I would intentionally avoid people who are sick to protect myself from a Norovirus infection | 0.72 | 5.31 | 1.25 | 0.53 |
| I would **not** sit next to someone who is actively sick in the classroom | 0.69 | 5.59 | 1.22 | 0.47 |
| I would leave a public restroom if there is someone actively sick in one of the stalls | 0.77 | 5.06 | 1.43 | 0.60 |
| I would avoid going to a self-service dining hall because it might get me sick with Norovirus | 0.80 | 4.98 | 1.42 | 0.64 |
| I would order food to my room to avoid eating around others in the dining hall | 0.77 | 4.53 | 1.71 | 0.59 |
| **KMO** | .701 | | | |

In total, 15 items were removed from the original 50 items that underwent PCA. All 10 of the items designed for the Response Cost component were removed from analyses. Severity and Susceptibility each lost one item as well. Similarly, both Response and Self-Efficacy for Social Distancing each lost an item due to high loadings on multiple components. Response-Efficacy Handwashing also lost an item, again due to high loadings on another component. Subsequently, all 15 items were then removed from the actual survey and the primary study was enacted with the remaining 35 items and their respective constructs. These items were systematically removed and the analyses performed again until all items met acceptable cutoff values. Table 7 below contains all items that were subsequently removed due to high loadings on more than one component (> .40) or low item loadings (< 0.40) in the pilot study. The remaining items were kept to use in the primary study. The primary study had a total sample (*n* = 1,389) which was randomly split into sample 1 (*n* = 694), which would undergo EFA, sample 2 (*n* = 695), which would undergo CFA and then the total sample would be analyzed utilizing SEM.

Table 7
*Descriptive Statistics of Removed Items*

| **Item** | *M* | *SD* |
|---|---|---|
| *Severity (SEV)* | | |
| Norovirus is too minor to impact my daily life | 5.41 | 1.28 |
| *Susceptibility (SUS)* | | |
| It is possible that I am infected by Norovirus unknowingly | 5.22 | 1.18 |
| *Response-Efficacy Handwashing (RE. HW)* | | |
| Regular handwashing would reduce my chances of contracting Norovirus | 6.03 | 1.07 |
| *Response-Efficacy Social Distancing (RE.SD* | | |
| If I follow Norovirus prevention media I would not get sick from Norovirus | 4.61 | 1.38 |
| *Self-Efficacy Social Distancing (SE.SD)* | | |
| I would be capable of successfully following Norovirus avoidance media | 5.39 | 1.03 |
| *Response Costs Handwashing (RC.HW)* | | |
| I would wash my hands every time I should, even if it takes a lot of time | 5.36 | 1.33 |
| I would wash my hands every time I should, even if the sink is far away | 5.27 | 1.38 |
| I would not use a restroom with broken sinks, even if the next usable restroom is far away | 4.25 | 1.74 |
| I would wash my hands after opening doors, even if it is inconvenient | 4.15 | 1.76 |
| I would still wash my hands with water, even if the soap dispenser was empty | 5.54 | 1.25 |
| *Response Costs Social Distancing (RC.SD)* | | |
| I would avoid people who are sick, even if it meant missing class or work | 5.09 | 1.38 |
| It would take too much effort to avoid people who are sick | 3.85 | 1.39 |
| It would take too much time to avoid people who are sick | 3.97 | 1.42 |
| I would avoid sitting close to anyone who is sick, even if it is inconvenient | 5.06 | 1.51 |
| It is not convenient to always avoid people who are sick | 5.12 | 1.46 |

*Note.* All items were removed due to low factor loadings (< .40) or heavy cross loadings (> .40).

Overall, the pilot study was useful in reducing the overall number of items to be used in the primary study. The PCA was able to find items that were able to measure Threat and Coping Appraisals, and Intentions accordingly. The final constructs and items to be used in the primary study can be seen in Table 8. Only items that were able to adhere to the cutoffs designated by the previous studies (Lwin & Shaw, 2007; Lwin, Stanaland, & Chan, 2010; Milne, Orbell, & Sheeran 2002) are utilized for primary research objectives. The Response Cost constructs each contained items that loaded heavily on the more than one component and only 2 actual items that loaded appropriately to avoid the previous mentioned cutoff values.

Table 8
*Initial Items and Proposed Latent Factors used for Primary Data Analysis*

| **Construct** | **Item** |
|---|---|
| Severity | Norovirus would make me very sick |
| | Norovirus would cause me to be hospitalized |
| | Norovirus would cause me to miss class/work |
| | Norovirus would affect my overall attitude regarding the semester |
| Susceptibility | My chances of contracting Norovirus are quite small |
| | It is possible that I will get Norovirus |
| | The chance of my peers getting Norovirus is rather large |
| | It is possible that I get Norovirus from a person rather than food |
| Response-Efficacy Handwashing | I think handwashing would be one of the best ways to prevent an illness caused by Norovirus |
| | Following advice about proper handwashing would help me not get sick from Norovirus |
| | Using hand soap reassures me that I am safe from Norovirus |
| | Handwashing would impact whether or not I get sick from Norovirus |
| Self-Efficacy Handwashing | I would know how to wash my hands effectively to reduce my risk of Norovirus |
| | I would be able to wash my hands when I want too. |
| | I would be capable of successfully following proper handwashing information |
| | I would have no difficulty practicing proper handwashing procedures |
| | I would know how to properly wash my hands to reduce my risk of Norovirus infection |

Table 8
*Continued*

| Construct | Items |
|---|---|
| Response-Efficacy Social Distancing | I think avoiding people who are sick would be one of the best ways to prevent an infection from Norovirus |
| | Avoiding people who are sick would have an impact on whether or not I am infected by Norovirus |
| | Avoiding people who are sick would reduce my chances of a Norovirus infection |
| | Actively avoiding people who appear sick would help keep me free from Norovirus infection |
| Self-Efficacy Social Distancing | I would know how to effectively avoid people who are sick |
| | I would be able to avoid people who are sick when I want too |
| | I would have no difficulty avoiding people who are sick |
| | I would be confident in my ability to avoid people who are sick |
| Handwashing Intentions | I would wash my hands to protect myself from a Norovirus infection |
| | I would wash my hands before eating |
| | I would wash my hands after eating |
| | I would wash my hands after using the restroom |
| | I would wash my hands after opening doors |
| Intentions Social Distancing | I would intentionally avoid people who are sick to protect myself from a Norovirus infection |
| | I would **not** sit next to someone who is actively sick in the classroom |
| | I would leave a public restroom if there is someone actively sick in one of the stalls |
| | I would avoid going to a self-service dining hall because it might get me sick with Norovirus |

**Primary Study**

The primary study utilized the data (*n* = 2,073) gather from MTurk (*n* = 1,631), Social Media (*n* = 104) and Email (*n* = 338). After data cleaning and elimination of incomplete responses and irregular response patterns, (i.e. those who chose the same answer choice for every item in the survey), the total sample to be used for analysis was 1,389. The total sample was randomly split in half and the first half (Sample 1, *n* = 694) was utilized for categorical EFA. The breakdown of demographics between the total sample, sample 1, and sample 2, can be seen in Table 9. The items and their demographics used in EFA can be seen in Table 10.

*Table 9*
*Demographics for each sample: Sex, College Classification, and Race*

| | **Total Sample** ($n$ = 1,389) | | **Sample 1** ($n$ = 694) | | **Sample 2** ($n$ = 695) | |
|---|---|---|---|---|---|---|
| | $n$ | % | $n$ | % | $n$ | % |
| *Sex* | | | | | | |
| Male | 571 | 41.11 | 300 | 43.23 | 271 | 38.99 |
| Female | 651 | 46.87 | 321 | 46.25 | 330 | 47.48 |
| Missing | 167 | 12.02 | 73 | 4.52 | 94 | 13.53 |
| *College Classification* | | | | | | |
| Freshmen/first-year | 31 | 2.20 | 19 | 2.70 | 12 | 1.70 |
| Sophomore | 103 | 7.40 | 58 | 8.40 | 45 | 6.50 |
| Junior | 155 | 11.20 | 72 | 10.40 | 83 | 11.90 |
| Senior | 290 | 20.90 | 149 | 21.50 | 141 | 20.30 |
| Graduate Student | 451 | 32.50 | 236 | 34.00 | 215 | 30.90 |
| Other | 193 | 13.90 | 86 | 12.40 | 107 | 15.40 |
| *Race* | | | | | | |
| White | 834 | 60.00 | 409 | 58.90 | 425 | 61.20 |
| Black or African American | 88 | 6.30 | 41 | 5.90 | 47 | 6.80 |
| American Indian or Alaska Native | 36 | 2.60 | 24 | 3.50 | 12 | 1.70 |
| Asian | 259 | 18.60 | 153 | 22.00 | 107 | 15.40 |
| Hispanic | 93 | 6.70 | 39 | 5.60 | 54 | 7.80 |
| Other | 18 | 1.30 | 2 | 0.30 | 15 | 2.20 |

Table 10
*Items and Factors for Exploratory Factor Analysis using WLSMV*

| Construct | Item | *M* | *SD* |
|---|---|---|---|
| Severity | Norovirus would make me very sick | 6.25 | 0.73 |
| | Norovirus would cause me to be hospitalized | 5.72 | 0.99 |
| | Norovirus would cause me to miss class/work | 6.13 | 0.81 |
| | Norovirus would affect my overall attitude regarding the semester | 5.75 | 1.09 |
| Susceptibility | My chances of contracting Norovirus are quite small | 5.33 | 1.17 |
| | It is possible that I will get Norovirus | 5.92 | 0.76 |
| | The chance of my peers getting Norovirus is rather large | 5.87 | 0.79 |
| | It is possible that I get Norovirus from a person rather than food | 5.92 | 0.76 |
| Response-Efficacy HW | I think handwashing would be one of the best ways to prevent an illness caused by Norovirus | 6.02 | 1.07 |
| | Following advice about proper handwashing would help me not get sick from Norovirus | 5.80 | 1.27 |
| | Using hand soap reassures me that I am safe from Norovirus | 5.20 | 1.40 |
| | Handwashing would impact whether or not I get sick from Norovirus | 5.49 | 1.23 |
| Self-Efficacy HW | I would know how to wash my hands effectively to reduce my risk of Norovirus | 5.84 | 1.15 |
| | I would be able to wash my hands when I want to | 5.77 | 1.14 |
| | I would be capable of successfully following proper handwashing information | 6.12 | 1.02 |
| | I would have no difficulty practicing proper handwashing procedures | 6.03 | 1.16 |
| | I would know how to properly wash my hands to reduce my risk of Norovirus infection | 5.89 | 1.1 |
| Response-Efficacy SD | I think avoiding people who are sick would be one of the best ways to prevent an infection from Norovirus | 5.65 | 1.14 |
| | Avoiding people who are sick would have an impact on whether or not I am infected by Norovirus | 5.64 | 1.22 |
| | Avoiding people who are sick would reduce my chances of a Norovirus infection | 5.75 | 1.13 |
| | Actively avoiding people who appear sick would help keep me free from Norovirus infection | 5.49 | 1.28 |

Table 10
*Continued*

| Construct | Item | *M* | *SD* |
|---|---|---|---|
| Self-Efficacy SD | I would know how to effectively avoid people who are sick | 5.14 | 1.42 |
| | I would be able to avoid people who are sick when I want too | 4.86 | 1.53 |
| | I would have no difficulty avoiding people who are sick | 4.72 | 1.63 |
| | I would be confident in my ability to avoid people who are sick | 4.81 | 1.63 |
| Intentions HW | I would wash my hands to protect myself from a Norovirus infection | 6.15 | 0.95 |
| | I would wash my hands before eating | 6.13 | 1.10 |
| | I would wash my hands after using the restroom | 6.46 | 0.88 |
| | I would wash my hands after eating | 5.66 | 1.33 |
| | I would wash my hands after opening doors | 5.16 | 1.37 |
| Intentions SD | I would leave a public restroom if there is someone actively sick in one of the stalls | 5.30 | 1.37 |
| | I would avoid going to a self-service dining hall because it might get me sick with Norovirus | 5.10 | 1.36 |
| | I would order food to my room to avoid eating around others in the dining hall | 5.14 | 1.28 |
| | I would intentionally avoid people who are sick to protect myself from a Norovirus infection | 5.81 | 1.12 |
| | I would not sit next to someone who is actively sick in the classroom | 5.88 | 1.14 |

**Exploratory Factor Analysis**

**Modified Threat Appraisals.** Threat Appraisals (i.e. severity and susceptibility) was put through an EFA for categorical data utilizing MPlus multivariate software. Results indicated that the pattern coefficients were appropriate for each indicator and their respective factor (see Table 11). Threat Appraisals had an excellent estimated model fit ($\chi^2$ (13) = 52.86, $p$ <.001; RMSEA = .066 (90%CI = .048, .086); CFI = .98, TLI = .95). The model chi-squared test was significant, which can sometimes mean the model does not fit well, however in cases of high sample sizes, the model chi-square is almost always significant and thus other fit indices should be consulted

(Hooper, Coughlan, Mullen, 2008). The Severity and Susceptibility factors were also significantly correlated (r = 0.521) at the .05 level.

Table 11
*Threat Appraisals Pattern Coefficients using WLSMV*

| | **Factors** | |
|---|---|---|
| **Items** | SEV | SUS |
| *Severity (SEV)* | | |
| Norovirus would make me very sick | 0.69* | -0.001 |
| Norovirus would cause me to be hospitalized | 0.70* | -0.06 |
| Norovirus would cause me to miss class/work | 0.58* | 0.10 |
| Norovirus would affect my overall attitude regarding the semester | 0.58* | 0.05 |
| *Susceptibility (SUS)* | | |
| My chances of contracting Norovirus are quite small | 0.05 | 0.54* |
| It is possible that I will get Norovirus | 0.03 | 0.67* |
| The chance of my peers getting Norovirus is rather large | -0.07 | 0.82* |
| It is possible that I get Norovirus from a person rather than food | 0.002 | 0.58* |

*$p < .05$

**Modified Coping Appraisals.** Coping Appraisals (i.e. Self-Efficacy & Response-Efficacy for Handwashing & Social Distancing) was examined next. The construct for 'Response-Efficacy Handwashing' had low pattern coefficients for its indicators, and heavy cross loadings with the other factors in the model (>.40). Items were systematically removed based on the largest cross loadings and smallest loadings on itself. This eventually lead to the majority of the items needing to be removed from this construct, thus violating the three-indicator rule for latent constructs (Bollen & Davis, 2009). Subsequently, this construct was removed entirely. Examining Model 2 without the 'Response-Efficacy Handwashing' led to strong pattern coefficients on each respective factor (see Table 12) and an excellent estimated model fit ($\chi^2$ (42) = 159.15, $p < .001$; RMSEA = .063 (90%CI = .053, .074); CFI = .99, TLI = .99). The Self-Efficacy Handwashing factor was significantly correlated with Response-Efficacy

Social Distancing (r = 582) and the Self-Efficacy Social Distancing (r = .190) factors at the .05 level. Response and Self-Efficacy Social Distancing factors were also significantly correlated (r = .417) at the .05 level.

Table 12
*Coping Appraisals Pattern Coefficients using WLSMV*

| | **Factors** | | |
|---|---|---|---|
| **Items** | SE.HW | RE.SD | SE.SD |
| *Self-Efficacy Handwashing (SE.HW)* | | | |
| I would know how to wash my hands effectively to reduce my risk of Norovirus | 0.82* | -0.14 | 0.12 |
| I would be able to wash my hands when I want to | 0.61* | 0.02 | 0.15 |
| I would be capable of successfully following proper handwashing information | 0.88* | 0.01 | -0.11 |
| I would have no difficulty practicing proper handwashing procedures | 0.82* | 0.01 | -0.09 |
| I would know how to properly wash my hands to reduce my risk of Norovirus infection | 0.86* | -0.07 | -0.005 |
| *Response-Efficacy Social Distancing (RE.SD)* | | | |
| I think avoiding people who are sick would be one of the best ways to prevent an infection from Norovirus | 0.01 | 0.82* | 0.06 |
| Avoiding people who are sick would have an impact on whether or not I am infected by Norovirus | 0.05 | 0.8* | 0.02 |
| Avoiding people who are sick would reduce my chances of a Norovirus infection | 0.11 | 0.82* | -0.05 |
| Actively avoiding people who appear sick would help keep me free from Norovirus infection | -0.05 | 0.77* | 0.14 |
| *Self-Efficacy Social Distancing (SE.SD)* | | | |
| I would know how to effectively avoid people who are sick | 0.15 | 0.16 | 0.67* |
| I would be able to avoid people who are sick when I want too | -0.02 | 0.09 | 0.84* |
| I would have no difficulty avoiding people who are sick | -0.01 | 0.03 | 0.92* |
| I would be confident in my ability to avoid people who are sick | 0.03 | 0.01 | 0.92* |

*$p < .05$

**Modified Handwashing Intentions.** Handwashing Intentions was a unidimensional model consisting of only one factor (see Table 13). This measurement model initially had 5 items after the pilot study, but during the EFA two items were found to be below the .40 cut off and/or wanting to load heavily on another factor (>.40). These items were subsequently removed one by one and the model was re-analyzed after each removal to see if the remaining items still abided by the previously distinguished cutoff values. The resulting model was estimated to be just identified as only 3 items remained on the one factor. The items lost from this factor can be seen in Table 14 along with the other items removed during the EFAs.

Table 13
*Handwashing Intention's Pattern Coefficients using WLSMV*

| | **Factor** |
|---|---|
| **Item & Factor** | HWI |
| *Handwashing Intentions (HWI)* | |
| I would wash my hands to protect myself from a Norovirus infection | 0.81** |
| I would wash my hands before eating | 0.77** |
| I would wash my hands after using the restroom | 0.81** |

**$p$ < .001

**Modified Social Distancing Intentions**. Social Distancing Intentions was another unidimensional model. This measurement model also retained all 5 items after the initial pilot study. Upon examination through EFA, 2 items were subsequently removed due to heavy cross loadings on another factor. The first item was removed due to loading almost .8 on another factor and upon removal of this factor one of the remaining factors dropped below well below the .40 cutoff and was then removed. This resulted in a just identified model. Table 14 displays the pattern coefficients for this factor and each item.

Table 14
*Social Distancing Intention's Pattern Coefficients using WLSMV*

| **Item & Factor** | **Factor** SDI |
|---|---|
| *Social Distancing Intentions (SDI)* | |
| I would intentionally avoid people who are sick to protect myself from a Norovirus infection | 0.79** |
| I would not sit next to someone who is actively sick in the classroom | 0.87** |
| I would leave a public restroom if there is someone actively sick in one of the stalls | 0.50** |

** $p < .001$

Table 15 displays all items removed during the EFAs due to loading heavily on another factor (>.40) or having a factor loading below 0.40. Subsequently, Table 16 displays all the remaining items and factors to be used in the CFA for model re-validation.

Table 15
*Items & Factors removed during Exploratory Factor Analyses*

| **Item & Factor** | *M* | *SD* |
|---|---|---|
| *Response-Efficacy Handwashing (RE.HW)* | | |
| I think handwashing would be one of the best ways to prevent an illness caused by Norovirus | 6.02 | 1.07 |
| Following advice about proper handwashing would help me not get sick from Norovirus | 5.80 | 1.27 |
| Using hand soap reassures me that I am safe from Norovirus | 5.20 | 1.40 |
| Handwashing would impact whether or not I get sick from Norovirus | 5.49 | 1.23 |
| *Handwashing Intentions (HW.I)* | | |
| I would wash my hands after eating | 5.66 | 1.33 |
| I would wash my hands after opening doors | 5.16 | 1.37 |
| *Social Distancing Intentions (SD.I)* | | |
| I would intentionally avoid people who are sick to protect myself from a Norovirus infection | 5.81 | 1.12 |
| I would **not** sit next to someone who is actively sick in the classroom | 5.88 | 1.14 |

*Note*. All items were removed due to low factor loadings (< .40) or heavy cross loadings (> .40).

**Confirmatory Factor Analysis**

Utilizing the second half of the data set (Sample 2, *n* = 695), confirmatory factor analyses were performed on each of the 4 measurement models (Modified Threat Appraisals: Severity & Susceptibility; Modified Coping Appraisals: Self-Efficacy Handwashing, Response-Efficacy Social Distancing, & Self-Efficacy Social Distancing; Modified Intention to wash hands: Handwashing Intentions; Modified Intention to social distance: Social Distancing Intentions) and the 27 items that remained after the exploratory factor analyses. The purpose of this analysis was to re-validate them based on their model fit and reliability index using a non-linear SEM reliability coefficient, which involves model threshold estimations (Green & Yang, 2009; Yang & Green, 2011). The measurement models needed to be re-validated before the overall structure model could be placed into structural equation modeling utilizing WLSMV since the original scales from which the items were taken had been modified to fit the context of hNoV infections. The list of items to be used in the confirmatory factor analyses can be seen below in Table 16 along with each of their respective mean and standard deviation.

Table 16
*Items and Factors for Confirmatory Factor Analysis using WLSMV*

| Construct | Item | *M* | *SD* |
|---|---|---|---|
| Severity | Norovirus would make me very sick | 6.28 | 0.88 |
| | Norovirus would cause me to be hospitalized | 5.73 | 1.10 |
| | Norovirus would cause me to miss class/work | 6.11 | 0.89 |
| | Norovirus would affect my overall attitude regarding the semester | 5.63 | 1.22 |
| Susceptibility | My chances of contracting Norovirus are quite small | 5.46 | 1.18 |
| | It is possible that I will get Norovirus | 5.75 | 0.85 |
| | The chance of my peers getting Norovirus is rather large | 5.70 | 0.90 |
| | It is possible that I get Norovirus from a person rather than food | 5.87 | 0.84 |
| Self-Efficacy HW | I would know how to wash my hands effectively to reduce my risk of Norovirus | 5.80 | 1.06 |
| | I would be able to wash my hands when I want to | 5.75 | 1.13 |
| | I would be capable of successfully following proper handwashing information | 6.12 | 0.95 |
| | I would have no difficulty practicing proper handwashing procedures | 6.03 | 1.14 |
| | I would know how to properly wash my hands to reduce my risk of Norovirus infection | 5.90 | 1.10 |
| Response-Efficacy SD | I think avoiding people who are sick would be one of the best ways to prevent an infection from Norovirus | 5.61 | 1.15 |
| | Avoiding people who are sick would have an impact on whether or not I am infected by Norovirus | 5.60 | 1.25 |
| | Avoiding people who are sick would reduce my chances of a Norovirus infection | 5.76 | 1.09 |
| | Actively avoiding people who appear sick would help keep me free from Norovirus infection | 5.35 | 1.29 |
| Self-Efficacy SD | I would know how to effectively avoid people who are sick | 5.02 | 1.33 |
| | I would be able to avoid people who are sick when I want too | 4.74 | 1.53 |
| | I would have no difficulty avoiding people who are sick | 4.61 | 1.62 |
| | I would be confident in my ability to avoid people who are sick | 4.83 | 1.57 |
| Intentions HW | I would wash my hands to protect myself from a Norovirus infection | 6.22 | 0.86 |
| | I would wash my hands before eating | 6.16 | 0.96 |
| | I would wash my hands after using the restroom | 6.56 | 0.81 |
| Intentions SD | I would intentionally avoid people who are sick to protect myself from a Norovirus infection | 5.72 | 1.11 |
| | I would not sit next to someone who is actively sick in the classroom | 5.75 | 1.20 |
| | I would leave a public restroom if there is someone actively sick in one of the stalls | 5.24 | 1.38 |

**Modified Threat Appraisals.** Threat Appraisals was found to have excellent estimated model fit parameters ($\chi^2$ (19) = 54.17, $p < .001$; RMSEA = 0.05 (90%CI = 0.033, 0.066); CFI = 0.99, TLI = 0.98). The estimated non-linear SEM reliability coefficient was found to be acceptable at .77. Ideally this value would be .80 or greater, but .70 still meets acceptable standards (Green & Yang, 2009). Table 17 displays the standardized coefficients for each observed variable in the Modified Threat Appraisals measurement model. All standardized coefficients were significant ($p < .001$) despite the first item under Susceptibility registering at only 0.39. The Severity and Susceptibility latent factors were also significantly correlated (0.48) at $p < .001$. The CFA diagram for modified threat appraisals can be seen in Figure 4.

Table 17
*Standardized Coefficients for Threat Appraisals using WLSMV*

| **Latent Construct & Observed Variables** | β | SE |
|---|---|---|
| *Severity* | | |
| Norovirus would make me very sick | 0.81** | 0.025 |
| Norovirus would cause me to be hospitalized | 0.75** | 0.023 |
| Norovirus would cause me to miss class/work | 0.58** | 0.031 |
| Norovirus would affect my overall attitude regarding the semester | 0.67** | 0.027 |
| *Susceptibility* | | |
| My chances of contracting Norovirus are quite small | 0.39** | 0.035 |
| It is possible that I will get Norovirus | 0.74** | 0.027 |
| The chance of my peers getting Norovirus is rather large | 0.77** | 0.029 |
| It is possible that I get Norovirus from a person rather than food | 0.55** | 0.030 |

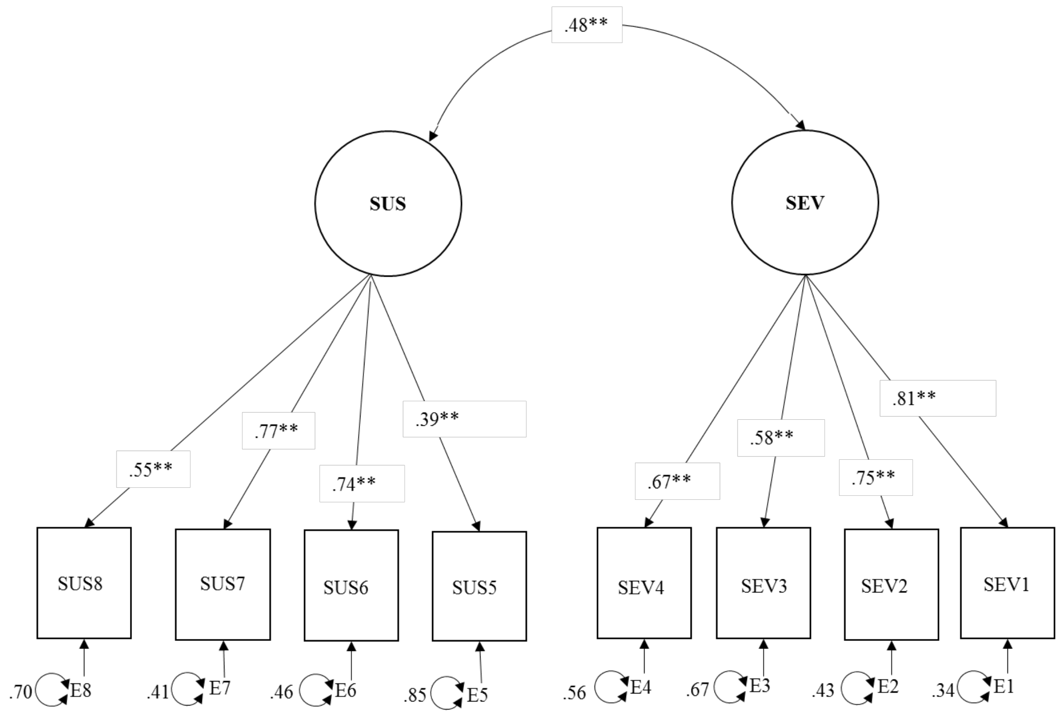


*Figure 4.* Confirmatory factor analysis for Threat Appraisals: Severity (SEV) & Susceptibility (SUS). $\chi^2(19) = 54.17$; CFI = .99; TLI = .98; RMSEA = 0.05; E = error; ***p* <.001.

**Modified Coping Appraisals.** Coping Appraisals was found to have marginally acceptable estimated model fit indices ($\chi^2$ (62) = 768.09, $p < .001$; RMSEA = .12 (90%CI = .10, .13); CFI = .95, TLI = .94). The estimated non-linear SEM reliability coefficient was found to be excellent at .92. These estimations coupled with all items having moderate to high significant standardized factor loadings ($p < .001$) suggest that this model was reliable and valid (see Table 18). Self-Efficacy-HW and Response-Efficacy-SD factors were found to be significantly correlated (.54) at $p < .001$. Similarly, Self-Efficacy-SD was significantly correlated with Self-Efficacy-HW (r = 0.18) and Response-Efficacy-SD (r = 0.35) at $p < .001$. Figure 5 displays the CFA diagram for Coping Appraisals.

Table 18

*Standardized Coefficients for Coping Appraisals using WLSMV*

| **Latent Construct & Observed Variables** | β | *SE* |
|---|---|---|
| *Self-Efficacy Handwashing (S.E.HW)* | | |
| I would know how to wash my hands effectively to reduce my risk of Norovirus | 0.74** | 0.02 |
| I would be able to wash my hands when I want too | 0.59** | 0.027 |
| I would be capable of successfully following proper handwashing information | 0.83** | 0.016 |
| I would have no difficulty practicing proper handwashing procedures | 0.78** | 0.019 |
| I would know how to properly wash my hands to reduce my risk of Norovirus infection | 0.81** | 0.016 |
| *Response-Efficacy Social Distancing (R.E.SD)* | | |
| I think avoiding people who are sick would be one of the best ways to prevent an infection from Norovirus | 0.82** | 0.014 |
| Avoiding people who are sick would have an impact on whether or not I am infected by Norovirus | 0.84** | 0.015 |
| Avoiding people who are sick would reduce my chances of a Norovirus infection | 0.92** | 0.01 |
| Actively avoiding people who appear sick would help keep me free from Norovirus infection | 0.77** | 0.016 |
| *Self-Efficacy Social Distancing (S.E.SD) items* | | |
| I would know how to effectively avoid people who are sick | 0.71** | 0.019 |
| I would be able to avoid people who are sick when I want too | 0.83** | 0.012 |
| I would have no difficulty avoiding people who are sick | 0.84** | 0.013 |
| I would be confident in my ability to avoid people who are sick | 0.93** | 0.009 |

** $p < .001$

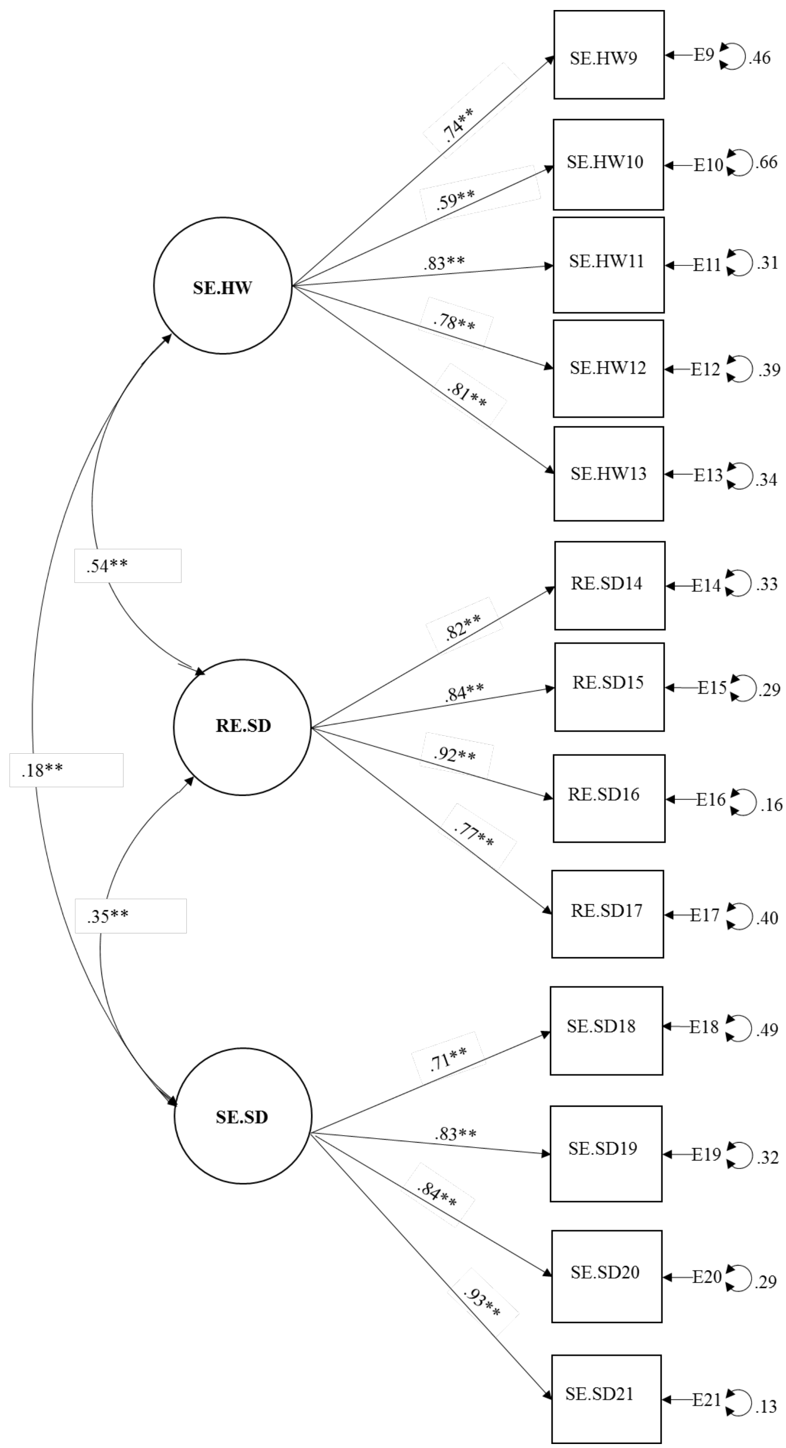


*Figure 5.* Confirmatory factor analysis for Coping Appraisals: Self-Efficacy Handwashing (SE.HW), Response-Efficacy Social Distancing (RE.SD), & Self-Efficacy Social Distancing (SE.SD). $\chi^2(62) = 768.09$; CFI = .95; TLI = .94; RMSEA = 0.12; E = error; $^{**}p < .001$.

**Modified Handwashing Intentions.** Handwashing Intentions was found to be a just identified model. As such, it holds a good estimated model fit. This was a just identified model and as such no model fit estimations were made. The estimated non-linear SEM reliability coefficient for this model acceptable at .71. These estimations and significant standardized coefficients ($p < .001$) suggest that this model was valid and reliable (see Table 19). Figure 6 displays the diagram for Handwashing Intentions.

Table 19
*Standardized Coefficients for Handwashing Intentions using WLSMV*

| **Observed Variables** | β | *SE* |
|---|---|---|
| I would wash my hands to protect myself from a Norovirus infection | 0.57** | 0.04 |
| I would wash my hands before eating | 0.93** | 0.05 |
| I would wash my hands after using the restroom | 0.56** | 0.04 |

**$p < .001$

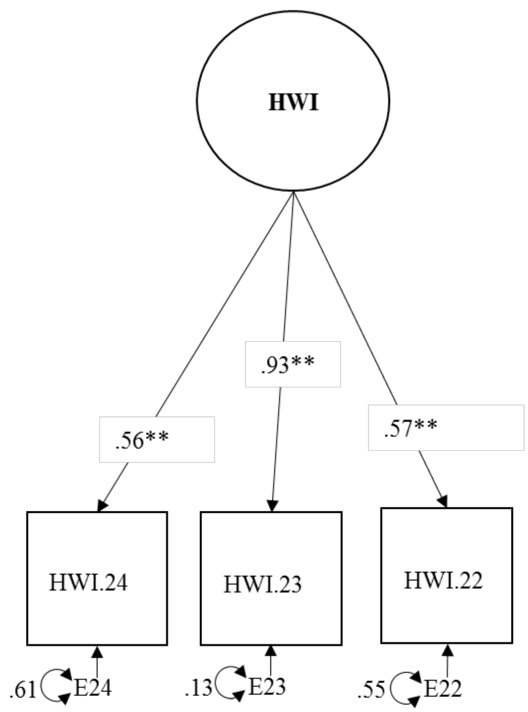


*Figure 6.* Confirmatory factor analysis for Handwashing Intentions (HWI). Just Identified Model; E = error; **$p$ <.001.

**Modified Social Distancing Intentions.** Social Distancing Intentions was also found to be a just identified model. This resulted in no model fit indices being reported. The estimated non-linear SEM reliability coefficient for this model was .75, which suggests this model met acceptable reliability standards. The item loadings for this model were also all significant at $p < .001$ (see Table 20). Figure 7 displays the just identified Modified Social Distancing Intentions.

Table 20
*Standardized Coefficients for Social Distancing Intentions using WLSMV*

| **Observed Variables** | β | *SE* |
|---|---|---|
| I would intentionally avoid people who are sick to protect myself from a Norovirus infection | 0.77** | 0.03 |
| I would not sit next to someone who is actively sick in the classroom | 0.83** | 0.03 |
| I would leave a public restroom if there is someone actively sick in one of the stalls | 0.55** | 0.03 |

***p* < .001

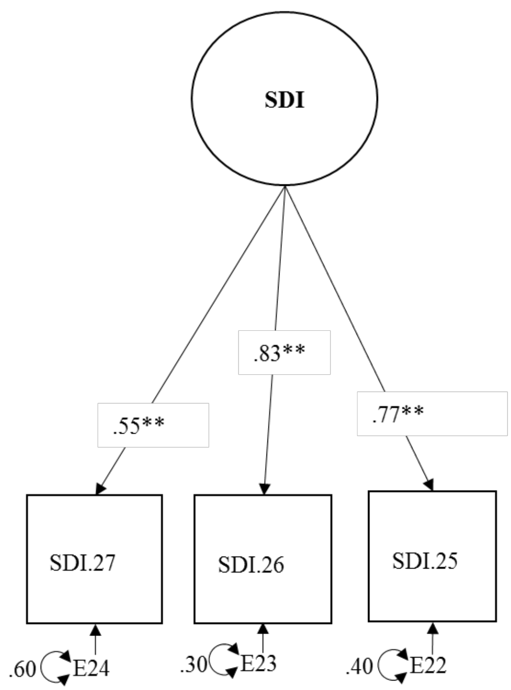


*Figure 7.* Confirmatory factor analysis for Social Distancing Intentions (SDI). Just Identified Model; E = error; ***p* <.001

## Structural Equation Modeling

The data was used collectively as one total sample (*n* = 1,389) to perform SEM analyses on the proposed structure model. The initial proposed structure model before any analyses were performed can be viewed in Figure 3. After preliminary factor analyses, the final proposed structure model was greatly reduced in size and complexity. Three latent factors, and 23 items had been removed (see Figure 8). Models 1-4 were all found to hold acceptable estimated fit standards and reliability. These constructs were then put into the structure model and SEM analyses with WLSMV was conducted. Table 21 demonstrates the items used in this analysis with their corresponding construct. The means and standard deviations for the items in the full data set are also presented.

The original proposed model could not reach convergence in MPlus. Inspection of the modification indices suggested initial start values be added to F1 (i.e. Severity). The systematic addition of these start values still resulted in model non-convergence, indicating a potential underlying issue with the content of F1. Therefore, after checking all preliminary start values, it was decided that F1 be removed from the model. This was likely due to the item content for this factor having highly skewed distributions, more on why this factor was removed can be found in the following section.

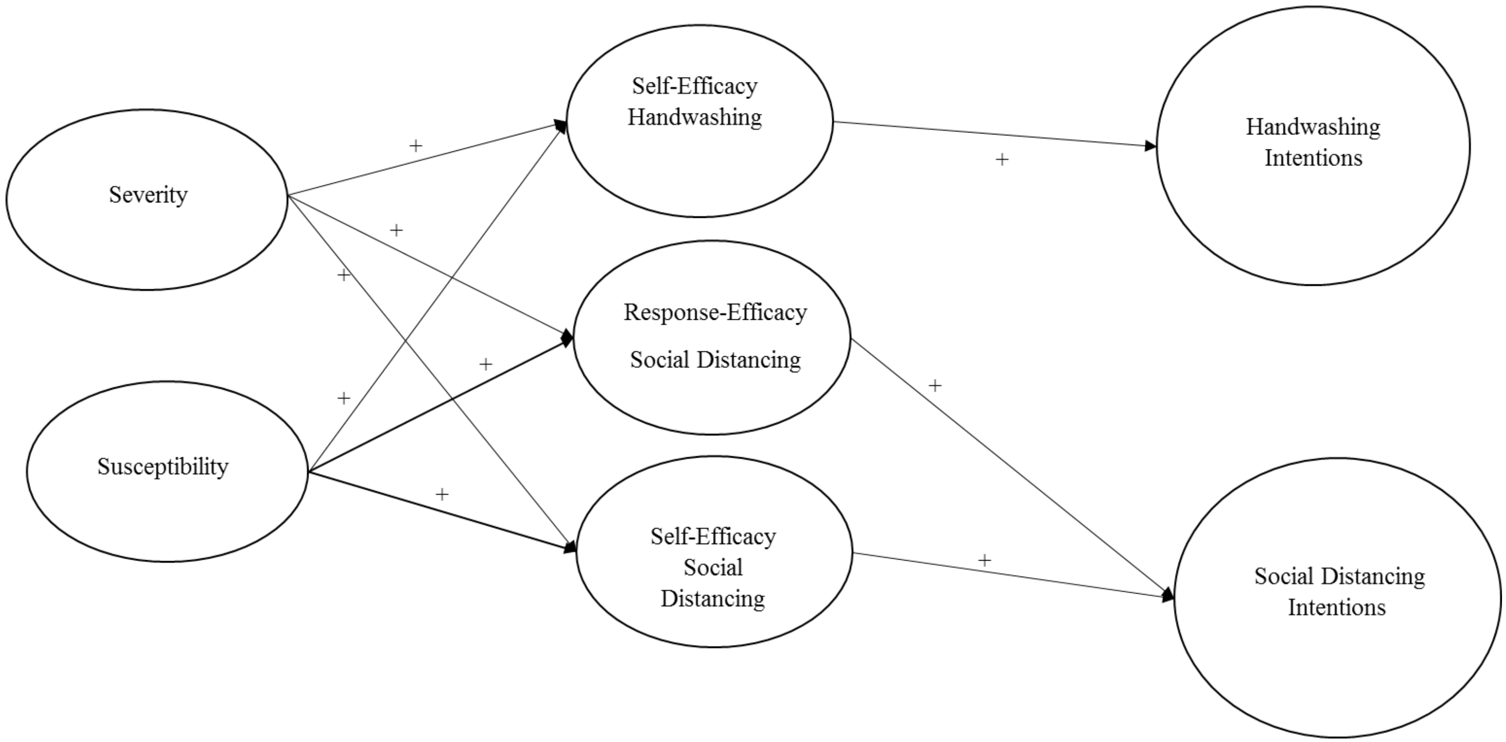


*Figure 8.* Final Proposed Structure Model for the combination of PMT and SCT in the context of hNoV prevention practices on college campuses.

Table 21
*Standardized Coefficients for the Final Structure Model*

| Construct | Item | *M* | *SD* |
|---|---|---|---|
| Severity | Norovirus would make me very sick | 6.20 | 0.81 |
| | Norovirus would cause me to be hospitalized | 5.73 | 1.05 |
| | Norovirus would cause me to miss class/work | 6.12 | 0.85 |
| | Norovirus would affect my overall attitude regarding the semester | 5.69 | 1.15 |
| Susceptibility | My chances of contracting Norovirus are quite small | 5.40 | 1.18 |
| | It is possible that I will get Norovirus | 5.83 | 0.81 |
| | The chance of my peers getting Norovirus is rather large | 5.79 | 0.85 |
| | It is possible that I get Norovirus from a person rather than food | 5.90 | 0.80 |
| Self-Efficacy HW | I would know how to wash my hands effectively to reduce my risk of Norovirus | 5.82 | 1.10 |
| | I would be able to wash my hands when I want to | 5.76 | 1.13 |
| | I would be capable of successfully following proper handwashing information | 6.12 | 0.98 |
| | I would have no difficulty practicing proper handwashing procedures | 6.03 | 1.15 |
| | I would know how to properly wash my hands to reduce my risk of Norovirus infection | 5.89 | 1.10 |
| Response-Efficacy SD | I think avoiding people who are sick would be one of the best ways to prevent an infection from Norovirus | 5.63 | 1.15 |
| | Avoiding people who are sick would have an impact on whether or not I am infected by Norovirus | 5.62 | 1.23 |
| | Avoiding people who are sick would reduce my chances of a Norovirus infection | 5.76 | 1.10 |
| | Actively avoiding people who appear sick would help keep me free from Norovirus infection | 5.42 | 1.29 |
| Self-Efficacy SD | I would know how to effectively avoid people who are sick | 5.10 | 1.37 |
| | I would be able to avoid people who are sick when I want too | 4.80 | 1.53 |
| | I would have no difficulty avoiding people who are sick | 4.67 | 1.63 |
| | I would be confident in my ability to avoid people who are sick | 4.82 | 1.60 |
| Intentions HW | I would wash my hands to protect myself from a Norovirus infection | 6.19 | 0.91 |
| | I would wash my hands before eating | 6.15 | 1.03 |
| | I would wash my hands after using the restroom | 6.51 | 0.85 |
| Intentions SD | I would intentionally avoid people who are sick to protect myself from a Norovirus infection | 5.76 | 1.12 |
| | I would not sit next to someone who is actively sick in the classroom | 5.81 | 1.17 |
| | I would avoid going to a self-service dining hall because it might get me sick with Norovirus | 5.27 | 1.38 |

The reduction in overall factors, ended in hypotheses 1a-2c, 3b, 3c, and 4c being eliminated as the underlying constructs needed for each of these hypotheses was removed from the final proposed model (i.e. Severity, Response-Efficacy Handwashing, & Response Cost Handwashing & Social Distancing). The reduced structure model underwent SEM testing again and all paths were found to be significant. The overall structure model presented a mediocre (MacCallum, Browne, & Sugawara, 1996) estimation of model fit ($\chi^2$ (223) = 3321.26, $p$ = < .001; RMSEA = 0.10 (90%CI = 0.09, 0.103); CFI = .92, TLI = .91).

Hypotheses 3a, 4a, & 4b were found to be significant (see figure 9). Susceptibility impacted handwashing and social distancing intentions in positive ways when mediated by Self-Efficacy HW, Response-Efficacy SD, and Self-Efficacy SD. Table 22 displays the standard coefficients for each measurement model's items and figure 9 demonstrates the structure model with standardized loadings. These results indicated that the more susceptible an individual feels they are to contracting hNoV, the more likely they were to believe they had the capability to wash their hands and in turn the more likely they were to engage in handwashing practices. Similarly, increases in an individuals' feeling of vulnerability to hNoV appeared to elevate their belief in their ability to distance themselves or avoid those who were sick. Additionally, increasing their belief that distancing themselves from others would help protect them, augmented their overall intention to practice social distancing from those who were sick or displayed ill symptoms in public. Interestingly, both outcome variables' disturbances were shown to have a relationship with one another. This could be due to the similar item wordings between intentions to perform actions to protect themselves from hNoV and due to avoiding sick people and washing one's hands can be seen as similar behaviors as they both help prevent the spreading of pathogens. It stands to reason that an outside factor not accounted for is helping to explain their relationship.

Table 22
*Standardized Coefficients for the Final Structure Model*

| | β | | | | | | |
|---|---|---|---|---|---|---|---|
| **Observed Variable** | SUS | SE.HW | RE.SD | SE.SD | HWI | SDI | *SE* |
| SUS5 | 0.23** | | | | | | 0.03 |
| SUS6 | 0.42** | | | | | | 0.03 |
| SUS7 | 0.42** | | | | | | 0.03 |
| SUS8 | 0.45** | | | | | | 0.03 |
| SE.HW9 | | 0.75** | | | | | 0.01 |
| SE.HW10 | | 0.63** | | | | | 0.02 |
| SE.HW11 | | 0.84** | | | | | 0.01 |
| SE.HW12 | | 0.79** | | | | | 0.01 |
| SE.HW13 | | 0.81** | | | | | 0.01 |
| RE.SD14 | | | 0.84** | | | | 0.01 |
| RE.SD15 | | | 0.83** | | | | 0.01 |
| RE.SD16 | | | 0.88** | | | | 0.01 |
| RE.SD17 | | | 0.78** | | | | 0.01 |
| SE.SD18 | | | | 0.80** | | | 0.01 |
| SE.SD19 | | | | 0.85** | | | 0.01 |
| SE.SD20 | | | | 0.86** | | | 0.08 |
| SE.SD21 | | | | 0.91** | | | 0.01 |
| HWI.22 | | | | | 0.85** | | 0.02 |
| HWI.23 | | | | | 0.74** | | 0.02 |
| HWI.24 | | | | | 0.48** | | 0.02 |
| SDI.25 | | | | | | 0.86** | 0.01 |
| SDI.26 | | | | | | 0.76** | 0.02 |
| SDI.27 | | | | | | 0.50** | 0.02 |

**$p<.001$

Due to the mediocre estimated model fit, the structure model loosely suggests that Susceptibility mediated by Self-Efficacy HW, Response-Efficacy SD, and Self-Efficacy SD, positively impacts an individuals' intentions to wash their hands and social distance themselves from those who are sick while on a college campus (see Figure 9). Suggesting that when an individual feels a degree of vulnerability to a hNoV infection, that feeling is processed in terms of what can be done about this threat, and will those actions or solutions actually help. If they will and the individual can perform the suggested behavior with confidence, then odds of practicing the preventative behaviors increase.

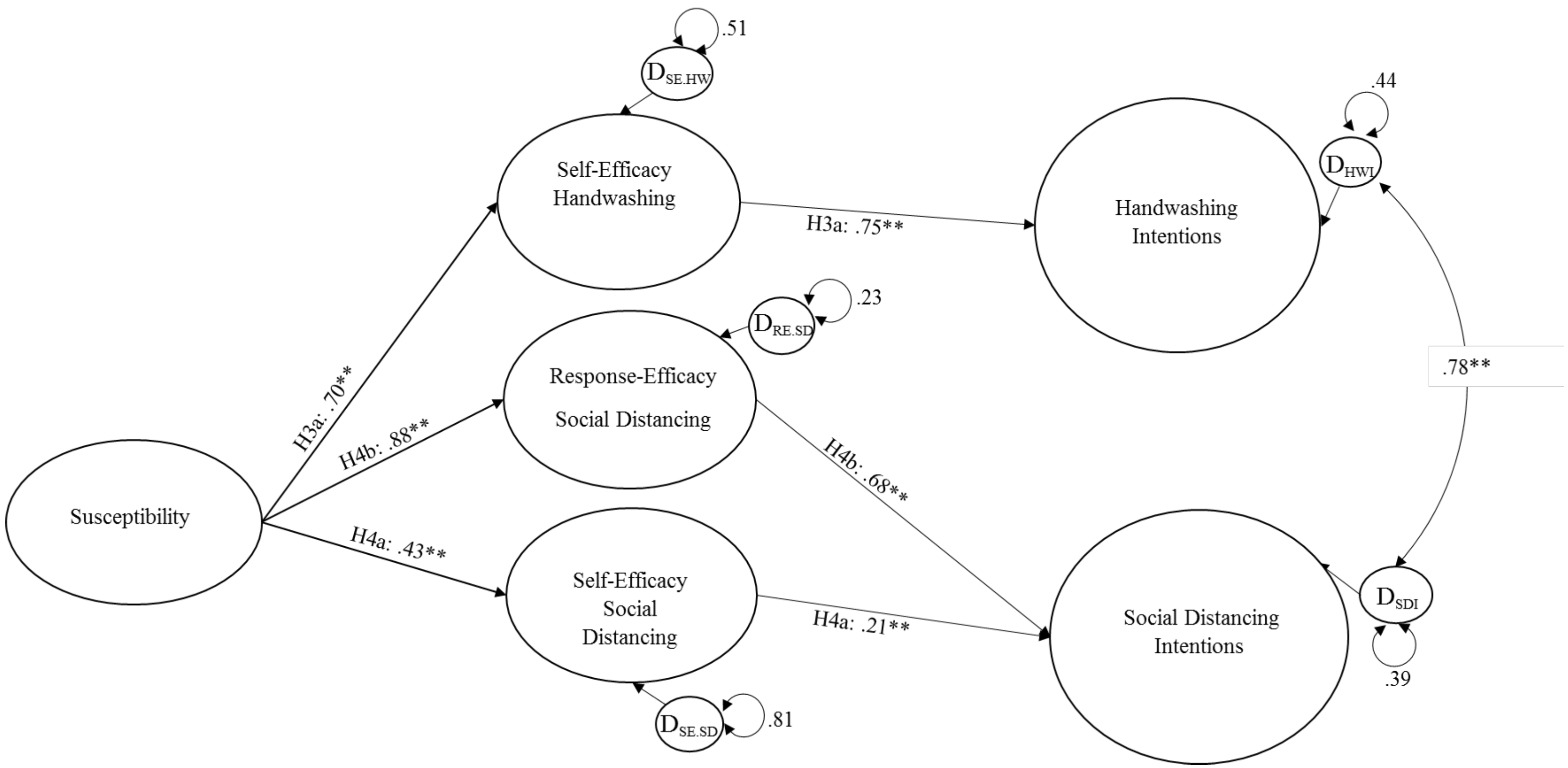


*Figure 9.* Final Structure Model for the combination of PMT and SCT in the context of hNoV prevention practices on college campuses. ***p* < .001

# CHAPTER V

## Discussion

### Components Removed During PCA

Through the use of PCA analysis on the pilot data the number of items to be utilized in this model was reduced from the initial proposed 50, to 35. The items removed during PCA were those that wanted to load heavily on more than one factor (>.40) and those that had loadings of less than .40 on a single factor (see Table 7). The components removed (i.e. Response Costs HW & SD) had high cross loading issues and low item loadings. After careful examination of the research and theory in question, it was decided that those items would be removed. The removal of these constructs came after an extensive literature review and re-examination of the studies that contained the root of the scales, which were pulled to be adapted to fit the context of this study.

**Response Costs HW & SD.** The constructs for Response Cost Handwashing and Response Cost Social Distancing were removed since 3 or more of the items that were designed to measure Response Costs were loading highly on other components. The items that did not have high cross loadings did not meet the three-indicator rule (Bollen & Davis, 2009) for latent constructs. Upon further examination of the data, the surrounding literature and theory involved, Response Costs were not considered viable factors to be utilized in this study, as the study in was perception based, and not an intervention study based on formal or hypothesized outbreak scenario. While the study was designed in the context of being on a college campus, there was no simulated outbreak scenario created nor was this study conducted with a population that rapidly experiences hNoV infection on a consistent basis as seen in past studies. Instead a brief background was given on hNoV and participants were asked to think in terms of being on a college campus (the majority of participants were current college students) and subsequently answered questions based on their perceived Threat Appraisals, Coping Appraisals, and Intentions to practice protection motivation behaviors. The scales were developed from articles that implemented intervention established approaches using the PMT based on simulated scenarios and studies that targeted high at-risk populations where the disease or problem in question was rampant and well known (Fisher et al., 2018; Lwin & Shaw, 2007; Lwin, Stanaland, & Chan, 2011; Milne, Sheeran, & Orbell, 2000). Lwin & Shaw (2007) conducted their study on myopia prevention in children by targeting adults in Singapore, a country with one of the highest rate of myopia in the world. Specifically targeting this single region, the authors were better able to design intervention-based approaches and understand parents' protection motivation factors for preventing myopia in their child.

The authors suggested that the scenarios, the common occurrence of myopia in these regions, and participants past knowledge and experience may have played a significant role in expressing a better measure of threat of this disease to parents and participants (Fisher et al., 2018; Lwin & Shaw, 2007; Lwin, Stanaland, & Chan, 2011; Milne, Sheeran, & Orbell, 2000). Lwin & Shaw (2007). Response costs for previous studies were monetary and time based; because of this, parent's perceptions could have been influenced since their child's best health interest was in question and not merely having to use extra time to wash their hands or go out of their way to avoid someone who is sick.

The decision to remove these constructs was made after revisiting the literature and re-examining a meta-analysis of PMT research where the authors concluded:

> Although all of the PMT variables exerted moderate effects in general, some may be more important in one area of protection versus another. Understanding the relative impact of the key variables associated with the targeted protective behavior would be important in formulating treatment interventions and

> persuasive communications. Reviews of specific health areas must be used to determine the emphasis placed on different PMT variables particular to that area (e.g. cancer prevention or adherence to medical-treatment regimens). Such information may help to pinpoint areas for intervention, or at the very least to identify obstacles to improved health or safety (Floyd, Prentice-Dunn, & Rogers, 2000, p. 422).

In conjunction with this conclusion, Gilbert, Friske, and Lindzey (1998) discussed how features from both the person and the situation in question can shape the influence of predictors specified by PMT. This leads to the belief that in a college setting, hNoV Response Costs (i.e. reasons to not practice protection motivations) may be of little informative power, since it is common practice for social norming to occur on college campuses (Miko et al., 2012). This is where students do not want to seem excluded, but rather feel included, so they will practice hygiene behaviors that they think will not alienate them from others or would help them feel affiliated (Curtis, Danquah, & Aunger, 2009). Handwashing can also be considered a common hygiene habit learned from an early age (Curtis, Danquah, & Aunger, 2009) and thus is more likely to be practiced than not, so the questions advocating reasons to not wash one's hands could have been rendered meaningless to participants. In the same study (Curtis, Danquah, & Aunger, 2009, p. 661) it was noted that some participants felt a general 'disgust' towards others for being dirty or contaminated and thus rejected a sense of affiliation with them. Participants made mention that it was outside of the social norm to associate with those who are contaminated for fear of being contaminated as well. This idea of social norming again could have played a role in why Response Costs for Social Distancing were dropped from the study. Since it can be considered a societal norm to avoid those who are sick and not come into contact with them, the questions regarding reasons to not avoid people who are sick may have been inconsequential to participants due to them naturally avoiding these sick persons regardless of any inconveniences. Overall, finding the reasons why college-aged millennials are not washing their hands and socially distancing themselves from those who are sick, was not deemed as important for this perceptual study, as finding out what driving factors motivate them to practice these behaviors.

**Factors Removed During EFA**

The factor, Response-Efficacy Handwashing, was originally part of a 4 factor model (i.e. Modified Coping Appraisals), which reduced to 3 factors (i.e. Self-Efficacy HW, Response-Efficacy SD, & Self-Efficacy HW). From examining the item loadings and cross loadings from the PCA (see Table 4) conducted during the pilot study, it can be seen that out of all the items within the Modified Coping Appraisals, Response-Efficacy Handwashing, had the lowest loadings and moderate cross loadings, but not high enough to warrant removal in the pilot study.

When placed into an EFA with the first half of the primary sample (i.e. sample 1), the Response-Efficacy HW construct had significant pattern coefficients on the cusp of 0.40 or lower on itself and numerous other factors. These coefficients were systematically removed one at a time and the analysis was performed again to check the fit and loadings once again. After the removal of 2 items, the Response-Efficacy HW remaining items were still unable to measure the latent factor intended and wanted to cross load heavily on both Self-Efficacy HW and Response-Efficacy SD. The entire construct was removed and the analysis performed again. The new analysis for Modified Coping Appraisals, with only 3 factors, produced not only an excellent estimated model fit, but also all pattern coefficients were significantly loading on the correct latent factors. The removal of this construct may be attributed to the item content. Many of the items in Response-Efficacy HW had key words or phrases found in both Response-Efficacy SD and Self-Efficacy HW. The RE.HW items "I think handwashing would be **one of the best ways to prevent** *an illness caused by Norovirus*" and "Following advice about **proper handwashing** would help me not get sick from Norovirus" contain the similar keys terms and concepts as the

RE.SD item, "I think avoiding people who are sick would be **one of the best ways to prevent** *an infection from Norovirus*" and the SE.HW item "I would have no difficulty practicing **proper handwashing** procedures". These similar key terms "*best ways to prevent Norovirus*" and performing "*proper handwashing*" could have played influential roles on how participants perceived items and their groupings. The similarities in this content could have led to misconceptions about what each item was trying ascertain, resulting in items sounding redundant to participants and similar response patterns emerging.

All of the items under the Modified Coping Appraisals construct were concerned with the concept of "Efficacy" this also could have played a role in the RE.HW factor removal. Since every item was concerned with efficacy, many items sounded remarkably similar, had repeated key words, and unless an individual has an excellent understanding of the differences between response-efficacy and self-efficacy, the items may have been thought of as a single unit of measure. Potential misconception about the items true meanings could have led to high cross loadings between factors in conjunction with the item wording. In the future, items concerning these 2 outlets of efficacy should be more clearly defined to help cut back on potential misconceptions from the participants.

**Structure Model Modifications**

This study was based on individuals' psychological perceptions of hNoV to determine their overall threat appraisal through severity and susceptibility. The determination of this overarching threat was hypothesized to impact behavioral intentions in a positive way when mediated by self and response efficacy. When participants were only given a small introduction to the pathogen, the illness it causes, and common infection routes, the content of the items in some constructs, Severity in particular, could have been at a level where people did not fully perceive the magnitude of the illness or they thought the severity items were too intense and they were not reflective of the pathogen. Previous studies utilized critically at risk populations and simulated outbreaks to help convey the seriousness of the matter to the survey participants, however these studies were also utilizing the original version of PMT where severity directly impacts protection motivations.

The item descriptions for Severity in this study did not connect with the other items on the remaining constructs. Where most items across the constructs had a few similar key words or suggested behaviors, the Severity items had no link. The item descriptions were straight forward with phrases like "*would cause me*" and the addition of the intensifier "*very*" may have been misconstrued due to either lack of knowledge, or doubt that it could actually make one critically sick. The word "*would*" was used in various other items, but in a different context. In the other items it was describing a person knowing how to perform an action or as in the case of the purely endogenous variables, actually perform the protective behavior. In the Severity instance, it was a direct action that happens to the individual reading the statements. The same could be said for the second item, "Norovirus **would cause me** to be hospitalized" this item again, was essentially stating something was definitely going to happen to the individual and not just a chance of it happening. Whereas the construct that followed, Susceptibility, dealt with "chances" and "possibilities". It appears the link to the rest of the items was lost and in a mediation model, if the items and constructs aren't aligning, or there is some disconnect occurring, the paths will not be significant nor potentially even exist.

Past studies treated Severity as a construct with a direct effect on behavioral intentions, but this study was aimed at Severity (i.e. Threat Appraisals) being mediated by Coping Appraisals before having an impact on protection motivations. The addition of the mediation variables could have changed the way the concept of Severity was needing to be interpreted for the participants. Direct statements telling individuals they would be sick or hospitalized, and then a direct behavior change occurring from these statements was no longer the case. Examination of the data helped to indicate that the phrasing of these items may need to be adjusted to reflect the mediation paths of interest. Subsequently it can be inferred that if the wording of these items were rectified to be reflective of the other constructs, a mediation path may indeed exist. Future research into the item development of this construct should be conducted in order to see if this hypothesized mediation model can work while retaining both exogenous factors under Threat Appraisals.

**Conclusions**

Despite the loss of Severity, the Susceptibility construct was able to demonstrate a positive impact on protection motivations when mediated by Coping Appraisals. This can be of particular importance to health professionals since this helps clarify that the relationships between hNoV and an individuals' protective behavioral intentions is not always a direct path. This could mean that media designed to frighten an individual into a behavior change by playing on their vulnerabilities may not be the best option. Without the inclusion of severity in this model, only assumptions based on how susceptible a person feels to hNoV and how it increases the likelihood of behavior change intentions when mediated by self-efficacy and response-efficacy can be made. Actual behavior change was not measured in this study and longitudinal studies utilizing this model could be explored in the future to ascertain if this is an effective method of real change. The current research contributes to health communication literature in several areas: an omnibus model based on the combination of PMT and SCT was tested using SEM. It is believed that using SEM in this study is a strength because of SEM's usefulness in helping researchers understand communication in terms of a complex set of relationships between variables. Although the entire model was not able to be utilized in the final analyses, (which is attributed to insufficient item content development by the researcher) a portion of the model still worked from start to finish. This helped elucidate the idea that college-aged millennial student's intention to practice health protective behaviors can be positively influenced by the feeling of susceptibility when mediated by response efficacy of preventative actions and the student's belief in their own capability of performing the actions (i.e. self-efficacy). This information can be used to help develop intervention strategies or mitigation media designed to target each of these aspects in the hopes it will also improve this populations intentions to practice protective health behaviors against hNoV infections.

The lessons learned during this exploratory model design should be utilized in developing a stronger working model. This research model can be the used as the ground work to develop more efficient methods of inciting behavioral change to protect against hNoV infections on college campuses. The inclusion of not only a threat, but also solutions that are both thought to help and can be performed with a relative ease during a student's daily college regimen.

Although hNoV is commonly seen on cruise ships and not as readily seen or discussed in the context of college campuses, it is still important to understand the best ways to communicate the need for protective behavior change to college-aged millennials. Coincidentally, as the researcher was finalizing data on this study, a North West Arkansas a popular restaurant/brewery was confirmed to be the source of a hNoV outbreak. There were over 250 reported illnesses, 175 of which were confirmed cases of hNoV by the Arkansas Health Department (4029 News, 2018). This location is less than 5 miles from the University of Fayetteville and considered a popular location for numerous college students, faculty, and citizens to attend since it is a large indoor/outdoor venue with numerous activities and the occasional venue for concerts. An outbreak so close to a college campus, could have meant it was only a matter of time before a student who visited the location brought the pathogen onto campus and potentially set off a chain of infections that could have proven quite detrimental not only the student body, but also the faculty and staff. Having interventional material prepared that targets college students' perceptions of personal vulnerability, while providing them methods that are known to reduce their chance of infection, all while showing how capable they are of performing these actions could promote positive protection motivation behaviors better than simply instilling fear through warnings. This outbreak solidifies the need for Hospitality and Food Science Programs to educate students on food safety and sanitation practices. It also denotes the importance of the National Restaurant Association in training managers how to communicate these threats to their employees so they will ensure proper sanitation practices are upheld and performed.

On the topic of education, this study did find that 70% of participants intended to learn more ($n$ = 972) about how to protect themselves from hNoV infections, while only 15.30% said they did not want to learn more about protection ($n$ = 213) and 14.70% were undecided ($n$ = 204). Understanding there is a need/desire for knowledge is only half the battle against human illnesses, the other half comes from understanding how to communicate the importance of various protective behaviors. This study offered the thought that if information is presented to individuals in a way that both instills a sense of threat, on a level of personal perceived severity and vulnerability, while giving an understanding that there are protective behaviors that can actually help and were presented in a way one feels capable of accomplishing, then it should promote intention to practice these protective behaviors. Presenting knowledge in this manner could be useful for health education and intervention practices. Demonstrating how severe and vulnerable a person can be to hNoV or other threats, elucidating the ease at which these various protective health behaviors can be accomplished, and providing justification that these behaviors actually help could aid in motivating individuals to practice health preventative behaviors.

Overall, it is strongly recommended that this research attempt to be duplicated and improved upon in an effort to retain all constructs of interest to get a more inclusive view of what approaches positively motivate college-aged millennials to practice protection motivations against hNoV and other health concern of interest.

**Limitations & Future Research**

The combination of PMT and SCT into a mediated model has been shown to be a useful and effective framework for understanding college-aged millennials' intentions regarding protection motivations relating perceived susceptibility to hNoV. The lessons learned during this exploratory research model design should be utilized to develop a stronger working model framework.

The importance of intensive methodical item development practices cannot be overlooked. Due to the poorly designed item content, various constructs had to be removed during analyses, which dropped the overall informative capabilities of this proposed model. Future research should strive to develop scales from the use of focus groups instead of adapting previous literature. Since this was a self-reported measure of perceptual beliefs on threat and coping appraisals, there is a degree of self-reporting bias that occurs which could have influenced the overall results. Implementing observational studies could help to reduce the risk of self-reporting bias. Since self-reported measures do not always reflect protection motivation behaviors, future studies regarding this adapted PMT model should include an observational component to measure actual behavior. This study supports the concept that PMT in conjunction with SCT can be used to predict behavioral intentions of college-aged millennials in relation to a hNoV outbreak, however it is important to discover if these findings support actual behavior.

Future research may benefit from the inclusion of videos, pictures, news stories or outbreak scenarios to demonstrate what can actually occur, how sick an individual can become, and how quickly hNoV can spread. These inclusions may help to increase the overall perceived severity and susceptibility and yield a better estimate to the efficiency of this mediator model. Previous knowledge of hNoV and the extent of each individuals' knowledge of this pathogen could have influenced the overall results. For a perceptual study, it can be difficult to convey the true threat of hNoV by simply reading a small introduction about the pathogen, its infectious capabilities, and symptoms. The term "virus" however, does retain a negative connotation in the English language (Merriam-Webster, 2018) and in part could have the ability on its own to convey a baseline for perceptions despite a lack of knowledge. Although, without having personally experienced or witnessed the true impact this pathogen can have on an individual, some people's perceptions of it may be dismissive. Two questions were included in the survey about past experiences with hNoV. The first asked if participants had previously heard of hNoV prior to this survey in which 59.9% of the pilot sample said yes ($n$ = 416) and 40.1% said no ($n$ = 278), where as in the primary study 60.2% said yes ($n$ = 836) and 39.7% said no ($n$ = 551). Unfortunately, no questions at this time were included to assess their overall knowledge of hNoV.

Before this research was conducted, the 2018 Winter Olympics (a largely televised world inclusive sporting event) in Pyeongchang, South Korea, was constantly in the news since many of the staff members had been infected by a strain of hNoV and had fallen ill right before the opening ceremonies were set to begin (News Desk, 2018). This could have been participants only source of knowledge on hNoV, but no definitive conclusions can be made about this statement, since no questions addressed where they gained the knowledge or how deep their knowledge was on the subject. This leads to the thought that prior knowledge could play a role in motivating behavioral intentions and should be considered a covariate in future research. The second question asked if they had ever been diagnosed with hNoV, to which 17.7% said yes ($n$ = 123) and 82.3% said no ($n$ = 571). This question again, helps garner some insight into if the participants have experienced this before, but it also uses the terminology "diagnosed", which means they would have needed to receive a formal diagnosis from a doctor who conducted tests to verify if it was indeed a strain of hNoV and not the "stomach flu" (i.e. a commonly confused illness). Past experiences and prior knowledge have been shown to influence behavior change, as seen in Liu and Pennington-Gray's (2016) study concerning hNoV outbreaks on cruise ships and individuals' crisis response patterns. The inclusion of these variables can prove to be invaluable and future research should strive to incorporate them into a foundationally sound mediation model.

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## Appendix A

## Recruitment Messages

### Email Script to Elicit Participation

Hello my name is Dylan Martinez and I am a doctoral student with the Food, Human Nutrition and Hospitality Innovation Program at the University of Arkansas.

I am conducting a study, which has been approved by the University of Arkansas Institutional Review Board (IRB), to gather information about Millennials' intention to practice protective behaviors in the context of Norovirus outbreaks on college campuses.

By conducting this online survey, I will be able to gather information about motivation factors for healthy behaviors among Millennials, in an effort to increase the effect of public health promotions for this generation.

Your input and participation will be very helpful in achieving these goals. Participation is voluntary. It will only take up to 10 minutes of your time.

Please pass along this link to your colleagues and students as well.

Thank you for your willingness to participate.

http://uark.qualtrics.com/jfe/form/SV_e3W9qclICfKd6WF

### Social Media Script to Elicit Participation

Hello everyone, you are invited to partake in a study I am conducting as a doctoral candidate with the Food, Human Nutrition and Hospitality Innovation Program at the University of Arkansas. This research has been approved by the University of Arkansas Institutional Review Board (IRB), to gather information about Millennials' intention to practice protective behaviors in the context of Norovirus outbreaks on college campuses.

By conducting this online survey, I will be able to gather information about motivation factors for healthy behaviors among Millennials, in an effort to increase the effect of public health promotions for this generation.

Your input and participation will be very helpful in achieving these goals. Participation is voluntary. It will only take up to 10 minutes of your time.

Please share this post with your friends as well.

Thank you for your willingness to participate.

http://uark.qualtrics.com/jfe/form/SV_e3W9qclICfKj3YV

## MTurk Script to Elicit Participation

I am conducting academic research, which has been approved by the University of Arkansas Institutional Review Board (IRB), to gather information about Millennials' intention to practice protective behaviors in the context of Norovirus outbreaks on college campuses.

By conducting this online survey, I will be able to gather information about motivation factors for healthy behaviors among Millennials, in an effort to increase the effect of public health promotions for this generation.

Your input and participation will be very helpful in achieving these goals. Participation is voluntary. It will only take up to 10 minutes of your time.

Thank you for your willingness to participate.

## Appendix B

## Pilot IRB & Survey

UNIVERSITY OF ARKANSAS

| | |
|---|---|
| **To:** | Dylan Conrad Martinez<br>BELL 4188 |
| **From:** | Douglas James Adams, Chair<br>IRB Committee |
| **Date:** | 04/11/2018 |
| **Action:** | **Exemption Granted** |
| **Action Date:** | 04/11/2018 |
| **Protocol #:** | 1709073211 |
| **Study Title:** | Risky Business: Media Content and Millennials' Protection Motivation Factors for Norovirus Outbreaks on College Campuses |

The above-referenced protocol has been determined to be exempt.

If you wish to make any modifications in the approved protocol that may affect the level of risk to your participants, you must seek approval prior to implementing those changes. All modifications must provide sufficient detail to assess the impact of the change.

If you have any questions or need any assistance from the IRB, please contact the IRB Coordinator at 109 MLKG Building, 5-2208, or irb@uark.edu.

cc: Kelly Ann Way, Investigator
Wen-Juo Lo, Investigator

**Risky Business: Millennials' Protection Motivation Factors for Norovirus Outbreaks on College Campuses.**

You are invited to complete a survey about: *Risky Business: Media Content & Millennials' Protection Motivation Factors for Norovirus Outbreaks on College Campuses.*
<u>Introduction/Description:</u> As part of my research project, I am conducting a study to investigate college-aged Millennials' intentions to practice protective behaviors regarding Norovirus outbreaks on college campuses. I will sincerely appreciate a few minutes of your time to participate in this study.
<u>Risks and Benefits:</u> The benefit received from your participation in this study benefits society by increasing the ability to promote health interventions regarding Norovirus outbreaks and

potentially limit the severity of outbreaks on college campuses and other public sectors. There are no anticipated risks to participating in the study.

Voluntary Participation: Your participation in the research is completely voluntary. If you choose to participate and complete the enclosed questionnaire, you may leave any items blank that you do not want to answer. You may withdraw from the survey at any time without consequence to you. It should take you about ten to fifteen minutes to complete the questionnaire.

Confidentiality: All responses will be anonymous. All data collected will be kept confidential to the extent allowed by law and University policy. All data will be combined and only group summaries will be included in the survey reports. No data will be reported in a manner that would allow a reader to associate any responses to individual respondents. All surveys will be completely anonymous. Results from the research will be reported as aggregate data. If you have any questions or concerns about this study you may contact Dylan Martinez or Kelly Way through any of the means below. For questions or concerns about your rights as a research participant, please contact Ro Windwalker, the University's Compliance Coordinator, at (479) 575-2208 or by e-mail at irb@uark.edu.

By filling out and submitting the survey you are consenting to participate. You acknowledge that you read the description, including the purpose of the study, the procedures to be used, the potential risks and side effects, the anonymity of all responses, as well as the option to withdraw from the study at any time. The survey will take you about 10-15 minutes to complete. Thank you in advance for taking the time to participate in this research. Please click the agree button on the survey to indicate that you have read this information and that you give your consent to participate.

Principal Investigator: Dylan Martinez Dcm005@uark.edu

Faculty Advisor: Dr. Kelly Way kway@uark.edu 479-575-4985

- **Agree**
- **Disagree**

**Please read the following information about Norovirus before completing the survey.**

*Norovirus is a highly contagious virus (Some Symptoms include: Vomiting, Diarrhea, Nausea) that accounts for about 21 million cases of acute gastro-enteritis in the U.S., about 70 thousand hospitalizations, and about 800 deaths per year. Symptoms resemble that of the flu and usually last anywhere from 24 to 72 hours. It is easily spread from touching contaminated surfaces, person-to-person contact, and consumption of contaminated food or water. College campuses are at an increased risk of potential infection due to close living quarters (dorms, fraternity/sorority houses), classrooms, and shared dining areas.*

***The following statements assess how severe you perceive Norovirus illness on COLLEGE CAMPUSES. Please select your level of agreement or disagreement with each statement.***

***When reading each of the following statements, please start with "WHILE ON A COLLEGE CAMPUS…" then continue reading the statement listed.***

**WHILE ON A COLLEGE CAMPUS…**

Norovirus would make me very sick

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

Norovirus would cause me to be hospitalized

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

Norovirus would cause me to miss class/work

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

Norovirus would affect my overall attitude regarding the semester

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

Norovirus is too minor to impact my daily life

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

***The following statements concern how vulnerable you feel to contracting an illness caused by Norovirus while on a COLLEGE CAMPUS.***

**WHILE ON A COLLEGE CAMPUS…**

My chances of contracting Norovirus are quite small

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

It is possible that I will get Norovirus

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

The chance of my peers getting Norovirus is rather large

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

It is possible that I am infected by Norovirus unknowingly

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

It is possible that I get Norovirus from a person rather than food

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

***The following statements are about your general handwashing practices. Please select the amount that best demonstrates your personal behaviors while on a COLLEGE CAMPUS.***

Please use the slider to estimate how many times a day you normally wash your hands.

**(1-50)**

Please use the slider to estimate how many times a day you normally use hand sanitizer.

**(1-50)**

***When reading each of the following statements, please start with "WHILE ON A COLLEGE CAMPUS…" then continue reading the statement listed.***

**WHILE ON A COLLEGE CAMPUS…**

I would use hand sanitizer instead of washing my hands if it is available

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

I think handwashing would be one of the best ways to prevent an illness caused by Norovirus

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

Regular handwashing would reduce my chances of contracting Norovirus

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

Following advice about proper handwashing would help me not get sick from Norovirus

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree

7. Strongly Agree

Using hand soap reassures me that I am safe from Norovirus

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

Handwashing would impact whether or not I get sick from Norovirus

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

I would know how to wash my hands effectively to reduce my risk of Norovirus

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

I would be able to wash my hands when I want too.

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

I would be capable of successfully following proper handwashing information

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

I would have no difficulty practicing proper handwashing procedures

1. Strongly Disagree

2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

I would know how to wash my hands effectively to reduce my risk of Norovirus infection

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

I would wash my hands every time I should, even if it takes a lot of time

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

I would wash my hands every time I should, even if the sink is far away

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

I would not use a restroom with broken sinks, even if the next usable restroom is far away

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

I would wash my hands after opening doors, even if it is inconvenient

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree

6. Agree
7. Strongly Agree

I would still wash my hands with water, even if the soap dispenser was empty

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

***The following statements concern social distancing. Social distancing can be defined as increasing the physical distance between yourself and someone who is sick.***

**WHILE ON A COLLEGE CAMPUS…**

I think avoiding people who are sick would be one of the best ways to prevent an infection from Norovirus

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

Avoiding people who are sick would have an impact on whether or not I am infected by Norovirus

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

Avoiding people who are sick would reduce my chances of a Norovirus infection

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

If I follow Norovirus prevention media I would not get sick from Norovirus

1. Strongly Disagree
2. Disagree

3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

Actively avoiding people who appear sick would help keep me free from Norovirus infection

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

I would know how to effectively avoid people who are sick

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

I would be able to avoid people who are sick when I want too

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

I would be capable of successfully following Norovirus avoidance media

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

I would have no difficulty avoiding people who are sick

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree

6. Agree
7. Strongly Agree

I would be confident in my ability to avoid people who are sick

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

I would avoid people who are sick, even if it meant missing class or work

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

It would take too much effort to avoid people who are sick

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

It would take too much time to avoid people who are sick

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

I would avoid sitting close to anyone who is sick, even if it is inconvenient

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

It is not convenient to always avoid people who are sick

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

***The following statements are in regard to your intention to wash your hands or social distance yourself from others while on a COLLEGE CAMPUS.***

**WHILE ON A COLLEGE CAMPUS…**

I would wash my hands to protect myself from a Norovirus infection

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

I would wash my hands before eating

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

I would wash my hands after eating

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

I would wash my hands after using the restroom

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

I would wash my hands after opening doors

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

I would intentionally avoid people who are sick to protect myself from a Norovirus infection

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

I would **not** sit next to someone who is actively sick in the classroom

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

I would leave a public restroom if there is someone actively sick in one of the stalls

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

I would avoid going to a self-service dining hall because it might get me sick with Norovirus

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

I would order food to my room to avoid eating around others in the dining hall

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree

5. Somewhat Agree
6. Agree
7. Strongly Agree

I intend to find out more about how to protect myself from Norovirus infections

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

***The final section contains demographics and questions regarding your prior experience with Norovirus.***

**What is your current age?**

________________

**Prior to this survey, had you ever heard of Norovirus?**

1. Yes
2. No

**Have you ever been diagnosed with Norovirus?**

1. Yes
2. No

**What is your race or ethnicity?** ***(Circle all that apply.)***

1 = White

2 = Black or African American

3 = Asian or Pacific Islander

4 = American Indian or Alaska Native

5 = Hispanic or Latino

6 = Other, please specify: ________________

**Which sex do you most identify with?**

1. Male
2. Female

**What is your classification in college?**

1. Freshmen/first-year
2. Sophomore
3. Junior

4. Senior
5. Graduate Student
6. Other, please specify: _____________

**Have you ever lived in a dorm or residence hall while attending college?**

1. Yes
2. No

**Do you currently live in a dorm or residence hall while attending college?**

1. Yes
2. No

**Have you ever lived in a fraternity or sorority house while attending college?**

1. Yes
2. No

**Do you currently live in a fraternity or sorority house while attending college?**

1. Yes
2. No

**While in college did you ever have a roommate(s)?**

1. Yes
2. No

**Do you currently have a roommate?**

1. Yes
2. No

***Thank you for taking the time to participate in this online survey. Your responses are greatly valued.***

**Appendix C**

**Primary Survey & IRB**

UNIVERSITY OF ARKANSAS

| | |
|---|---|
| **To:** | Dylan Conrad Martinez<br>BELL 4188 |
| **From:** | Douglas James Adams, Chair<br>IRB Committee |
| **Date:** | 05/30/2018 |
| **Action:** | **Exemption Granted** |
| **Action Date:** | 05/30/2018 |
| **Protocol #:** | 1805121738 |
| **Study Title:** | Risky Business: Millennials' Protection Motivation Factors for Norovirus Outbreaks on College Campuses |

The above-referenced protocol has been determined to be exempt.

If you wish to make any modifications in the approved protocol that may affect the level of risk to your participants, you must seek approval prior to implementing those changes. All modifications must provide sufficient detail to assess the impact of the change.

If you have any questions or need any assistance from the IRB, please contact the IRB Coordinator at 109 MLKG Building, 5-2208, or irb@uark.edu.

cc: Kelly Ann Way, Investigator
Wen-Juo Lo, Investigator
Kristen E Gibson, Investigator
Zola Knowles Moon, Investigator

**Risky Business: Millennials' Protection Motivation Factors for Norovirus Outbreaks on College Campuses.**

You are invited to complete a survey about: *Risky Business: Millennials' Protection Motivation Factors for Norovirus Outbreaks on College Campuses.*
Introduction/Description: As part of my research project, I am conducting a study to investigate college-aged Millennials' intentions to practice protective behaviors regarding Norovirus outbreaks on college campuses. I will sincerely appreciate a few minutes of your time to participate in this study.
Risks and Benefits: The benefit received from your participation in this study benefits society by increasing the ability to promote health interventions regarding Norovirus outbreaks and potentially limit the severity of outbreaks on college campuses and other public sectors. There are no anticipated risks to participating in the study.
Voluntary Participation: Your participation in the research is completely voluntary. If you choose to participate and complete the enclosed questionnaire, you may leave any items blank

that you do not want to answer. You may withdraw from the survey at any time without consequence to you. It should take you about ten to fifteen minutes to complete the questionnaire.

Confidentiality: All responses will be anonymous. All data collected will be kept confidential to the extent allowed by law and University policy. All data will be combined and only group summaries will be included in the survey reports. No data will be reported in a manner that would allow a reader to associate any responses to individual respondents. All surveys will be completely anonymous. Results from the research will be reported as aggregate data. If you have any questions or concerns about this study you may contact Dylan Martinez or Kelly Way through any of the means below. For questions or concerns about your rights as a research participant, please contact Ro Windwalker, the University's Compliance Coordinator, at (479) 575-2208 or by e-mail at irb@uark.edu.

By filling out and submitting the survey you are consenting to participate. You acknowledge that you read the description, including the purpose of the study, the procedures to be used, the potential risks and side effects, the anonymity of all responses, as well as the option to withdraw from the study at any time. The survey will take you about 10-15 minutes to complete. Thank you in advance for taking the time to participate in this research. Please click the agree button on the survey to indicate that you have read this information and that you give your consent to participate.

Principal Investigator: Dylan Martinez Dcm005@uark.edu

Faculty Advisor: Dr. Kelly Way kway@uark.edu 479-575-4985

- **Agree**
- **Disagree**

***The first section contains demographic questions.***

**What is your current age?**

______________

**What college did/do you attend for your undergraduate degree?**

______________

**What is or was your major in college?**

______________

**What is your classification in college?**

1. Freshmen/first-year
2. Sophomore
3. Junior
4. Senior
5. Graduate Student
6. Other, please specify: _____________

**Please read the following information about Norovirus before completing the survey.**

*Norovirus is a highly contagious virus (some symptoms include: vomiting, diarrhea, nausea) that accounts for about 21 million cases of self-limiting gastroenteritis in the U.S., about 70 thousand hospitalizations, and about 800 deaths per year. Norovirus can sometimes be referred to as the "stomach flu". Symptoms usually last anywhere from 24 to 72 hours. It is easily spread from touching contaminated surfaces, person-to-person contact, and consumption of contaminated food or water. College campuses have close living quarters (dorms, fraternity/sorority houses), classrooms, and shared dining areas that have the potential to increase infection rates.*

***The following statements assess how severe you perceive Norovirus illness on COLLEGE CAMPUSES. Please select your level of agreement or disagreement with each statement.***

***When reading each of the following statements, please start with "WHILE ON A COLLEGE CAMPUS…" then continue reading the statement listed.***

**WHILE ON A COLLEGE CAMPUS…**

Norovirus would make me very sick

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

Norovirus would cause me to be hospitalized

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

Norovirus would cause me to miss class/work

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

Norovirus would affect my overall attitude regarding the semester

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree

4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

***The following statements concern how vulnerable you feel to contracting an illness caused by Norovirus while on a COLLEGE CAMPUS.***

**WHILE ON A COLLEGE CAMPUS…**

My chances of contracting Norovirus are quite small

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

It is possible that I will get Norovirus

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

The chance of my peers getting Norovirus is rather large

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

It is possible that I get Norovirus from a person rather than food

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

***The following statements are about your general handwashing practices. Please select the amount that best demonstrates your personal behaviors while on a COLLEGE CAMPUS.***

Please use the slider to estimate how many times a day you normally wash your hands.

**(1-50)**

Please use the slider to estimate how many times a day you normally use hand sanitizer.

**(1-50)**

***When reading each of the following statements, please start with "WHILE ON A COLLEGE CAMPUS…" then continue reading the statement listed.***

**WHILE ON A COLLEGE CAMPUS…**

I would use hand sanitizer instead of washing my hands if it is available

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

I think handwashing would be one of the best ways to prevent an illness caused by Norovirus

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

Regular handwashing would reduce my chances of contracting Norovirus

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

Following advice about proper handwashing would help me not get sick from Norovirus

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

Using hand soap reassures me that I am safe from Norovirus

1. Strongly Disagree
2. Disagree

3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

Handwashing would impact whether or not I get sick from Norovirus

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

I would know how to wash my hands effectively to reduce my risk of Norovirus

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

I would be able to wash my hands when I want too.

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

I would be capable of successfully following proper handwashing information

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

I would have no difficulty practicing proper handwashing procedures

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree

7. Strongly Agree

I would know how to wash my hands effectively to reduce my risk of Norovirus infection

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

***The following statements concern social distancing. Social distancing can be defined as increasing the physical distance between yourself and someone who is sick.***

**WHILE ON A COLLEGE CAMPUS…**

I think avoiding people who are sick would be one of the best ways to prevent an infection from Norovirus

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

Avoiding people who are sick would have an impact on whether or not I am infected by Norovirus

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

Avoiding people who are sick would reduce my chances of a Norovirus infection

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

Actively avoiding people who appear sick would help keep me free from Norovirus infection

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree

4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

I would know how to effectively avoid people who are sick

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

I would be able to avoid people who are sick when I want too

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

I would be capable of successfully following Norovirus avoidance media

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

I would have no difficulty avoiding people who are sick

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

I would be confident in my ability to avoid people who are sick

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

***The following statements are in regard to your intention to wash your hands or social distance yourself from others while on a COLLEGE CAMPUS.***

**WHILE ON A COLLEGE CAMPUS…**

I would wash my hands to protect myself from a Norovirus infection

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

I would wash my hands before eating

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

I would wash my hands after eating

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

I would wash my hands after using the restroom

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

I would wash my hands after opening doors

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

I would intentionally avoid people who are sick to protect myself from a Norovirus infection

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

I would **not** sit next to someone who is actively sick in the classroom

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

I would leave a public restroom if there is someone actively sick in one of the stalls

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

I would avoid going to a self-service dining hall because it might get me sick with Norovirus

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

I would order food to my room to avoid eating around others in the dining hall

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree
4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

I intend to find out more about how to protect myself from Norovirus infections

1. Strongly Disagree
2. Disagree
3. Somewhat Disagree

4. Neither Agree nor Disagree
5. Somewhat Agree
6. Agree
7. Strongly Agree

***The final section contains additional demographics and questions regarding your prior experience with Norovirus.***

**Prior to this survey, had you ever heard of Norovirus?**

1. Yes
2. No

**Have you ever been diagnosed with Norovirus?**

1. Yes
2. No

**What is your race or ethnicity?** ***(Circle all that apply.)***

1 = White

2 = Black or African American

3 = Asian or Pacific Islander

4 = American Indian or Alaska Native

5 = Hispanic or Latino

6 = Other, please specify: ________________

**Which sex do you most identify with?**

1. Male
2. Female

**Have you ever lived in a dorm or residence hall while attending college?**

1. Yes
2. No

**Do you currently live in a dorm or residence hall while attending college?**

1. Yes
2. No

**Have you ever lived in a fraternity or sorority house while attending college?**

1. Yes
2. No

**Do you currently live in a fraternity or sorority house while attending college?**

1. Yes
2. No

**While in college did you ever have a roommate(s)?**

1. Yes
2. No

**Do you currently have a roommate?**

1. Yes
2. No

***Thank you for taking the time to participate in this online survey. Your responses are greatly valued.***