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Systems Engineering Approaches to Minimize the Viral Spread of Social Media Challenges

Amro Khasawneh
Clemson University, akhasaw@g.clemson.edu

SYSTEMS ENGINEERING APPROACHES TO MINIMIZE THE VIRAL SPREAD OF SOCIAL MEDIA CHALLENGES

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Amro Khasawneh
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Accepted by:
Dr. Kapil Chalil Madathil, Committee Chair
Dr. Anand Gramopadhye
Dr. Patrick Rosopa
Dr. Kevin Taaffe
Dr. Heidi Zinzow

ABSTRACT

Recently, adolescents' and young adults' use of social media has significantly increased. While this new landscape of cyberspace offers young internet users many benefits, it also exposes them to numerous risks. One such phenomenon receiving limited research attention is the advent and propagation of viral social media challenges. Several of these challenges entail self-harming behavior, which combined with their viral nature, poses physical and psychological risks for the participants and the viewers. One example of these viral social media challenges that could potentially be propagated through social media is the Blue Whale Challenge (BWC). In the initial study we investigate how people portray the BWC on social media and the potential harm this may pose to vulnerable populations. We first used a thematic content analysis approach, coding 60 publicly posted YouTube videos, 1,112 comments on those videos, and 150 Twitter posts that explicitly referenced BWC. We then deductively coded the YouTube videos based on the Suicide Prevention Resource Center (SPRC) Messaging guidelines. We found that social media users post about BWC to raise awareness and discourage participating, express sorrow for the participants, criticize the participants, or describe a relevant experience. Moreover, we found most of the videos on YouTube violate at least 50% of the SPRC safe and effective messaging guidelines. These posts might have the problematic effect of normalizing the BWC through repeated exposure, modeling, and reinforcement of self-harming and suicidal behavior, especially among vulnerable populations, such as adolescents.

A second study conducted a systematic content analysis of 180 YouTube videos (~813 minutes total length), 3,607 comments on those YouTube videos, and 450 Twitter

posts to explore the portrayal and social media users' perception of three viral social media-based challenges (i.e., BWC, Tide Pod Challenge (TPC), and Amyotrophic Lateral Sclerosis (ALS) Ice Bucket Challenge (IBC)). We identified five common themes across the challenges, including: education and awareness, criticizing the participants and blaming the victims, detailed information about the participants, giving viewers a tutorial on how to participate, and understanding seemingly senseless online behavior. We found that the purpose of posting about an online challenge varies based on the inherent risk involved in the challenge itself. However, analysis of the YouTube comments showed that previous experience and exposure to online challenges appear to affect the perception of other challenges in the future.

The third study investigated the beliefs that lead adolescents and young adults to participate in these activities by analyzing the ALS IBC to represent challenges with minimally harmful behaviors intended to support philanthropic endeavors and the Cinnamon Challenge (CC), to represent those involving harmful behaviors that may culminate in injury. We conducted a retrospective quantitative study with a total of 471 participants between the ages of 13 and 35 who either had participated in the ALS IBC or the CC or had never participated in any online challenge. We used binomial logistic regression models to classify those who participated in ALS IBC or CC versus those who didn't with the beliefs from the Integrated Behavioral Model (IBM) as predictors. Our findings showed that both CC and ALS IBC participants had significantly greater positive emotional responses, value for the outcomes of the challenge, and expectation of the public to participate in the challenge in comparison to individuals who never participated in any

challenge. In addition, only CC participants perceived positive public opinion about the challenge and perceived the challenge to be easy with no harmful consequences, in comparison to individuals who never participated in any challenge. The findings from this study were used to develop interventions based on knowledge of how the specific items making up each construct apply specifically to social media challenges.

In the last study, we showed how agent-based modeling (ABM) might be used to investigate the effect of educational intervention programs to reduce social media challenges participation at multiple levels- family, school, and community. In addition, we showed how the effect of these educational based interventions can be compared to social media-based policy interventions. Our model takes into account the "word of mouth" effect of these interventions which could either decrease participation in social media challenge further than expected or unintentionally cause others to participate.

DEDICATION

This dissertation is dedicated to my parents, Dr. Nofan Khasawneh and Samar Al-Awamleh. Without their enormous sacrifice and love, I would have never become the individual that I am today.

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CHAPTER ONE

INTRODUCTION

Social media use by adolescents has rapidly increased from 12% in 2005 to approximately 90% in 2015 (Lenhart et al., 2015). Although this new landscape of cyberspace offers its users a wide variety of benefits (Boyd, 2015; Khasawneh, Abu-Ghazaleh, Ponomarev, & Yu, 2017; Livingstone & Helsper, 2010;; Saldivar, Daniel, Cernuzzi, & Casati, 2019), it also opens them to risks, such as cyberbullying (Hinduja & Patchin, 2010; Tahmasbi & Rastegari, 2018) and self-harm content (Mitchell, Wells, Priebe, & Ybarra, 2014). Recent research has found that this exposure is linked to the increased level of non-suicidal self-injury (NSSI) and suicidal ideation in this population (Dyson et al., 2016; Zhu et al., 2016). This issue has become more important today as the number of adolescents reporting depressive symptoms and suicidal thoughts as well as suicide-related outcomes in the United States has increased over recent years after being stable for nearly two decades (Twenge, Joiner, Rogers, & Martin, 2018).

There is a new phenomenon on social media known as "social media challenges," also known as online challenges. In these challenges, people challenge one another on social media by posting pictures of or recording themselves participating in activities and posting them online. Users then encourage their peers to participate and share their experiences as well (Hilton, 2017). There is a wide variety of challenges that have propagated across several social media platforms. These challenges vary in their inherent level of self-harm behavior and risk to individuals, include the Tide Pod Challenge (TPC), the Cinnamon Challenge (CC), the Amyotrophic Lateral Sclerosis (ALS) Ice Bucket

Challenge (IBC), and the Blue Whale Challenge (BWC) (Grant-Alfieri, Schaechter, & Lipshultz, 2013; Martinez, 2017; Stanford, 2016).

Some of these challenges promote philanthropic causes and tend to present lower risks of harm for participants than others. For example, the risks associated with the ALS IBC, which raises awareness of and funding for finding a cure for ALS research, are considered minimal (The ALS Association, 2019). On the other hand, most social media challenges yield few positive results yet may involve harm to youths and young adults. For example, teenagers are biting into and swallowing Tide Pods (chemical detergent pods used for laundry), a challenge that resulted in more than eight cases of poisoning as reported by the American Association of Poison Control Centers (AAPCC) (Ducharme, 2018; Hider, 2018). Even more extreme, other challenges require intentional and more severe self-injurious behavior. For example, the BWC, as described in the media, reportedly involves tasks, such as carving the outline of a blue whale into the skin of one's arm, that culminate in a participant ultimately attempting suicide (Mukhra, Baryah, Krishan, & Kanchan, 2017). However, reports of suicide attempts worldwide, and particularly in the U.S., have yet to be confirmed to be associated with BWC.

All of these challenges have been the subject of speculation concerning their harmful impact, but the controversy still remains as to whether they are a public safety risk or simply sensationalized by news media. Yet, we argue that these viral social media challenges present an inherent risk to adolescents even if their existence is partly or entirely fictional or if the user does not actively participate in them, simply due to the potential of self-harm and suicide contagion effects (Young, Subramanian, Miles, Hinnant, &

Andsager, 2017). Further, those who do not directly engage in the challenges, or in fact find them difficult to understand and entirely unappealing, may still propagate these potentially harmful messages because of the emotions they elicit in their viewers. For instance, surprise, disgust, fear, or anger can motivate recipients of viral messages to spread them further (Dobele, Lindgreen, Beverland, Vanhamme, & Van Wijk, 2007), as can altruism and concern for others (Ho & Dempsey, 2010). Thus, a user who hears about an online social media challenge that they perceive to be a threat may forward the message as a means to warn others or speak out against them, but unwittingly contributing to the contagion effects. Therefore, the objective of this research is to:

1. Investigate the portrayal of viral social media challenges on social media platforms and set the foundation for future research in this area.
2. Enhance our understanding of how adolescents' and young adults' beliefs contribute to willingness to participate in online challenges and discern which beliefs are more influential than others.
3. Guide the development of interventions to reduce participation in harmful social media challenges among adolescent and young adult populations.
4. Develop the first conceptual agent-based model that represents the contagion dynamics of the social media challenges and evaluate the efficacy of potential interventions.

This dissertation consists of five more chapters with chapter 2, 3, 4, and 5 present the completed studies and chapter 6 present the conclusion of this work. Chapter 2 details the results of examining the self-harm and suicide contagion effects related to the portrayal

of BWC on social media. Chapter 3 presents a qualitative analysis on social media content to understand the viral spread of three different social media challenges. Chapter 4 discusses a quantitative study to further investigate the spread of these viral challenges. Chapter 5 talks about using Agent Based Modeling (ABM) approach to help visualize the spread of these challenges and implement and evaluate several potential alternative solutions to reduce the spread of the harmful challenges. Each chapter starts with an introduction and summary of the related literature, followed by the used methodology and results, and finally a discussion of the findings.

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CHAPTER TWO

EXAMINING THE SELF-HARM AND SUICIDE CONTAGION EFFECTS RELATED TO THE PORTRAYAL OF BLUE WHALE CHALLENGE ON YOUTUBE AND TWITTER

Introduction and Background

Adolescents and young adults are the largest population using the internet as it has become essential for their schoolwork, information collection, and socializing (Baker & White, 2010; Gutowski, White, Liang, Diamonti, & Berado, 2018; Khasawneh, Ponathil, Ozkan, & Chalil Madathil, 2018; Lerman et al., 2017; Khasawneh, Abu-Ghazaleh, Ponomarev, & Yu, 2018; Ponathil, Agnisarman, Khasawneh, Narasimha, & Chalil Madathil, 2017; Subrahmanyam & Lin, 2007). Communication tools on the internet, including emails, direct texting, and blogging, have become fundamental in adolescents' social development (Lenhart et al., 2015; Lenhart, Madden, Smith, & Macgill, 2009; Scharett et al., 2017). More recently, online social networks, also known as social media, such as Facebook, Instagram, Twitter, and YouTube have become increasingly popular and common among adolescents as sites where they can develop public accounts or profiles to connect with other individuals and see their list of connections and posts (Boyd & Ellison, 2010; Chalil Madathil, Greenstein, & Juang, 2013; Lenhart et al., 2015, 2009; Khasawneh, 2016).

While social media has created a number of opportunities for individuals to garner social support online (Blackwell et al., 2016; Gonzales, 2017; Gutowski et al., 2018; Jackson, Bailey, & Foucault Welles, 2018; Lerman et al., 2017), it also has the potential to further marginalize particularly vulnerable individuals. Recent studies have highlighted

how social media can be used to harass, discriminate (Fritz & Gonzales, 2018; Lawson, 2018), dox (Wood, Rose, & Thompson, 2018), and socially disenfranchise already marginalized individuals (Flores-Yeffal, Vidales, & Martinez, 2019; Linabary & Corple, 2018; Page, Wisniewski, Knijnenburg, & Namara, 2018). Some research even suggests that social media use may be a contributing factor to the significant increase in suicide rates and depressive symptoms among adolescents in the past decade (Guan, Hao, Cheng, Yip, & Zhu, 2015; Lerman et al., 2017; Mitchell et al., 2014). Evidence suggests that suicidal behavior can be propagated through social contagion effects, which model, normalize, and reinforce self-harming behavior (Berry, Bucci, & Lobban, 2017; Hilton, 2017; Zhu et al., 2016).

The public health and psychological literature has established that non-suicidal self-injury (NSSI), or the purposeful infliction of damage to one's body through cutting, burning, or bruising, can be propagated through social modeling, or imitating the behaviors of those we observe (Hilton, 2017; Jarvi, Jackson, Swenson, & Crawford, 2013). Similarly, direct exposure to suicidal behavior through peers and/or media leads to an increase in suicidality through imitation and modeling (Gould, Petrie, Kleinman, & Wallenstein, 1994; Insel & Gould, 2008). These effects are referred to as suicide contagion and are most notable in adolescents and young adults (Cheng, Li, Silenzio, & Caine, 2014; Jarvi et al., 2013; Young et al., 2017). There is a strong relationship between stories of suicide in traditional media and a subsequent increase in suicide rates (Stack, 1993, 1996), especially for particularly prominent stories (Gould, Jamieson, & Romer, 2003). Vulnerable adolescents with pre-existing mental health conditions and suicide risk factors are at a

higher risk to perceive maladaptive self-injurious behavior as an effective coping strategy (Nock et al., 2008), particularly when they see others use these behaviors to achieve an attractive goal like garnering the attention of others (Purington & Whitlock, 2010). Depictions of suicide and self-harm in traditional media have been shown to have harmful effects on vulnerable individuals, even when they describe a false or fictional behavior (Gould et al., 2003; Hawton et al., 1999). Through the social contagion, these harmful behaviors may occur more frequently because of the repetitive exposure and modelling via social media, especially when such content goes "viral" (Berry et al., 2017; Hilton, 2017; Zhu et al., 2016). Virality is defined as "achieving a large number of views in a short time period" (Tellis, MacInnis, Tirunillai, & Zhang, 2019). Such widespread exposure to harmful or suggestive content is particularly detrimental to vulnerable individuals, including adolescents and young adults (Klingle & Van Vliet, 2019; Purington & Whitlock, 2010).

In the social media literature, Facebook's controversial 'emotional contagion' study provides large-scale empirical evidence that indirect interactions via social media can also unknowingly influence one's emotional state (Harris & Roberts, 2013; Kramer, Guillory, & Hancock, 2014; Lachmar, Wittenborn, Bogen, & McCauley, 2017). For instance, researchers interviewed 90 inpatient adolescents with a history of NSSI, finding that most of the participants were exposed to NSSI via traditional or social media prior to engaging in self-harming behaviors (Zhu et al., 2016). Recent attention has focused on how social media in particular may play a role in mental health (Hilton, 2018) and suicide risk (Berrouiguet et al., 2018; Schlichthorst et al., 2018). Social media may influence suicidality

via factors such as cyberbullying, peer pressure in forums to engage in self-injurious behavior, and glamorized graphic videos and images depicting lethal means used in such behavior (Luxton, June, & Fairall, 2012; Robert, Suelves, Armayones, & Ashley, 2015). In addition, exposure to certain methods of self-injury was directly related to engaging in this behavior, and the more frequently youth were exposed to self-injury related content in the media, the more frequently they engaged in self-injurious activities (Zhu et al., 2016). However, exposure to self-injury alone does not relate to engagement in this behavior; rather, it is the frequency of the exposure to self-injury as a coping mechanism that can result in engagement (Zhu et al., 2016). The necessity for studying this contagion effect in the era of social media is that it can be spread and propagated through online social networks more rapidly and widely than through traditional media (Wong et al., 2019). Such widespread exposure to harmful or suggestive content is particularly detrimental to vulnerable populations, including adolescents and young adults (Purington & Whitlock, 2010; Tellis et al., 2019). Thus, suicide contagion is the theoretical framework that motivates this study.

Most of the literature regarding adolescent online safety focuses on sexual or aggressive behaviors that put youth at risk (Livingstone & Smith, 2014). Unfortunately, less research has examined how social media can influence adolescents and young adults to engage in self-harming behavior (Pater & Mynatt, 2017; Robert et al., 2015; Zhu et al., 2016). Therefore, interdisciplinary research is beginning to highlight the urgent need to form a cohesive research agenda around digital self-harm (Pater & Mynatt, 2017), online NSSI (Lewis & Seko, 2016), the use of social media to discuss deliberate self-harm acts,

and acts of cyber-suicide (Muñoz-Sánchez, Delgado, Parra-Vidales, & Franco-Martín, 2018; Patton et al., 2014). Most of this work, however, is in its early stages with few drawing upon the developmental aspect of vulnerable adolescents' social media use.

One example of viral self-harming behavior that has generated significant media attention is the Blue Whale Challenge (BWC). Allegedly, in this challenge adolescents and young adults are encouraged to engage in self-harm and eventually kill themselves. The media claims that this challenge, which was first released in Russia in 2013, includes a series of 50 challenges sent directly to teens, each with increasing levels of self-harm and isolation (Mukhra et al., 2017). According to the media, the creator of the game, Philipp Budeikin, a Russian psychologist, wanted to "cleanse the society of biological waste," meaning the people who are willing to kill themselves for the game are "biological waste" (Thaploo, 2017). While there is not sufficient evidence to support the existence of the challenge, we believe its portrayal on social media (or any similar medium) has an impact on vulnerable individuals. Research exploring ethical concerns related to the BWC, the effects the game may have on adolescents, and potential governmental interventions is needed. Yet, we are unaware of any research that examines potential suicide and NSSI contagion regarding the challenge. To address this gap in the literature, the current study uses qualitative and content analysis research techniques to illustrate the risk of self-harm and suicide contagion through the portrayal of the BWC on YouTube and Twitter Posts. More specifically, the purpose of this study is to explore the following questions:

RQ1: How the Blue Whale Challenge (BWC) is presented and described on YouTube and Twitter?

RQ2: To what extent are YouTube videos compliant with the safe and effective suicide messaging guidelines provided by the Suicide Prevention Resource Center (SPRC)?

Methodology

Study Overview

In this study we selected two social media platforms for data collection, YouTube and Twitter, as these are among the most popular social media platforms among youth and young adults (Maina, 2018). We identified the common themes/categories of YouTube videos, comments on those videos, and Twitter posts by conducting a thematic content analysis on the data extracted from these platforms (Padgett, 2011). Then, we deductively coded the YouTube videos based on the Suicide Prevention Resource Center (SPRC) safe and effective messaging guidelines to explore whether these videos violated or adhered to these guidelines, the extent of violation, and which guidelines were violated the most frequently. This research was exempted from approval by the Clemson University Institutional Review Board because the study used publicly available data.

Data Collection

YouTube and Twitter were selected as appropriate sources for data collection for two reasons. First, both platforms are ranked among the top 20 most popular social media sites and second, the posts on these platforms are normally open to the public (Maina, 2018; Pater, Miller, & Mynatt, 2015; Pater, Haimson, Andalibi, & Mynatt, 2016). The videos were collected using the YouTube search engine with the key phrase “Blue Whale Challenge.” Next, we sorted the results by relevance, an option provided by YouTube that

ranks the videos in descending order relative to the keyword queries based on several factors including as "how well the title, description, and video content match the query and which videos have driven the most engagement for the query" (YouTube Creator Academy, 2019). Covington, Adams, and Sargin describes the algorithms used by YouTube (Covington, Adams, & Sargin, 2016). We collected information from the first 60 videos on the list, which combined, have a length of around 12 hours. The process of collecting and coding the data was iterative, an approach suggested by Saunders et al. (2018), to assure data saturation (Fusch & Ness, 2015), which indicates that "on the basis of the data that have been collected or analyzed hitherto, further data collection and/or analysis are unnecessary" (Saunders et al., 2018). We did so by beginning the coding process with 40 videos and continued collecting videos until by the 60th video, wherein no more new codes emerged. Interestingly, only 5 of these 60 videos required age verification. The following information was collected for each video: the link, the number of views, and the first 30 comments sorted by 'Top comments,' if present, since at this point data saturation was achieved as found by iteratively collecting and coding data (Fusch & Ness, 2015). Top comments are based on how many individuals like versus dislike a comment. A total of 1,112 comments were collected for coding. Inclusion criteria for the videos were relation to the BWC and in English, translated into English, or contained English subtitles. Inclusion criteria for the comments were the comment had to be in English and include words. This data collection strategy was chosen to mimic the typical user behavior search strategy (Bromberg, Augustson, & Backinger, 2012; Luo, Zheng, Zeng, & Leischow, 2014; Richardson & Vallone, 2014).

In addition, 150 Twitter posts were randomly collected using the social media monitoring and analytics tool Radian6, which is a social media analytic tool that listens, tracks, and analyzes conversations across different online channels based on keywords (Radian6, 2019). While Radian6 can only analyze posts in ten different languages and is the most expensive social media monitoring tool, it can analyze almost all types of complex posts including Forums/News/Media, Blogs, Microblogs, Geography, History, and Sentiment (Laine & Frühwirth, 2010). These posts were collected from the period between February 2012 to February 2018 using the keywords and inclusion criteria provided in Table 2.1. The timeline for collecting the data was chosen to cover the time period where it is believed that BWC was most active (Khattar, Dabas, Gupta, Chopra, & Kumaraguru, 2018).

Table 2.1 Keywords, hashtags, and inclusion criteria for collecting twitter posts using Radian6.

Keywords	Hashtags	Inclusion criteria
"Blue Whale Challenge"	"#BlueWhaleChalllenge"	The post had to be in
"Blue Whale Game"	"#BlueWhaleGame"	English and related to the
"BWC"	"#Blue_Whale_Challlenge"	BWC.
	"#Blue_Whale_Game"	No duplicates.
	"#BWC"	

Data Analysis Approach

Due to the different policies, technical affordances, and data types of these platforms (Pater et al., 2015; Pater et al., 2016; Pater & Mynatt, 2017), we decided to build different codebooks for each type of data, analyze the data for each site, and then compare the codebooks across platforms. To identify the common themes and categories of the YouTube videos, YouTube comments, and Twitter posts, codebooks were developed by

dividing the top 40 videos, their top 40 related comments, and 100 Twitter posts between two raters. Each rater then developed an individual codebook before convening to discuss the common themes/categories found in the videos, comments, and Twitter posts. We initially collected 100 Twitter posts for analysis and continued to collect and code posts until no new codes emerged, meaning all posts collected reflected the existing code book, with data saturation (Saunders et al., 2018) occurring at 150 posts.

Each of the individual rater's codebooks were then converged and discussed by the two raters, resulting in three first-round codebooks (one for each Twitter posts, YouTube videos, and YouTube comments). We conducted a pilot analysis on the top 40 YouTube videos, 695 YouTube comments under those videos, and 100 Twitter posts to ensure that the initial codebooks sufficiently summarized the data. Following the completion of the pilot analysis, the codebooks were modified by the raters together to more accurately summarize the data.

Once the codebooks were finalized, the full analysis of 60 YouTube videos, 1,112 YouTube comments under those videos, and 150 Twitter posts was conducted. The two raters individually coded without collaboration to negate bias. The inter-rater reliability measured by Cohen's Kappa ranged between 0.61 and 0.88. When the two raters disagreed on a code, video, comment, or tweet, it was set aside for consensus coding, a process where the two raters discussed the difference in coding until they agreed on a category (Saldana, 2015). The final codebooks and results are provided in Appendices A, B and C. All the coding results were entered into Atlas.ti (ATLAS.ti, 2019), a qualitative coding software,

to conduct axial coding and develop emergent themes across the three data types. The entire data collection and analysis processes are summarized in Figure 2.1.

Safe and Effective Messaging Guidelines

SPRC developed nine safe and effective messaging guidelines based on best practices from research to reduce the risk of inducing self-harm or suicide-related contagion in those who view a message; see Table 2.2 (Suicide Prevention Resource Center, 2006; Chambers et al., 2005; Gould et al., 2003). Either following or violating these guidelines represents a metric for the contagion risk associated with a social media post. Each of the YouTube videos was compared to the nine SPRC Safe Messaging Guidelines by two researchers. The inter-rater reliability measured by Cohen's Kappa was 0.66. If the two raters disagreed on a code, the video was set aside for further consensus coding.

Results

This research focused on two main components: first, exploring the types of messages social media users share about the BWC via YouTube and Twitter, and second, the violation of SPRC guidelines in the YouTube videos. We examined the common themes across YouTube videos and comments, and Twitter posts, then used an inductive coding approach to explore how many of the YouTube videos violated the SPRC guidelines. We subsequently compared these videos to the number of views and finally looked at which of the guidelines tend to be violated more often than others.

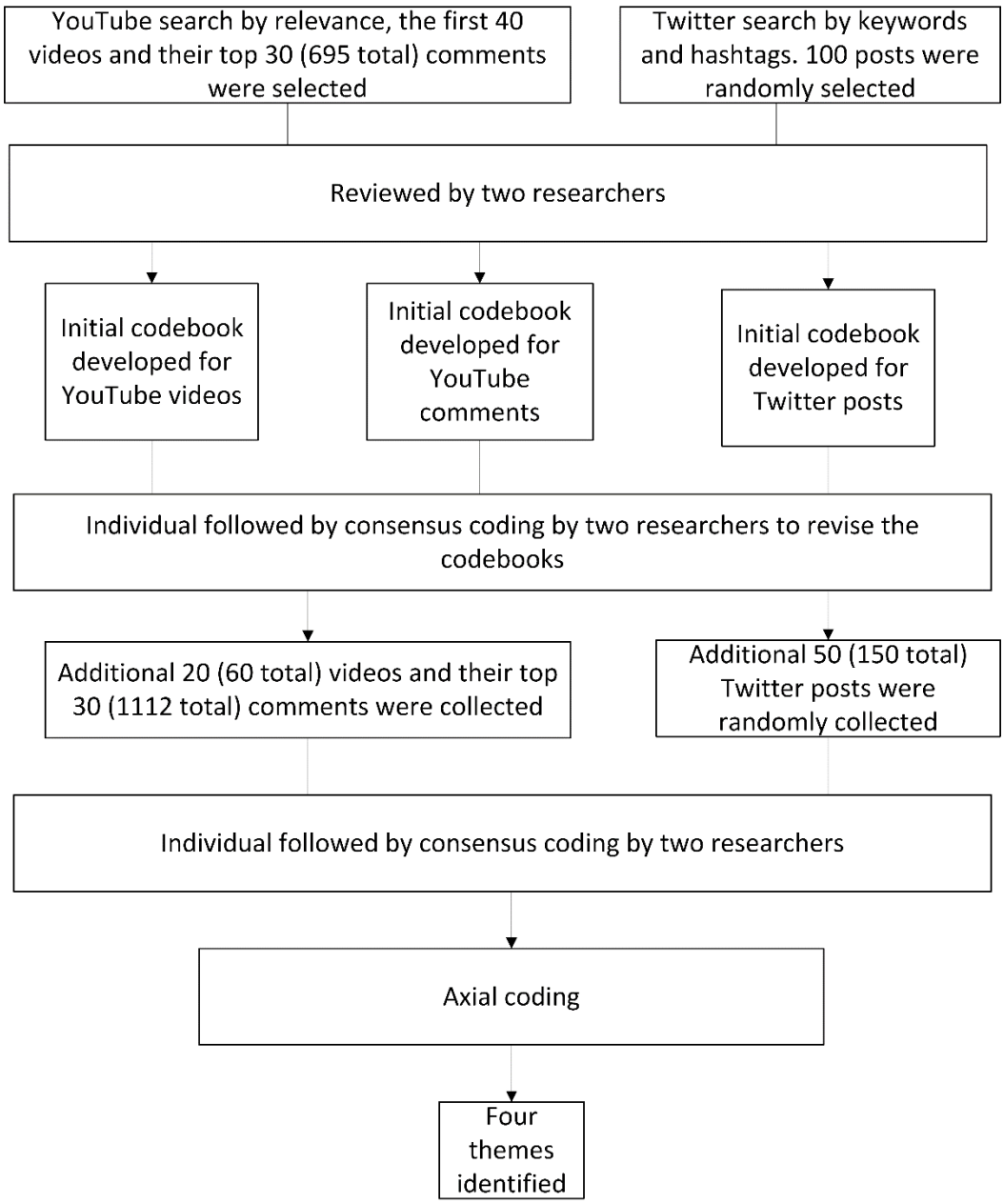

Figure 2.1 Data collection and data analysis flow chart.

Table 2.2 SPRC Safe and Effective Messaging for Suicide Prevention (Suicide Prevention Resource Center, 2006).

Guideline	Description
Emphasize seeking help and provide information on where to find it.	Provide steps for finding mental health treatment. Advise that help is available through local service providers and crisis centers, and through the National Suicide Prevention Lifeline (1-800-273-TALK [8255]).
Emphasize prevention.	Highlight that suicide is avoidable and preventable and that there are actions for individuals who have suicidal thoughts to prevent them from acting on those thoughts (U.S. Department of Health and Human Services, 2012).
List the warning signs, as well as risk and protective factors of suicide.	List the warning signs like the ones developed by the American Association of Suicidology. List what could both reduce and increase the risk of suicide; these can be found on pages 35-36 in the National Strategy for Suicide Prevention. Educate people how to identify a person with self-harming thoughts.
Highlight effective treatments for underlying mental health problems.	46% of people who died by suicide from 2014-2016 had a known mental health condition, with 67% them having a history of treatment for substance abuse. Among them, 46.7% had recently been released from a psychiatric facility (Stone et al., 2018), a percentage which can be reduced by providing improved access to effective treatments and social support (Baldessarini, Tondo, & Hennen, 1999).
Avoid glorifying or romanticizing suicide or people who died by suicide.	Vulnerable younger adults may relate to the attention given to and sympathy for a person who committed suicide (Fekete & Schmidtke, 1995).

Guideline	Description
Avoid normalizing suicide by presenting it as a common event.	Suicide ideation is not seen as normal by most people, and they do not consider it an option. However, presenting suicide as a common event may remove this bias (Cialdini, 2003).
Avoid presenting suicide as an inexplicable act or explain it as a result of stress only.	Doing so may encourage identification with the victim as well as ignoring the complexity and preventability of suicide. Presenting suicide as explainable or a result of stress only misleads vulnerable individuals to believe that it is a normal response to common life situations (Suicide Prevention Resource Center, 2006; Cialdini, 2003; Fekete & Macsai, 1990; Jacobs, 1999; Sonneck, Etzersdorfer, & Nagel-Kuess, 1994).
Avoid focusing on personal details of people who died by suicide.	Vulnerable younger adults may feel they are like the person who committed suicide, eventually leading them to consider taking their lives in the same way (Fekete & Macsai, 1990).
Avoid presenting overly detailed descriptions of suicide victims or methods of suicide.	Including pictures and/or descriptions of where and how an individual died by suicide may lead a vulnerable person to imitate the act (Fekete & Macsai, 1990; Sonneck et al., 1994).

Common Themes Across the Social Media Platforms (RQ1)

We identified four common themes among all the posts in the three data types included in this study. Table 2.3 presents the themes, the corresponding codes (codes definitions can be found in Appendices A, B, and C), and the percentages of posts from each type of data.

Theme 1: Raising awareness about the BWC and discouraging participation:

The first theme included social media posts in which users were trying to raise awareness and warn parents about this dangerous phenomenon. YouTube videos in this context were either news reports or bloggers that started their videos by listing different names for the BWC and the statistics on how many people died by suicide due to this game, and then by discussing the tasks involved in the BWC, including that the only way out of the game is suicide. These videos frequently included clips from interviews with victims' parents or pictures of the victims while describing the BWC. The YouTube comments in Theme 1 were against BWC and suggested that parents and authorities pay more attention to their children's safety. For example, one of the comments in Theme 1 is:

"This is getting ridiculous. The government or FBI or someone needs to do something (sic)."

The Twitter posts in Theme 1 centered on awareness of this dangerous game. One example of the Twitter posts in this theme is:

"Please understand & beware of Blue Whale Challenge -4 parents (sic)."

This theme was most common in the YouTube videos (~83%) and Twitter posts (~69%), suggesting that the majority of the users on these two platforms are trying to spread the word about the danger of BWC.

Table 2.3 Common themes and corresponding codes among the three data types.

Theme	Relevant Codes from Each Codebook	YouTube Videos	YouTube Comments	Twitter Posts
Raising awareness about BWC and discouraging participation	**YouTube Videos codebook:** *Inform or Raise Awareness/Warning, Facts about the Challenge, Recommendations* **YouTube Comments codebook:** *Criticizing the Game, Intervention/Recommendation* **Twitter codebook:** *Warning/Awareness/Intervention, Information About the Challenge*	83%	28.3%	68.7%
Expressing sorrow for people with mental health issues	**YouTube Videos codebook:** *Remembering the Victims, Negative Tone of Speaker* **YouTube Comments codebook:** *Expressing Sorrow/Concern, Encouraging Teens/Parents* **Twitter codebook:** *Mental Health*	47%	11.1%	3.3%
Criticizing the participants or the challenge	**YouTube Videos codebook:** *Sarcastic, Funny, or Prank* **YouTube Comments codebook:** *Criticizing the Game; Criticizing the Victims; Sarcastic, Funny, or Prank* **Twitter codebook:** *Sarcastic/Funny/Jokes*	10%	46.7%	16.0%

Theme	Relevant Codes from Each Codebook	YouTube Videos	YouTube Comments	Twitter Posts
Providing experiences	**YouTube Videos codebook:** *Victims Related (both in video content and parties participating), Parents* **YouTube comments codebook:** *Participating, Personal Experience* **Twitter codebook:** *Personal experience*	60%	16.0%	0.7%

Theme 2: Expressing sorrow for people with mental health issues:

The second theme included social media posts in which the users felt sympathy for those who participated in the BWC or people with mental illness. These videos primarily presented pictures of these people accompanied by sad music. The YouTube comments in Theme 2 included words of encouragement and support for people with mental health issues. An example of these supportive comments is:

"Love you girl so many people care about you. Depression is a horrible :(stay strong girl!! (sic)."

The Twitter posts in Theme 2 primarily mentioned that people participate in the BWC because they have mental health issues. One example of the Twitter posts reflecting this theme is:

"Blue Whale Challenge: Hey Mr. Scribe, Brush Up Your Archaic Knowledge of Mental Healths (sic)."

A high percentage of the YouTube videos (~47%) fell under this theme, but fewer YouTube comments (~11%) and Twitter posts (~3%) did.

Theme 3: Criticizing the participants or the challenge:

The third theme included social media posts from individuals who either criticized the teenagers who participated in the BWC or made sarcastic comments about them. The 6 YouTube videos that fell under this theme (10%) mentioned that teenagers participate in BWC just to "show off" and criticized them harshly or made sarcastic comments about them. The 511 YouTube comments in this theme (46%) criticized the BWC participants by saying things such as:

"people who play this game are more stupid than the game itself. How can one lost his sense and manipulated by others...grow up guys...u have brains to think what is good and bad... (sic)."

The 24 Twitter posts in this theme (16%) were primarily sarcastic. For example, one of these Twitter posts is:

"Husband silently downloaded the blue whale game on his #wife's phone. 50 days later the #bluewhale committed suicide (sic)."

Theme 4: Providing experiences:

The last theme we identified included social media posts where users spoke in detail about someone who had participated. This theme was very common in the YouTube videos (60%), where these 36 videos interviewed teenagers' parents and provided pictures of the adolescents' bodies showing instances of self-harm. This theme was slightly less common among the YouTube comments (16%), and these 178 comments were mainly about

experiences of acquaintances or users who were asking to participate in the BWC. An example of the comments by someone asking to participate in BWC is

"I want to play blue whale game plz give me link (sic)."

Only 2 Twitter posts fell in this theme (~1%), which tended to be acquaintance stories. For example, one user posted the following on Twitter:

"We just had a meeting here at work and this lady told us that her 10-year-old niece committed suicide because of this other Blue Whale Challenge (sic)."

Safe and Effective Messaging Guidelines (RQ2)

Of the 60 YouTube videos evaluated based on the SPRC Safe Messaging Guidelines, 22 (37%) met fewer than 3 of the 9 safe messaging guidelines, meaning the videos were considered more unsafe than safe. Approximately 50% (30 videos) were considered neutral, meaning they met only 4 to 6 of the guidelines, while the remaining 13% (8 videos) were considered more safe than unsafe because they met 7 or more of the guidelines.

When compared to the number of views on each video, 50% (10 videos) of the top 20 viewed videos were more unsafe than safe, meaning the videos violated at least 6 of the 9 criteria for safe and effective messaging about suicide. Only 10% (2 videos) of these 20 videos were considered more safe than unsafe and 40% (8 videos) were considered neutral. The top 20 viewed videos had 46,099,923 views in total. Of the middle 20 most viewed videos, 30% (18 videos) were considered more unsafe than safe, 25% (15 videos) more safe than unsafe, and 45% (27 videos) neutral. The middle 20 viewed videos had 1,169,054 views in total. Of the 20 least viewed videos, 30% (18 videos) were considered more unsafe

than safe, 5% (3 videos) more safe than unsafe, and 65% (39 videos) neutral. The 20 least viewed videos had only 123,450 views total. All videos met at least one of the nine guidelines, and only one video met all 9 criteria. The total number of views for all 60 videos was 47,392,427, with the top 20 videos having 97.27% of the total views.

To better understand which guidelines were most frequently violated, we include the number of videos that violated each guideline in Table 2.4. The guidelines most frequently violated were "Highlight effective treatments for underlying mental health problems" and "Emphasize seeking help and provide information on where to find it." As seen in Table 2.3, most YouTube were intended to raise awareness and warn parents and society about the BWC. It is expected and advisable for these types of videos to provide steps on how to treat such problems or information on where these details could be found such as the National Suicide Prevention Lifeline (Stone et al., 2018). However, as our results indicate, these videos failed to do so.

In addition, most of the videos violated the guidelines "Avoid presenting overly detailed descriptions of suicide victims or methods of suicide," "Avoid glorifying or romanticizing suicide or people who died by suicide," and "Avoid focusing on personal details of people who died by suicide." These videos tended to include personal pictures of the victims, such as pictures of an arm with a whale carved on it. Most of the videos also mentioned that Philipp Budeikin, a 22-year-old dropout psychology student, is the curator of the challenge. They included pictures and quotes from the curator of the game, the most frequently occurring quote as:

"The people who have died by the BWC are biological waste, and I was cleaning the society from them."

A smaller percentage of the videos included clips from interviews with the victims' families and mock conversations between a victim and the curator showing how a person can participate in the challenge. Additionally, they mentioned that the challenge has other names, including but not limited to, The Silent House, A Sea of Whales, Wake Me Up at 4:20 AM, and F57. The majority of the videos described and provided details about the challenge's tasks and methods for attempting suicide, including jumping off a high building, jumping in front of a train, and self-hanging. These videos also mentioned specific names of suicide cultures and online suicide groups or forums on social media that contributed to the spread of this challenge.

Approximately, 67% (40 videos) of these videos violated the guideline "Avoid normalizing suicide by presenting it as a common event." In these videos, general facts and statistics about the BWC, such as the number of suicides related to the challenge and the countries in which they occurred were provided. On the other hand, only a few videos provided support hotlines and recommendations to teenagers and parents about how to avoid this game.

Table 2.4 Percentage of videos violating each SPRC safe messaging guideline.

Guideline	Percentage (%)
Highlight effective treatments for underlying mental health problems.	90%
Emphasize seeking help and provide information on where to find it.	78%
Avoid presenting overly detailed descriptions of suicide victims or methods of suicide.	75%
List the warning signs, as well as risk and protective factors of suicide.	72%
Avoid normalizing suicide by presenting it as a common event.	67%
Avoid glorifying or romanticizing suicide or people who died by suicide.	55%
Emphasize prevention.	50%
Avoid focusing on personal details of people who died by suicide.	50%
Avoid presenting suicide as an inexplicable act or explain it as a result of stress only.	33%

Discussion

To the best of our knowledge, our study is the first to systematically document the quality, portrayal, and reach of the BWC on social media. In this study, we found that it is easy for adolescents to access almost any post about the BWC on social media since only five of the YouTube videos blocked minors from viewing the content. We assessed the portrayal of BWC on social media by investigating the common themes of the videos and posts and the videos' adherence to the safe and effective messaging guidelines. We found that social media users post about BWC to raise awareness and discourage participation, to express sorrow for the participants, to criticize the participants, or to describe a relevant experience. Moreover, we found the majority of the videos on YouTube violate at least 50% of the SPRC safe and effective message guidelines.

Common Themes Across the Social Media Platforms (RQ1)

Posts in Theme 1 were meant to raise awareness and warn parents and society about the BWC. These posts were primarily anti-BWC, as opposed to pro-BWC. This finding implies that it is harder to find information on how to participate in BWC in comparison to obtaining pro-BWC or pro-suicide information on the internet as found by a previous study (Recupero, Harms, & Noble, 2008). It also implies that it is hard to find videos from actual participants of the BWC. This finding could partially be due to the nature of the challenge in that it encourages participants to conduct self-harm secretly.

Another topic highlighted in BWC-related social media posts was that the users felt sympathetic towards people who participated in BWC or people with mental illness (Theme 2). This also parallels our first two implications that it is not easy to find pro-BWC information on social media and even harder to find posts from actual participants. However, posts of this kind make the viewer think that there are a significant number of others participating in the BWC. This conclusion could lead them to believe suicide and self-harm are normal responses to common life situations (e.g. stress) rather than outcomes that can be prevented.

On the other hand, as seen in Theme 3, there were many posts in which people either criticized the adolescents who participated in the BWC or made fun of them, agreeing with the purpose of the BWC to clean "society of people with mental issues," or showing a misunderstanding on why teenagers participate in these kinds of challenges. This finding indicates that some users misunderstand why youth participate in self-harming activities.

Lastly, as reported in Theme 4, we found a large number of social media users tend to speak in detail about someone who participated in the BWC, providing their demographics or interviewing their parents or acquaintances who provide more details about the participant's personal life. This theme was also found by other researchers who examined traditional media posts about suicide (Fekete & Schmidtke, 1995). It is possible that reporting this level of detail might lead vulnerable adolescents to feeling that they are similar to the adolescents who participated in the BWC and make them more likely to participate or harm themselves (Fekete & Macsai, 1990).

Safe and Effective Messaging Guidelines (RQ2)

We suggest that videos similar to those we examined could contribute to the spread of these deadly challenges instead of their intention of raising awareness to decrease participation. Most posts romanticized people who have died by following this challenge, and younger vulnerable adolescents may see the victims as role models, possibly leading them to end their lives in the same way (Fekete & Schmidtke, 1995; Noble-Carr & Woodman, 2018). In violation of guidelines, the videos presented statistics about the number of suicides believed to be related to this challenge in a way that made suicide seem common (Cialdini, 2003). In addition, the videos presented extensive personal information about the people who have died by suicide while playing the BWC. They also provided detailed descriptions of the final task, including pictures of self-harm and means of suicide, material that may encourage vulnerable adolescents to consider ending their lives and provide them with methods on how to do so (Fekete & Macsai, 1990; Sonneck et al., 1994). On the other hand, these videos both failed to emphasize prevention by highlighting

effective treatments for mental health problems and failed to encourage individuals with mental health problems to seek help as well as providing information on where to find it.

The SPRC safe and effective messaging guidelines are provided to help people working in suicide prevention, mental health promotion, or any other forms of media ensure that messages about suicide are safe, positive, and strategic. Thus, these guidelines are applicable for assessing the appropriateness and safety of the content in messages in suicide campaigns and those discussing suicide across a variety of platforms (Suicide Prevention Resource Center, 2006; Noble-Carr & Woodman, 2018). Since adolescents often look for emotional support from the internet, it is critical that internet-based resources follow these guidelines as not doing so may contribute to and/or increase the likelihood of someone with suicidal thoughts attempting suicide (Suicide Prevention Resource Center, 2006; Cialdini, 2003; Fekete & Macsai, 1990; Jacobs, 1999; Sonneck et al., 1994).

Implications and Recommendations

Though there are no studies investigating how the BWC (or similar challenges such as the Momo Challenge) messages on social media may affect an individual's perception, belief, or behavior regarding self-harm, other studies have shown the dramatic effects of movie and TV portrayals that have led to increased rates of suicide and self-harm using the same methods (Ayers, Althouse, Leas, Dredze, & Allem, 2017; Cooper, Bard, Wallace, Gillaspy, & Deleon, 2018; Gould et al., 2003; Gould & Shaffer, 1986; Tanner, Murray, & Phillips, 1988). For example, Cooper et al. (2018) and Ayers et al. (2017) both reported suicide admission counts increase coinciding the release of the Netflix series 13 Reasons Why. Suicide contagion has been shown across a variety of entertainment and

communication mediums, and social media has been the focus of recent research interest as a medium for contagion due to the ease with which harmful content can be spread (Arendt et al., 2017; Hong et al., 2019; Ortiz & Khin Khin, 2018; Zimerman, Caye, Salum, Passos, & Kieling, 2018).

As two of the most popular websites and social media platforms, YouTube and Twitter are potentially capable of influencing countless adolescents (Gutowski et al., 2018; Luo et al., 2014; Maina, 2018; Pater et al., 2015; Swendeman et al., 2019; Vaterlaus, Tulane, Porter, & Beckert, 2018). With most of the BWC related posts on these platforms found to be potentially harmful to vulnerable populations, our findings suggest that it is urgent to monitor social media posts related to the challenge and similar self-harming challenges. The SPRC should appropriately inform social media users, particularly those with greater influence (e.g., celebrities, news anchors, etc.) on how to address suicide or self-harm in a safe way in order to reduce contagion. This could be achieved using an algorithm that detects harmful content in the video prior to posting and provide recommendations to the user to edit or remove such content. Even though most YouTube users found the BWC to be a threat and forwarded a message as means to warn others or speak out against it, they may unintentionally contribute to self-harm contagion. Therefore, it is critical for social media users to evaluate sources before creating and sharing information. They should also be educated on how to respond to unsafe posts and how to report such posts to social media administrators.

YouTube has the potential to become a powerful positive information dissemination platform with the contribution of mental health professionals and

organizations (Chalil Madathil, Rivera-Rodriguez, Greenstein, & Gramopadhye, 2015). Professionals and organizations can do so by actively participating on YouTube channels by creating and uploading videos that are safe, accurate, and trustworthy. Moreover, while only minimal barriers can realistically be applied to video uploads due to the nature of such platforms, there is a need to develop advanced algorithms and interfaces to highlight information that is safe, accurate, and trustworthy. In addition, integrating approved information available from federal agencies such as SPRC might increase the veracity and safety of information available. Greater effort is needed to educate the community about mental health and factors that could lead to self-harm, in addition to educating users on how to respond to unsafe posts. This could be accomplished by adding resources in suicide prevention campaigns or by social media platforms through providing a link on suicide-related videos to educate the public on how to identify and respond to unsafe videos. In addition, features such as crowdsourcing, whereby users are able to report inaccurate and misleading information to prevent the spread of misinformation, could be integrated on social media sites.

Limitations and Future Work

There are several limitations to our study with many related to the data used. We only studied videos and posts about BWC that are publicly available. It is possible that more harmful videos could be posted on private pages or personal accounts. Additionally, the YouTube videos were selected by relevance to the topic based on one keyword. Ideally, videos should be randomly selected using several keywords. Moreover, our sample may differ from videos sampled at a subsequent time since YouTube is rapidly changes by

nature. Further, this study focused on two social media platforms, while people could be posting about the challenge on other platforms including, but not limited to, Facebook, VKontakte, Snapchat, and Instagram. Our study focused on one self-harm and suicide challenge, the BWC; while there are many other self-harm challenges such as the Tide Pod Challenge and other suicide challenges such as the Momo Challenge.

Future research could include a comparison of the characteristics of posts about different challenges at various levels of self-harm to better understand the reasons for their viral spread. Understanding these factors will help build simulations models, such as agent-based models, to visualize the spread of these challenges. In addition, understanding these factors will help develop and adopt improved policies and interventions for eliminating the spread of harmful challenges among teenagers, such as those found provided by Luxton, June & Fairall (2012). Integrating these policies in simulation models will help to identify the policies most effective in reducing these challenges with minimal cost.

Conclusion

We investigated the characteristics of YouTube and Twitter posts focusing on the BWC and the characteristics of these posts that make them potentially harmful to vulnerable populations. Through our qualitative analysis, we found that while most videos and Twitter posts attempt to raise awareness about the challenge and inform parents, they may have unintentional harmful effects since most violated the SPRC safe messaging guidelines. We conclude that safe messaging guidelines should be more widely disseminated. Our data show that the majority of posters were not professionals and were likely to violate safe messaging guidelines. More efforts are needed to disseminate and

educate the average person on messaging guidelines as well as factors that encourage contagion effects.

CHAPTER THREE

INVESTIGATION OF THE PORTRAYAL OF SOCIAL MEDIA CHALLENGES ON YOUTUBE AND TWITTER

Introduction and Background

Based on our knowledge, no existing studies have explored the relationship between social media, self-harm, and suicide contagion in the specific context of viral social media challenges. These challenges might be of distinct theoretical interest given that multiple factors contribute to the contagion effect: peer pressure, a vulnerability for self-harming behavior, the normalization of self-harm, and social modeling (Jarvi et al., 2013). Moreover, these online challenges could be particularly harmful since even the activities involving the least amount of harm are treated as a game to encourage a broad participation that rapidly spreads through social media (Gomez-Rodriguez, Leskovec, & Krause, 2012). To address these issues, the goal of this study is to investigate how social media users post about these challenges and to compare their portrayal themes across social media platforms and different challenges including, Amyotrophic Lateral Sclerosis (ALS) Ice Bucket Challenge (IBC), Tide Pod Challenge (TPC), and Blue Whale Challenge (BWC). We will accomplish this by first studying the portrayal of these three challenges on social media to better understand the societal perception toward them, and why the social media users think adolescents are participating in these challenges. We will also investigate whether the way the social media users speak about these challenges could potentially contribute to the willingness of adolescents to participate. We will be looking at how the social media users shape and depict these challenges in terms of the type of media they use, the purpose of the post, the content of the post and any other themes that

emerge in the analysis. We then compare our findings with previous literature conducted on factors that might affect human behavior in general and self-injurious behavior specifically (Cheng et al., 2014; Montano & Kasprzyk, 2015; Phillips, 1974). These three challenges (e.g. ALS IBC, TPC, and BWC) were selected because they vary in the level of self-harm involved. The last stage of the BWC, for example, reportedly requires the participant to attempt suicide, the TPC involves swallowing laundry detergent, and the ALS IBC involves having participants drench themselves with ice water, the least harmful of the challenges. We will also make comparisons among the three challenges to assess whether certain patterns are generalizable to other social media challenges and which characteristics are unique to each particular challenge. In this study, we focus on addressing how the perception of society toward a challenge changes based on the level of harm involved. More specifically, we address the following research questions:

RQ1*:* Why do social media users post about the BWC, TPC, and ALS IBC?

RQ2*:* What contents and topics do the social media users include in their portrayal about BWC, TPC, and ALS IBC?

***R*Q3:** How do the portrayal patterns differ across the three different challenges and across platforms (e.g. YouTube and Twitter)?

RQ4*:* How do the portrayal patterns affect the post viewers' opinion of the three different challenges?

Methodology

This study identifies and compares the common themes found in social media posts collected from two publicly available platforms of the top 20 most popular social media

sites: YouTube and Twitter (Maina, 2018; Pater et al., 2015; Pater et al., 2016). We first inductively coded the collected data, then we identified the common themes for the three challenges to see how they differ across the challenges and platforms.

Data Collection

For this study, we collected social media trace data from YouTube and Twitter. YouTube's search engine was used to collect the videos manually for this study, with the key words presented in Table 3.1 being searched separately to obtain videos on each of these challenges in March 2018. The results were sorted by Relevance, an option provided by YouTube that lists videos in descending order relative to the keywords queries and the videos are ranked based on several factors such as "how well the title, description, and video content match the query and which videos have driven the most engagement for the query" (YouTube Creator Academy, 2019). The first 60 related videos for each challenge were selected for coding, meaning a total of 180 videos were collected (~813 minutes total length, with a mean of 4.5 and a standard deviation of 4.3). Information such as number of views, the user/video owner, and the top 30 comments sorted by Top Comments, another YouTube option, were also collected for each video, with a total of 1112, 1305, and 1190 comments being collected for coding for the BWC, TPC, and ALS IBC, respectively. In addition to relation to the three challenges, inclusion criteria for the videos included they had to be in English, translated in English, or have English subtitles. Inclusion criteria for the comments stipulated they were in English and contained words, meaning Emoji only comments were excluded. This kind of data collection strategy was chosen to mimic the

typical user behavior search strategy as suggested by the literature (Bromberg et al., 2012; Luo et al., 2014; Richardson & Vallone, 2014).

Table 3.1 YouTube and Twitter search terms.

Challenge	YouTube keywords	Twitter keywords	Twitter hashtags
BWC	Blue Whale Challenge	"Blue Whale Challenge","Blue Whale Game", and "BWC"	"#BlueWhaleChallenge," #BlueWhaleGame," "#Blue_Whale_Challenge, "#Blue_Whale_Game," and "#BWC."
TPC	Tide Pod Challenge	"Tide Pods Challenge" and "Tide Pod Game"	"#TidePodChallenge," #TidePodGame," "#Tide_Pod_Challenge," and "Tide_Pod_Game."
ALS IBC	ALS Ice Bucket Challenge	"ALS Ice Bucket Challenge," "Ice Bucket Challenge," "ALS Ice Bucket Game," and "Ice Bucket Game"	"#ALSIceBucketChallenge," "#IceBucketChallenge," "#ALSIceBucketGame," "#IceBucketGame," "#ALS_Ice_Bucket_Challenge," "#Ice_Bucket_Challenge," "#ALS_Ice_Bucket_Game," and "#Ice_Bucket_Game."

Data Analysis Approach

A thematic content analysis was conducted on the data to identify the themes in these platforms (Joffe & Yardley, 2004; Padgett, 2011). The purpose of building the codebooks used here was to help determine the common themes on how social media users talk about these online challenges and to explore the similarities and differences between

the portrayal patterns of these challenges. YouTube and Twitter have different policies, technical affordances, norms, and audiences (Pater et al., 2015; Pater et al., 2016; Pater & Mynatt, 2017), therefore we decided to build different codebooks for each data type, analyze the data for each site, and then compare the codebooks across challenges. Three codebooks were built for the three challenges, one for the YouTube videos, one for the YouTube comments, and one for the Twitter posts. These codebooks went through two phases of generation (i.e. two rounds of coding) to ensure they thoroughly represented the data. Two raters coded the data for each of the challenges (six raters in total). To build the codebooks, each rater watched 20 YouTube videos, read their related comments, and read 50 Twitter posts, all related to one challenge. Each pair of raters individually built codebooks, then discussed the common codes among the different types of data. This process resulted in preliminarily codebooks.

The raters then completed a preliminary coding on part of the data set to make sure the codebooks were comprehensive. Round one of coding involved 120 YouTube videos (40 videos for each of the three challenges), 2,364 comments and 300 Twitter posts (100 for each of the challenges). For each challenge, a pair of raters coded the data individually to ensure no bias and then discussed any disagreement on the code for a video, comment, or Twitter post until consensus was reached. After the first round of coding, each pair of coders reviewed and discussed the codebooks, editing them to build representative and comprehensive codebooks.

The final round of coding involved 160 YouTube videos (the 120 from the first round plus an additional 40). There were 3,607 comments for those videos, 1,112 for BWC,

1,305 for TPC, and 1,190 for ALS IBC. Four hundred and fifty Twitter posts were analyzed in this round, 150 for each of the challenges. The same pair of raters coded the data individually to negate bias. When a pair of raters disagreed on the code, the data were set aside for further consensus coding. To answer the last research question and compare the ways social media users talk about the different challenges, we conducted axial coding to map the emergent themes across the codebooks based on similarities (Saldana, 2015).

Codebooks

The focus of this study is to investigate the portrayal of three different challenges on social media and we did so by inductively coding three types of social media data about these challenges. This will help us answer the first two research questions concerning with the way social media users talk about the online challenges. Appendix D represents the resulting codebook for the YouTube videos for the three challenges. The interrater reliabilities for the YouTube videos were found to be substantial, Cohen's kappa ranged between 0.61 - 0.88. We followed the initial coding by consensus coding. The final codebook for the YouTube comments and examples for each of the codes are shown in Appendix E. If a comment expressed more than one of the codes, it was placed into the one that best reflected its meaning. Interrater reliability analyses indicated a Cohen's Kappa range of 0.675 - 0.729 before the raters conducted consensus coding. The codebook for the Twitter posts along with examples for each code is presented in Appendix F. The interrater reliability based on Cohen's kappa ranged between 0.67 - 0.77 and the raters conducted a consensus coding after the initial round of coding.

Results and Findings

This research focused on two main components: exploring the types of messages social media users share about the social media challenges via different platforms and investigating the differences and similarities about how they talk about challenges with different characteristics. We used an axial coding approach to identify the common themes among the different social media platforms, then explored how these themes vary across challenges. We identified five common themes among all the posts in the three social media platforms included in this study. Table 3.2 presents the themes, the corresponding codes from each platform, and the percentages of posts corresponding to each of the challenges.

Theme 1: Education and awareness:

The first theme included posts where social media users were trying to raise awareness about the challenges and/or educate parents in order to reduce the risk of any potential participation in them. This was the most common theme in the BWC YouTube videos (83.33%) and BWC Twitter posts (65.33%). BWC YouTube videos in this context were either news or blog clips that listed different names of the BWC (see Figure 3 in Appendix G), statistics on how many people died by suicide due to this game, and the tasks involved in BWC, including that the only way out of the game is to die by suicide. These videos tend to provide brief clips from interviews with victims' parents/families or provide pictures of the victims while describing the BWC (see Figure 2 in Appendix G). The YouTube comments surrounding education and awareness of the BWC were primarily against participation in the BWC and suggested that parents and authorities pay more attention to children's safety. For example, a comment reads:

"This is getting ridiculous. The government or FBI or someone needs to do something (sic)"

Similar to the YouTube videos and comments, the BWC twitter posts were centered around awareness and education of this dangerous game:

"Please understand & beware of Blue Whale Challenge -4 parents (sic)"

Education and awareness as the most common theme shows that most of the users on both YouTube and Twitter are trying to spread awareness about the BWC to eliminate potential participation.

YouTube videos about the Tide Pod Challenge pertaining to this theme were, to some extent, similar to the BWC YouTube videos. Their main purpose was to increase awareness about the TPC so that parents would pay more attention to their child's safety. The videos were mainly news clips and a few blog posts describing the TPC and providing examples of teenagers participating in the challenge (see Figure 4 in Appendix G). These videos commonly provided facts about the challenge, such as indicating how many people they believe got poisoned by participating in TPC. Additionally, the TPC YouTube comments in this theme were intended to tell the parents or the children to "do their laundry" using the Tide pods instead of doing TPC. TPC Twitter posts were very similar to the YouTube comments stating things like:

"Hey teenagers, here's the REAL #Tide pod challenge: put it in the washing machine and do your OWN laundry!!! (sic)"

Another post reads:

"The viral trend on social media, the Tide Pod Challenge, has driven teenagers to biting into (sometimes eating) these poisonous little pods."

However, education and awareness theme did not appear frequently in the TPC YouTube videos (3.83%) but appeared more in the YouTube comments (25.30%) and Twitter posts (32.87%).

Education and awareness was one of the most common themes seen in ALS IBC videos (75.00%). These videos were mainly personal videos posted by people and bloggers who have actually participated in the challenge (see Figure 7 in Appendix G). These videos commonly explained ALS and emphasized the importance of donating money to finding a cure for the disease. Around 11.00% of the YouTube comments fell under this theme and were mainly approval comments about the content of the videos. For example:

"Bro, I can see the passion in your eyes. You make a difference with this. I have known what ALS is and its effects but hearing/seeing you talk about it with first-hand experience shows me just how much damage it can do. Be strong man, and know this video spread a strong message to me and I am sure to others"

The majority of Twitter posts also fell into this theme (69.33%) and often gave general information and positive outcomes about the challenge, such as how much money the challenge has raised, or saying positive things about the person who created the challenge:

"@CharlieBakerMA Just signed the "Ice Bucket Challenge" bill honoring @PeteFrates3 and his family for their incredible work on ALS (sic)"

Theme 2: Criticizing the participants and blaming the victims:

Distinct from the first theme, the second theme included posts that either criticized the person who participated in the challenges, made fun of them, or mentioned that the participants deserved any harm they experienced. A small percentage of the BWC YouTube videos fell under this theme (10.00%). These videos mentioned that the adolescents participate in BWC just to "show off" and criticized them harshly or made fun of them. The majority of the BWC YouTube comments fell under this category (29.41%), and most of these comments were criticizing the BWC participants by saying things like:

"people who play this game are more stupid than the game itself. How can one lost his sense and manipulated by others...grow up guys...u have brains to think what is good and bad (sic)"

The Twitter posts in this theme (16.00%) were mainly sarcastic:

"Husband silently downloaded the blue whale game on his #wife's phone. 50 days later the #bluewhale [died by] suicide (sic)"

This theme was the most frequent among TPC posts. The majority of TPC YouTube videos (71.62%) fit into this category and were mainly bloggers making fun of and criticizing the people who participate in TPC. Most started by saying that they are participating in the TPC or mimic participation but then stop and say for example:

"I am not stupid to do this thing to get more views"

Other videos in this theme tried to deliver a message to TPC participants that they should "grow up and do their laundry" instead of doing the challenge. A very high percentage of YouTube comments (40.69%) and Twitter posts (48.98%) were criticizing and making jokes about TPC. For example, one of the YouTube comments was:

"I recommend eating them in cupcake form, savour the flavor (sic)"

A user on Twitter writes:

"an actual challenge for people to eat a pod with detergent in it. If you partake in this challenge, you are an idiot, and you deserve every bit of what coming to you."

This theme was not as common in ALS IBC YouTube videos (21.67%) as in TPC videos, and the content of these videos was distinct. The ALS IBC videos were mainly failed completions of the challenge. For example, in one of the videos, the water was to be poured on the participant from a second-floor porch, but the person that was supposed to pour the water lost control of the bucket and it fell on the participant's head. This theme was very common in the YouTube comments (36.21%). Most of these comments were about the participant's reaction while doing the challenge, for example:

"lol the girl at 4:22 sounds like a bird 😂. (sic)"

This theme was not very common in Twitter posts (2.00%). Only a few posts mentioned that this challenge is a waste of water and people are only doing it without donating money to ALS.

Theme 3: Detailed information about the participants:

The third theme included posts that tend to speak in detail about someone who already participated in a social media challenge. For the BWC, this theme overlapped highly with the first theme of education and awareness and was very common in the YouTube videos (44.94%). Videos often gave information through interviewing the participants' parents and providing pictures of their body parts showing evidence of self-harm. This theme was slightly less common among the YouTube comments (15.64%), and

these posts were mainly about experiences of acquaintances or users that were asking to participate in BWC. For example:

"I want to play blue whale game plz give me link (sic)"

Very few Twitter posts were in this theme (0.67%) and were also about acquaintances stories:

"We just had a meeting here at work and this lady told us that her 10-year-old niece [died by] suicide because of this other Blue Whale Challenge (sic)."

This theme occurred frequently in the TPC YouTube videos as well (38.33%). Many of the news videos and bloggers showed videos of teenagers eating and biting on tide pods (see Figures 4 & 5 in Appendix G). This theme was not very common in YouTube comments (3.21%) and Twitter posts (5.36%) because these platforms were mainly users describing an experience related to TPC. For example, one of the Twitter posts was:

"A third teenager in the Phoenix area has been sickened by taking part in the Tide Pod Challenge"

A high number of the ALS IBC YouTube videos were in this theme (53.33%) and these videos were mainly posted by the actual participants doing the challenge. These videos commonly mentioned the person who nominated them to the challenge and then nominated at least three others to do the same. Only a few YouTube comments were in this category (2.77%) and no Twitter posts.

Theme 4: Giving viewers a tutorial on how to participate:

The fourth theme covers posts that provided extensive and step by step illustrations of how to do a challenge. This theme was present in the YouTube videos. 24.72% of the

BWC YouTube videos did so by providing a reenactment between a participant and an administrator of the game asking to perform certain tasks (see Figure 3 in Appendix G) followed by the participant fake performing these tasks. TPC YouTube videos did so by fake participation in the challenge as well and 23.33% fell under this theme. ALS IBC videos, however, explained how to do the challenge by just speaking about how to do it (43.33%).

Theme 5: Understanding seemingly senseless online behavior:

The last theme we identified was common in YouTube videos and included posts that provided or suggested reasons why adolescents participate in these challenges. 15.79% of BWC YouTube videos mentioned potential reasons for participating in this challenge. These videos mentioned that BWC participants are adolescents with mental health problems and people who are already suffering from depression and suicidal thoughts. Additionally, these videos tended to provide clips from interviews with psychologists commenting about this phenomenon. The BWC YouTube comments (3.06%) also described the same reason for participating and did so indirectly by providing encouraging comments to people with suicidal thoughts. For example, one post reads:

"Love you girl so many people care about you. Depression is a horrible :(stay strong girl!! (sic)".

A few of the twitter posts (3.33%) provided links to articles that talk about why teens participating in BWC, for example one of the posts was:

"The Blue Whale Challenge: What is the psychology behind it?"

This theme was frequent among TPC (68.33%) and ALS IBC (88.33%) YouTube videos. The creators of the TPC videos mentioned that adolescents are participating in this challenge to become more popular, to get more views and likes, peer pressure, and/or curiosity to see what the Tide pods actually taste like. The ALS IBC videos depicted the participants mentioning that they are engaging in the challenge for one or more of the following reasons: peer pressure, get more views and likes on the video, and the good cause of the challenge.

Table 3.2 Themes identified across platforms and challenges (see Appendices D, E and F for detailed description of the codes).

Theme	Codes (subcategory)	BWC	TPC	ALS IBC
Education and awareness	**YouTube Videos:** Purpose of the Video (Inform or Raise Awareness), Video Topics (Recommendations), Reasons for Participation (The Cause)	83.33%	3.83%	75.00%
	YouTube Comments: Criticizing the Challenge, Intervention/Recommendation	28.33%	25.30%	11.00%
	Twitter: Warning/Awareness, Information About the Challenge, Recommendation	65.33%	32.87%	69.33%
Criticizing the participants and blaming the victims	**YouTube Videos:** Purpose of the Video (Sarcastic, Funny, or Prank)	10.00%	71.67%	21.67%
	YouTube Comments: Sarcastic, Funny, or Prank, Criticizing the Victims, Criticizing the Video/Video Maker	29.41%	40.69%	36.21%

Theme	Codes (subcategory)	BWC	TPC	ALS IBC
	Twitter: Sarcastic/Funny/Jokes, Opinion or Criticizing	16.00%	48.98%	2.00%
Detailed information about the participants	**YouTube Videos:** Purpose of the Video (Remembering the Victims), Video Content (Participation), Video Topics (Victim-Related)	44.94%	38.33%	53.33%
	YouTube Comments: Participating, Personal Experience	15.64%	3.21%	2.77%
	Twitter: Personal Experience	0.67%	5.36%	0.00%
Giving viewers a tutorial on how to participate	**YouTube Videos:** Video Content (Parents, Interaction Between Admin and Victim)	24.72%	23.33%	43.33%
	YouTube Comments: N/A	N/A	N/A	N/A
	Twitter: N/A	N/A	N/A	N/A
Understanding seemingly senseless online behavior	**YouTube Videos:** Reasons for Participating (Popularity, Views, or Likes, Look Tasty, Peer Pressure, The Cause, Curiosity, Mental Health Issues)	15.79%	68.33%	88.33%
	YouTube Comments: Encouraging Teens/Parents	3.06%	0.00%	0.00%
	Twitter: Mental Health	3.33%	0.00%	0.00%

Discussion

The objective of this study was to investigate the portrayal of three different online challenges on social media. To do so we conducted inductive coding of data from YouTube and Twitter to address our research questions. Below we discuss the coding results based on data type. Then we compare our findings with other previous literature to investigate the implications of how the challenges are portrayed on the viewer's perception of the online challenges.

YouTube Videos

Education and awareness and criticizing the participants and blaming the victims:

Most of the BWC YouTube videos were Digital Media, Blogs/Short Film, or News; the TPC videos, Blog/Short Film; and the ALS IBC videos were primarily of a personal nature (see Appendix D). These results may be due to the ban of the BWC and TPC from social media. Most of the videos included in this study mentioned that YouTube and other social media platforms have decided to ban these two challenges, meaning the videos of those potentially participating in them have been deleted and this

could be the reason for not finding personal videos on YouTube about BWC and TPC but not ALS IBC. In addition, this led to our next finding that the majority of the BWC YouTube videos were intended to raise awareness about the challenge. This trend is similar to the one found in the ALS IBC, even though the media type was different, primarily personal videos, perhaps due to the purpose of the challenge itself. Even though ALS IBC involved a level of self-harm, albeit a minimal one, it was created for a philanthropic cause. On the other hand, the BWC is potentially deadly with the purpose of causing harm

to people with mental health issues. Therefore, most of the people participating in the ALS challenge mentioned why it is important to donate and help find a cure for the disease. Interestingly, most of the TPC videos were found to be criticizing or sarcastic. Since most adolescents and young adults, according to the video makers, participate in this challenge for such reasons as to increase their visibility through adding to their views and likes, peer pressure, or curiosity (as shown in Theme 5), most of the videos were harshly judging people willing to do anything for the social media views. This analysis was also reflected in the way the video creators spoke about these challenges. Unlike the speakers in the BWC videos who expressed sorrow about the victims and encouraged their families, the speakers in TPC were neither discouraging participation nor being rude or harsh. Based on these findings, we conclude that the portrayal of the challenges on social media, specifically YouTube, appears to vary partially based on the level of self-harm involved in the challenge.

Detailed information about the participants and giving viewers a tutorial on how to participate:

The videos of the BWC tend to have a considerable amount of victim-specific related information, such as providing quotes that the victims posted on their social media platforms before they attempted suicide and pictures of their hands or other body parts showing evidence of self-harm. In addition, these videos included clips of interviews with the victims' parents providing details about their child's personal life. A considerable number of videos role-played interaction between the administrator and the victim, showing how the victims found out about the challenge, how the administrator approached

the victims, or how the victims were convinced to participate in the challenge. Unfortunately, these videos that were intended to raise awareness could be harmful for a vulnerable population, since depicting means of suicide, romanticizing individuals who engage in suicidal behavior, and providing details about people who died by suicide have been proven to contribute to the contagion effect of suicide (Fekete & Macsai, 1990; Fekete & Schmidtke, 1995; Sonneck et al., 1994). In addition, these videos contained pictures of and quotes from the curator of the challenge explaining its purpose: "the participants are biological waste and I was cleaning the society from them." These words could also affect the mental status of vulnerable adolescents and young adults.

Just like BWC, we suggest that the majority of the TPC videos would increase the adolescents and young adults' willingness to participate, since they contained clips of people eating Tide Pods or pretending to participate in the challenge. These videos go on to say that they are not stupid like the others, and therefore, they won't eat it. These clips may actually contribute to the spread of the challenge via social modeling effects, making adolescents more willing to participate when they see others doing so (Ajzen, 2011; Coleman, 2004; Helfgott, 2015; Phillips, 1974; Queinec et al., 2011).

The ALS IBC videos, however, were primarily depicting either individuals participating in the challenge or a combination of clips of many people participating, all mentioning who nominated them and nominating other people to do the same. Since this challenge was intended for a positive cause, no social media platforms have banned the challenge, making it easy to find videos of people doing the challenge online, which also potentially contributed to the significant spread of this challenge, in addition to the minimal

level of harm included in it (Ajzen, 2011; Phing & Yazdanifard, 2014; Queinec et al., 2011).

BWC's and TPC's videos that fell under this theme tend to provide facts about the number of people participating in the challenges, providing recommendations to the parents to pay more attention to their children's safety, and blaming social media for the spread of these challenges. We believe that people tend to talk about these two challenges in a similar manner due to the following reasons: both target the same population, engaging them in self-harm activities, and in most of these cases, the parents are reportedly not aware that their child is participating in these challenges. This finding shows that even though people might discuss these challenges differently based on the nature of the challenge, they are still discussed in similar manners, such as providing numbers and statistics on how many people participated, including clips of people who have participated, or mimicking participation.

The BWC videos were primarily created by bloggers or news anchors who in some cases, conducted interviews with those who saw the victims, the parents of the victims, or suicide prevention specialists. Most of the ALS IBC videos were of celebrities participating in the challenge, due to the number of views these videos received. Most of the celebrities participated in this challenge to show support for ALS patients, and their videos had a significant number of views, meaning they were likely to appear in our search. This involvement of celebrities also could be one of the contributing factors to the larger viral spread of ALS IBC compared to the other two. Research has shown that when people view celebrities participating in a challenge (their role model in some cases), they are even more

willing to participate in the same challenge themselves (MacCallum & Beltman, 2002; Pinsky, Young, & Stern, 2009).

Understanding seemingly senseless online behavior:

Analyses of Theme 5 indicated common motivating factors for TPC and IBC, with different reasons offered for participation in BWC. The TPC videos provided several reasons explaining why adolescents participated in these challenges. Some videos, for example, suggest that it started as a meme that adolescents are now trying to make a reality in order to get more views and likes on their videos. Others claim that participation is primarily due to peer pressure and adolescents challenging one another. The same trend was seen in the ALS IBC. While the challenge supports a good cause, many believe participation is solely due to peer pressure or for popularity and increased views. In fact, when someone challenges another person in this challenge, he or she can either donate money or choose the ice water bath, but not both. However, most people indicated that they chose the ice bath for the views and to answer a challenge, even those who also donated to the cause, a result seen in the "Encouragement" code. In contrast, the reasons for participating in the BWC were completely different. According to the majority of the videos, adolescents who participated in NSSI and deadly challenges might have exhibited symptoms of mental health issues such as depression, social anxiety, loneliness, lack of social support, low self-esteem, and suicidal ideation.

YouTube Comments

A high percentage of the comments on the YouTube videos for the three challenges were criticizing or sarcastic, perhaps a result of the nature of YouTube as a platform, the

context of the videos, or a misunderstanding of these challenges. Common themes emerged across TPC and BWC in terms of posters criticizing the challenge participants with the assumption that participants were trying to achieve social media fame. For example, most commenters who made comments that fell in this category made jokes about and negatively judged individuals willing to do anything for views. This response is perhaps what has led some people to potentially misunderstand why people participate in the BWC, assuming the reasons to be similar to those for TPC and other social media challenges, that adolescents are participating in the BWC for social media fame. Therefore, commenters made fun of those individuals, and some criticized those victims harshly. However, comments on ALS IBC fell under these two codes for different reasons. First, because most of the participants in those videos had a humorous reaction, commenters frequently laughed and found the video amusing. Second, since most of the participants were celebrities, commenters also talked about other topics related to their work such as their latest movies or their most recent game.

Twitter Posts

Content of Twitter posts varied between challenges, ranging from raising awareness and criticizing participation to encouraging participation. The majority of the Twitter posts on the BWC focused on raising awareness, warning parents to pay more attention to their children, or providing such information about the challenge as the number of people who have died participating in it. Most of these Twitter posts contained links to articles providing more details about the BWC including describing the challenge, the tasks involved, and why adolescents participate in it. On the other hand, Twitter posts related to

TPC primarily criticized or made fun of the participants. Even the recommendations provided by the posters served as an indirect criticism as they suggested adolescents do their laundry with the pods rather than eating them. Most of these posts included links that led to expired/deleted content, probably because any content related to this challenge is banned from YouTube and other social media platforms. Since social media platforms have deleted those videos, the links provided in these Twitter posts are probably referencing deleted videos although some led to news clip, videos, or articles that provided general information about the challenge. However, the Twitter posts about ALS IBC were distinct. These posts primarily encouraged participants to contribute to the spread of the challenge and, thus, increasing the donations as they focused on the research findings and the positive outcomes of the challenge or gave general information and updates about the challenge. Very few comments criticized this challenge. The links provided in the corresponding Twitter posts mainly discussed the positive outcomes of the challenge or led to videos of people participating in the challenge. This also supports our first conclusion that the portrayal of the challenge on social media will vary to some extent based on the nature of the challenge.

Overall, one can conclude that people's reactions and opinions concerning social media challenges vary, largely based on the purpose of the challenge and the level of inherent risk to individuals who participate. However, previous individual experiences and exposure to a challenge can affect opinion of future challenges. For example, a person who heard about the ALS IBC might have a positive first impression about any online social media challenge. On the other hand, a person who heard about TPC might assume that

teenagers are participating in these challenges for reasons such as social media fame. Other studies have found that people's first impressions affect their future decision-making, underscoring the importance of understanding how potentially harmful social media challenges are portrayed (Agnisarman, Khasawneh, Ponathil, Lopes, & Chalil Madathil, 2018; Agnisarman, Ponathil, Lopes, & Chalil Madathil, 2018; Khasawneh et al., 2018; Khasawneh, Rogers, Bertrand, Chalil Madathil, & Gramopadhye, 2019; Klein, Moon, & Hoffman, 2006; Klein et al., 2003; Ponathil et al., 2017). In addition, the results showed how the public opinion varies largely between the three different challenges. This could be one of the factors that leads to increased participation in one over the other. For instance, since public opinion about ALS IBC mainly positive, the participation was high. On the other hand, TPC wasn't as popular since it received large criticism from the public.

While adolescents participate in these challenges for reasons that vary based on the purpose of the challenge itself, we argue that there are common factors that could potentially contribute to willingness to participate. Some factors might contribute to one challenge more than another, and these factors are parallel to the ones suggested by Montano & Kasprzyk (2015). These factors include attitude, perceived norms, personal agency, knowledge and skills, salience of the behavior, environmental constraints, and habit. Past research showed how people's emotions and feelings, perception of the public opinion, and the ease of a risky behavior directly contribute to willingness to participate in it (Montano & Kasprzyk, 2015). We believe similar factors could predict participation in social media challenges.

There are additional risk factors that might lead the participants to investigate participation in challenges specific to NSSI and/or suicide: trauma history, depression, social anxiety, loneliness, lack of social support, low self-esteem, and suicidal ideation. These factors could contribute to NSSI and suicide in general, and since these kinds of challenges normally target people who already have suicidal thoughts (Skegg, 2005; Swannell, Martin, Page, Hasking, & John, 2014), it is possible that some may consider participating in these challenges as a means to investigate or engage in self-harming or suicidal behavior. It is important to further explore, validate, and quantify the actual effect of these factors on the societal perception of different social media challenges and teenagers' willingness to participate, as well as studying how the effect of these factors will vary based on the nature of the challenge quantitatively. Doing so will provide critical insight for developing a verified model characterizing the nature and spread of potentially harmful, viral challenges on social media and, subsequently, develop interventions to minimize suicide contagion risks at a societal level.

This content analysis is not without limitations. The search string was very specific and may not have captured all relevant videos and posts, especially those on private accounts. Additionally, the exclusion of videos and posts not published in English may limit the generalizability of our findings to the worldwide portrayal patterns of these challenges.

Conclusion

This research conducted a systematic study to explore the portrayal of viral social media-based challenges and to better understand whether these portrayal patterns are

generalizable or unique to a specific challenge through examining publicly provided social media posts. We conducted a thematic content analysis on scraped data from two of the most popular social media platforms, YouTube and Twitter. We identified five common themes across the challenges, which are: raising awareness, criticizing the challenge or participants, provide information about participants of the challenge, provide information on how to participate, and/or talk about why people participant in the online challenges. We found that the purpose of posting about an online challenge varies based on the inherent risk involved in the challenge itself. However, previous experience and exposure to the challenges affected the viewers opinion of new challenges. It is important for future research to verify and quantify these potential factors, including their influence on participation, propagation, and risky behavior, in order to enable the development of preventative measures to mitigate the spread of harmful viral internet messages and to better understand how to protect vulnerable individuals who receive invitations to participate in such challenges. This is critical given the psychological issues facing these age groups coupled with the amount of time spent on social media.

CHAPTER FOUR

FACTORS CONTRIBUTING TO ADOLESCENTS' AND YOUNG ADULTS' PARTICIPATION IN SOCIAL MEDIA CHALLENGES

Introduction and Background

Online challenges, or social media challenges, are popular phenomena especially among adolescents and young adults, perhaps because of their frequent use of online social networks. In these challenges, participants record themselves engaging in specific activities and share their experience through social media. These challenges are ubiquitous and can be found on many social media platforms including YouTube, Instagram, Facebook, and WhatsApp (Rosenthal, Cha, & Clark, 2018). Although the activities involved in online challenges can vary from fun to fatal (Mahadevaiah & Nayak, 2018), they can generally be classified into two categories: (a) minimal harm challenges, which in some cases support a philanthropic cause such as the Amyotrophic Lateral Sclerosis (ALS) Ice Bucket Challenge (IBC) (Song, 2014) or (b) harmful challenges, which entail self-injurious behavior such as the Cinnamon Challenge (CC) (Grant-Alfieri et al., 2013). Although the ALS IBC has faced criticism (e.g., safety concerns and waste of water), it is the most successful and influential fund-raising event to date (Song, 2014). In addition to raising more than $115 million for ALS research (The ALS Association, 2019), it is also credited for increasing public awareness about the disease (The ALS Association, 2019).

In contrast, CC involves swallowing a teaspoon of ground cinnamon without drinking any liquid for sixty seconds. The problem is that cinnamon does not dissolve nor biodegrade in the lungs, as evidenced by studies of lab rats which experienced symptoms

ranging from mild multifocal granulomatous inflammation to alveolar lipoproteinosis and alveolar cell hyperplasia (Grant-Alfieri et al., 2013; Muhle, Ernst, & Bellmann, 1997; Tatrai, Adamis, & Ungvary, 1995; Tátrai & Ungváry, 1992). For humans, the consequences are just as serious because swallowing a large amount of cinnamon can cause pulmonary inflammation, allergic and irritant reactions, and in even more serious situations, hypersensitivity-induced asthma attacks, which can be fatal (Grant-Alfieri et al., 2013). However, none of these potentially fatal consequences have stopped adolescents and young adults from participating in CC. As of 2013, there are more than 51,100 public YouTube clips of someone accepting this challenge, with some videos garnering more than 19 million views globally (Grant-Alfieri et al., 2013).

Given the significant amount of controversy concerning these online challenges, there is little research on the factors that lead individuals to participate in such challenges. For example, the extant literature on self-harm focuses primarily on a single challenge and its effect on public health and safety (Avery, Rae, Summitt, & Kahn, 2016; Deklotz & Krakowski, 2013; Grant-Alfieri et al., 2013; Mukhra et al., 2017) or on how viewing content showing self-harm could lead to intentional self-harm by modeling the behavior of those we observe (Baker & Algorta, 2016; Mitchell et al., 2014; Zhu et al., 2016). Furthermore, the literature on adolescent online risk focuses on the effects of engaging in online sexual and aggressive risk exposure (Chopik, 2016; Livingstone & Smith, 2014). To our knowledge, there is no quantitative research that comprehensively investigates the phenomenon of online challenges and why adolescents and young adults engage in these activities.

In this study, we collected quantitative data to explore adolescents' and young adults' exposure to online challenges, as well as the determinants of their engagement with them through direct participation. We applied the Integrated Behavioral Model (IBM) (Montano & Kasprzyk, 2015) and investigated its generalizability to these online behaviors. It is important to reassess this and other existing behavioral theories in relation to online behaviors because what may be true about traditional human behaviors may not apply to virtual ones (Gearhart & Zhang, 2015). As seen in Figure 4.1, IBM suggests that the intention to perform a behavior is driven by three factors: attitude, perceived norms, and personal agency regarding behavior.

Attitude, defined as individual preference for a certain behavioral performance, is composed of two dimensions: experiential attitude and instrumental attitude (Fishbein, Ajzen, Albarracin, & Hornik, 2007; French et al., 2005; Triandis, 1980). Experiential attitude is an individual's emotional reaction to a behavior. For example, an individual with a positive emotional response towards a specific social media challenge is more likely to engage in it than an individual with a negative emotional response. Instrumental attitude is cognitively based, meaning that it is affected by a person's beliefs about the outcomes of the behavior depending on the value of those outcomes.

Perceived norms regarding the behavior, the social pressure to perform it, is comprised of injunctive and descriptive norms. Injunctive norms refer to the normative beliefs about others' opinions toward participating in a challenge and the motivation to comply (if others approve or disapprove of the behavior). Descriptive norms refer to

common patterns of behavior that lead to expectations of people behaving according to that pattern.

Personal agency consists of two constructs: perceived control and self-efficacy. Perceived control refers to personal beliefs about the degree of control over performing the behavior. These beliefs are based on individual perceptions of how environmental factors will make performance of the behavior difficult or easy. Self-efficacy is the individual's certainty in their ability to perform the behavior in addition to their belief that they can overcome each prohibitive condition or obstacle (Montano & Kasprzyk, 2015).

The purpose of this study is to use IBM quantitatively to enhance our understanding of how each belief contributes to adolescents' and young adults' willingness to participate in online challenges and discern which beliefs are more influential than others. The findings from this study can be used to guide the development of interventions to reduce participation in harmful social media challenges among adolescent and young adult populations.

Specifically, this research addressed the following research question: What is the effect, if any, of attitudes, perceived norms, and personal agency beliefs on adolescents' and young adults' willingness to participate in CC and ALS IBC?

To explore our research question, we applied the IBM developed by Montano & Kasprzyk (2015) depicted in Figure 4.1 to our hypotheses listed in Table 4.1.

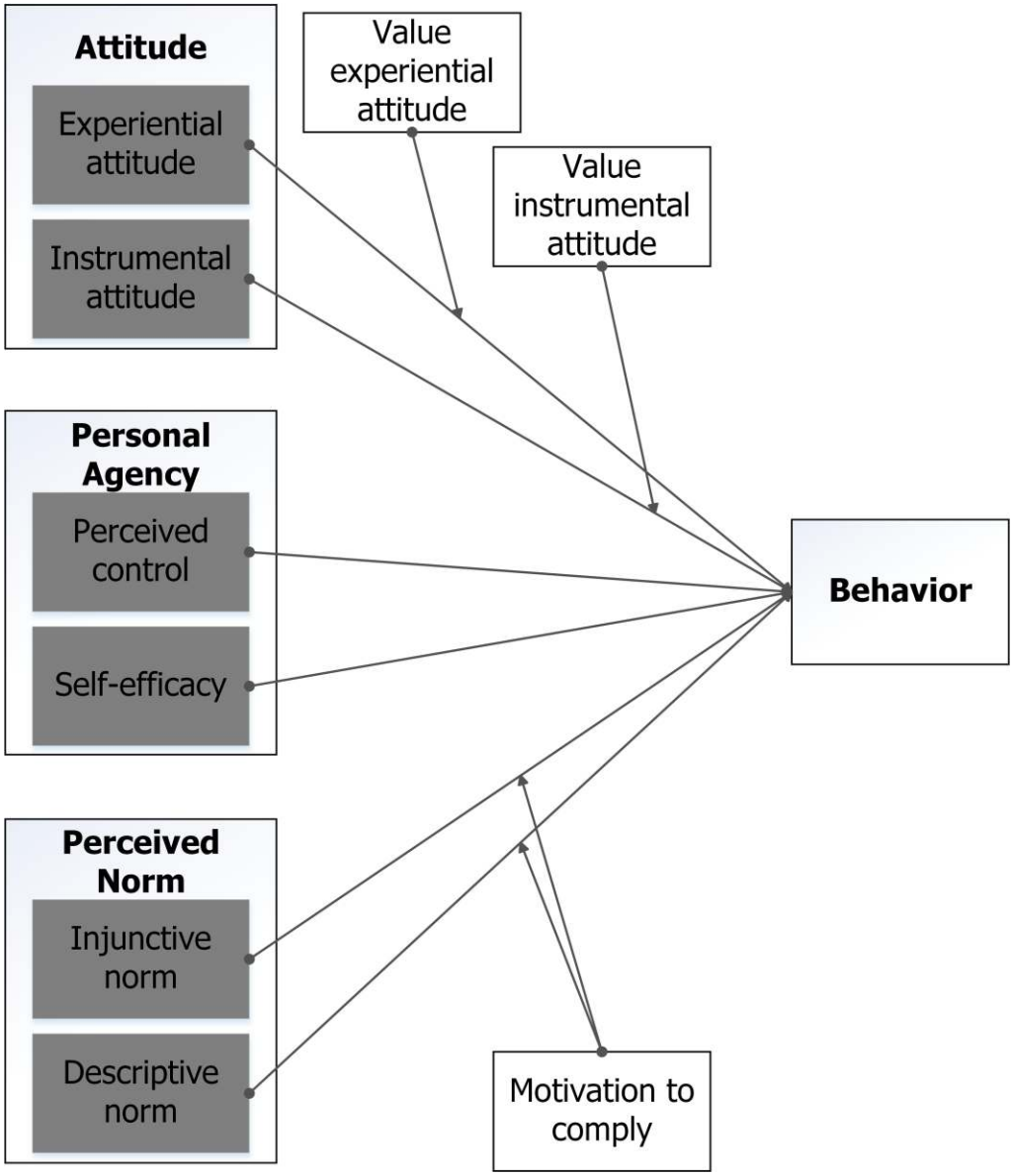

Figure 4.1 Integrated Behavior Model.

Table 4.1 Research hypotheses.

Hypothesis 1	The experiential attitude is positively related to CC and ALS IBC participation.
Hypothesis 2	The instrumental attitude is positively related to CC and ALS IBC participation.
Hypothesis 3	The value afforded to experiential attitude items moderates the relationship between experiential attitude and CC and ALS IBC participation.
Hypothesis 4	The value afforded to the instrumental attitude items moderates the relationship between instrumental attitude and CC and ALS IBC participation.
Hypothesis 5	The injunctive norm is positively related to CC and ALS IBC participation.
Hypothesis 6	The descriptive norm is positively related to CC and ALS IBC participation.
Hypothesis 7	The motivation to comply moderates the relationship between the injunctive norm and CC and ALS IBC participation.
Hypothesis 8	The motivation to comply moderates the relationship between the descriptive norm and CC and ALS IBC participation.
Hypothesis 9	Perceived control is positively related to CC and ALS IBC participation.
Hypothesis 10	Self-efficacy is positively related to CC and ALS IBC participation.

Methodology

This study applied the IBM to investigate and predict social media challenge behavior in adolescents and young adults using quantitative methods for collecting data related to social media challenge participation. First, we developed a survey that included measures of the constructs in the IBM. Second, we pilot-tested and modified the questionnaire accordingly. This questionnaire was then used to explore the reasons for participation in these challenges, retrospectively.

Measures

The survey included three main sections—a demographic section, a section related to participation in the CC, and a section related to participating in the ALS IBC. The demographic section included questions about the participant's age, gender, race/ethnicity, education, Internet usage, and social media challenge participation. The second and third sections included the following theoretical constructs related to the CC and the ALS IBC. Note that the scale score for each construct was obtained by computing the mean of the relevant items.

Attitude was measured using two sub-constructs, experiential attitude and instrumental attitude. Experiential attitude was measured using four items, each using a 7-point Likert scale. Instrumental attitude was measured using two items, each using a 7-point Likert scale. The value afforded to each item for both instrumental attitude and experiential attitude was measured using a 7-point bipolar scale.

Perceived norm was measured using two sub-constructs, injunctive norm and descriptive norm, each was measured using seven items on a 7-point Likert scale. The

motivation to comply construct assessing the participants' willingness to comply with the individuals and their beliefs was measured using seven items, each using a 7-point bipolar scale.

Personal agency was assessed using two sub-constructs, perceived control and self-efficacy. Perceived control was assessed using six items measured on 7-point Likert scales while self-efficacy was measured using four 7-point Likert scale items.

The items for these constructs were developed using the strategy suggested by Glanz, Rimer, & Viswanath (2008) in two stages. First, a team of researchers used the data from a previous qualitative study on this topic to develop the initial set of items that measured each of the sub-constructs (see Chapter 3). Then, the survey was pilot-tested using a sample of 20 participants. The results of the pilot testing were used to delete the questions that had little to no variance (Montano & Kasprzyk, 2015) and to improve the clarity of the remaining questions. Internal consistency reliability was calculated for each scale using Cronbach's alpha (see Table 4.2). Examples of the specific items that comprise each construct for the CC are reported in Appendix H.

In addition to the measures listed above, we measured the participants intention to participate in ALS IBC and CC on a 7-point Likert scale and other factors that could potentially influence the intention to participate in the challenges that focus more on personalities and individual differences. These additional factors were used and analyzed Chapter 5 and therefore, are not mentioned again in this chapter. The following the scales we adapted from the literature to assess these factors: (1) Sensation Seeking (Zuckerman, Kolin, Price, & Zoob, 1964) (2) Impulsivity (Eysenck & Eysenck, 1977) (3) Adolescent

Egocentrism/Risk Taking Personality (Greene et al., 2000) (4) Emotion Regulation (Gratz & Roemer, 2004) (5) Social Avoidance and Distress (Watson & Friend, 1969) (6) Barriers to Help Seeking (Wilson, Deane, Ciarrochi, & Rickwood, 2005) (7) Loneliness (Rokach, 2000) (8) Self-esteem (Zimprich, Perren, & Hornung, 2005) and (9) Depression (Kroenke, Spitzer, & Williams, 2001). We also collected three constructs of the big five personality traits which are Openness, Extraversion, and Agreeableness (Morizot, 2014). Specific items used in the study are provided Appendix I.

Table 4.2 Construct reliability measured using Cronbach's alpha.

Construct	CC	ALS IBC
Experiential attitude	0.813	0.667
Instrumental attitude	0.867	0.686
Evaluation of experiential attitude	0.852	0.667
Evaluation of instrumental attitude	0.922	0.908
Injunctive norm	0.939	0.917
Descriptive norm	0.912	0.878
Motivation to comply	0.88	0.877
Perceived control	0.698	0.839
Self-efficacy	0.657	0.777

Participants

We used Qualtrics Research Suite to deploy the surveys to the participants. Inclusion criteria for the participants were participation in either the CC or the ALS IBC

(not both) or no participation in any social media challenge and within the age range of 13-35 years old at the time of the study (adolescents or young adults only). A total of 471 participants completed the study. Approximately half of the participants were under 18 (adolescents) and the rest were between 18-35 (young adults), with ~83% females. Approximately one third of the respondents had participated in the CC only, one third in the ALS IBC only, and the remaining had not participated in any social media challenge. More information about the participants is provided in Table 4.3.

Table 4.3 Participants demographics.

Variable		Number	%
Gender	Female	389	82.6
	Male	78	16.6
	Prefer not to answer	4	0.8
Education	Some High School	171	36.3
	High School/GED	155	32.9
	Two-year College Degree	26	5.5
	Some College	58	12.3
	Four-year College Degree	33	7.0
	Master's Degree	21	4.5
	PhD Degree	2	0.4
	Professional Degree (e.g. JD, MD)	5	1.1
Race	White/Caucasian	220	46.7

Variable		Number	%
	African American	132	28.0
	Native American	4	0.8
	Asian	32	6.8
	Pacific Islander	2	0.4
	Hispanic/Latino	55	11.7
	Other	26	5.5
Employment	Full-Time	86	18.3
	Part-Time	87	18.5
	Student	236	50.1
	Retired	2	0.4
	Unemployed	60	12.7
Age	Under 18	234	46.7
	18 - 35 years old	237	50.3
Social Media Participation	CC	153	32.5
	ALS IBC	155	32.9
	Nothing	163	34.6
Internet usage per day	Less than an hour	16	3.4
	1-2 hours	30	6.4

Variable		Number	%
	2-3 hours	63	13.4
	3-4 hours	98	20.8
	More than 4 hours	264	56.1

Procedure

First, the participants read and signed the informed consent form, then read the introduction to the study and answered the questions about their demographics and social media and Internet usage, followed by a set of screening questions. Qualtrics Research Suite facilitated the data collection process. Any participant who did not meet the inclusion criteria based on the screening questions was not eligible to participate in the study. The screening questions were "Have you participated in any online challenges?" "Which of the following challenges did you participate in?" and "Of the following statements, which one matches what you did in this challenge?". For the group of participants that never participated in any challenges, they have to state that in the first screening question. For the other two groups, if the challenge and the description did not agree, the participant was not eligible for the study. In addition, we restricted the number of participants for each challenge to 75 adolescents and 75 young adults to ensure we had participants from each group. The participants then answered questions to assess the constructs reported in the Measures section (attitude, perceived norms, and personal agency) about the CC and the ALS IBC. The order of the CC and ALS IBC sections was randomly assigned to the

participants. We compensated each participant with $10 after completing the study. Figure 4.2 shows the flowchart of the study procedure.

Data Analysis

A binomial logistic regression analysis was performed using SPSS 24.0 to predict CC participation first with 7 predictors: age group, experiential attitude, instrumental attitude, injunctive norm, descriptive norm, perceived control, and self-efficacy. Four interaction predictors were also added to the model: experiential attitude by value of experiential attitude, instrumental attitude by value of instrumental attitude, injunctive norm by motivation to comply, and descriptive norm by motivation to comply. People who had participated in the CC and did not participate in any challenge were included in this model (N = 316). A second binomial logistic regression model was used to predict ALS IBC participation using similar predictors assessing the participants' perception of the ALS IBC. People who had participated in the ALS IBC and those who did not participate in any challenge were included in the second model. For each model, fit indices, pseudo R^2, effect size estimates, estimated regression coefficients and their significance, corresponding odds ratios and their confidence intervals were calculated.

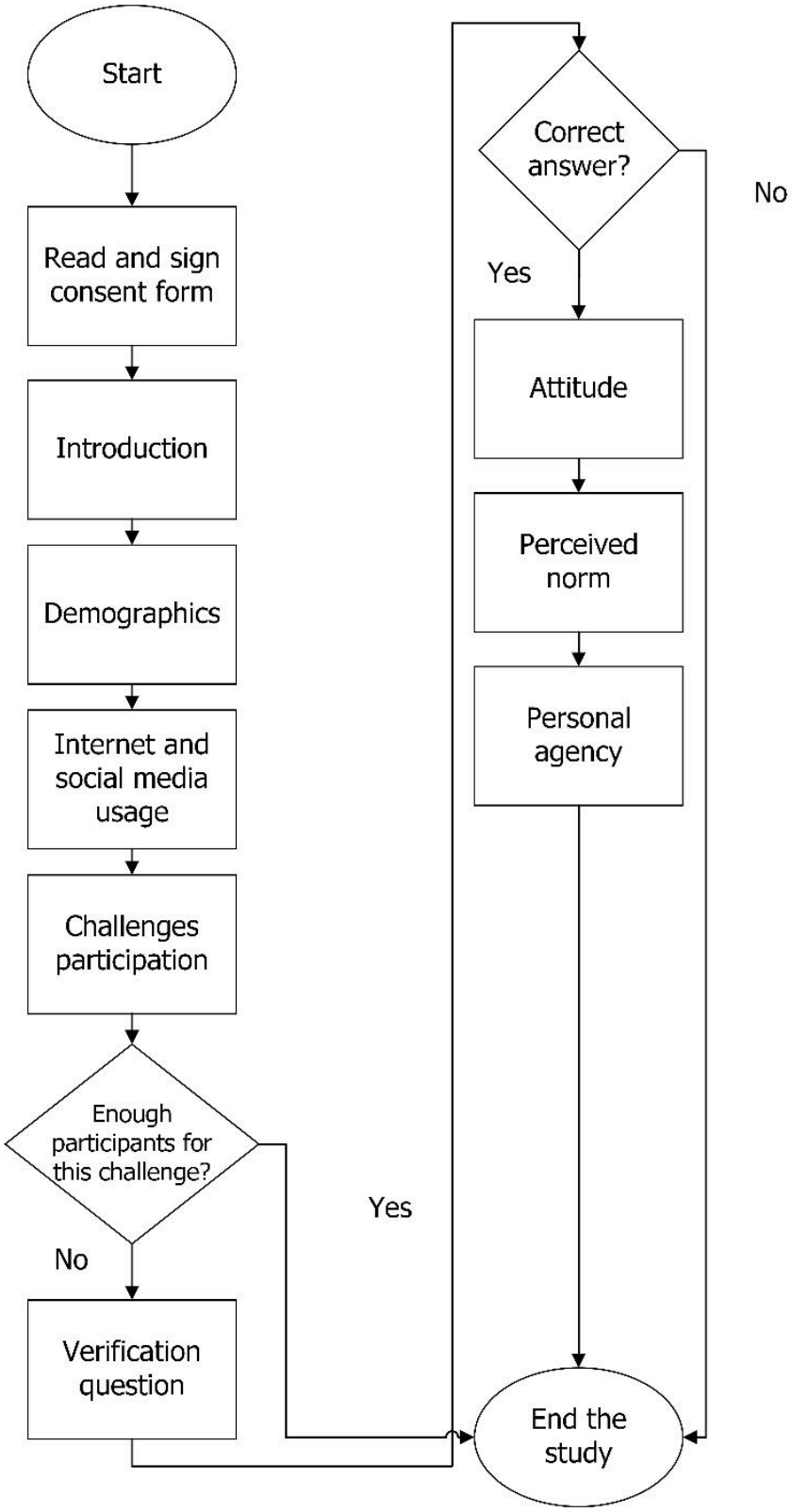

Figure 4.2 Procedure flow chart.

Results

The results from the direct logistic regression model predicting CC participation are presented in Table 4.4. A test of the full model with all predictors against a constant-only model was statistically significant, $\chi 2$ (11, $N = 316$) = 221.75, $p < .001$, indicating that the predictors, as a set, reliably distinguished between people who had participated in the CC and those who had not. The deviance in participating in the CC accounted for by these predictors was large with $R^2_L = 0.5$. To test the significance of each predictor, each variable was removed from the model and the change in $\chi 2$ was examined to determine if removal of a variable led to a worsening of the model fit (Cohen, West, & Aiken, 2014; Moore, Gomer, Pagano, & Moore, 2009). Independent removal of four of eleven predictors significantly harmed the model fit, specifically instrumental attitude ($\Delta\chi 2 = 11.50$, $p < .001$), injunctive norm ($\Delta\chi 2 = 30.43$, $p < .001$), descriptive norm ($\Delta\chi 2 = 6.62$, $p < .05$), and the interaction term injunctive norm by motivation to comply ($\Delta\chi 2 = 8.82$, $p < .01$). To interpret the significant interaction for injunctive norm by motivation to comply, simple slopes were calculated from the regression coefficients at the mean of motivation to comply and one standard deviation above and below the mean of motivation to comply (Cohen et al., 2014). This analysis found the slope of injunctive norm and probability to participate at the mean of motivation to comply to be B = 1.01, and at one standard deviation above and below the mean of motivation to comply to be B = 1.80 and B = 0.23, respectively.

A similar approach was used to predict ALS IBC participation, with the results being presented in Table 4.5. The predictors, as a set, reliably distinguished between people who had participated in the ALS IBC and those who had not, $\chi 2$ (11, $N = 318$) = 151.05, p

< .001 with R^2_L = 0.34. Independent removal of two of eleven predictors significantly harmed the model fit, specifically experiential attitude ($\Delta\chi2$ = 20.37, p < .001) and descriptive norm ($\Delta\chi2$ = 9.61, p < .01).

Table 4.4 Results of binomial logistic regression model predicting CC participation.

Predictor	*B*	SE *B*	$\Delta\chi2$	OR	95% CI for OR	
					Lower	Upper
Constant	-0.68	0.29	-	-	-	-
Age group	0.12	0.35	0.11	1.12	0.57	2.26
Experiential attitude	-0.31	0.16	3.95	0.73	0.53	1.00
Instrumental attitude	0.42	0.13	11.50***	1.52	1.19	1.96
Injunctive norm	1.15	0.24	30.43***	3.15	2.04	5.15
Descriptive norm	0.57	0.23	6.62**	1.78	1.15	2.80
Perceived control	0.53	0.28	3.85	1.71	1.00	3.00
Self-efficacy	0.25	0.19	1.71	1.30	0.89	1.87
Experiential attitude * value of experiential attitude	-0.09	0.12	0.65	0.91	0.72	1.14
Instrumental attitude * value of instrumental attitude	0.10	0.07	2.40	1.11	0.97	1.27
Injunctive norm * motivation to comply	-0.48	0.16	8.82**	0.62	0.45	0.85

Predictor	*B*	SE *B*	Δχ2	OR	95% CI for OR	
					Lower	Upper
Descriptive norm * motivation to comply	-0.12	0.15	0.7	0.88	0.64	1.17

Notes: * $p < .05$, ** $p < .01$, $p < .001$, Model $\chi2 = 221.75$, $df = 11$, $N = 316$, $R^2_L = 0.5$. Null -2 Log Likelihood (-2LL) = 437.65, Model -2LL with predictors = 216.

Table 4.5 Results of binomial logistic regression model predicting ALS IBC participation.

Predictor	*B*	SE B	Δχ2	OR	95% CI for OR	
					Lower	Upper
Constant	0.05	0.23				
Age group	-0.26	0.30	0.71	0.78	0.43	1.40
Experiential attitude	0.66	0.16	20.37***	1.94	1.44	2.69
Instrumental attitude	-0.25	0.13	3.97	0.78	0.60	1.00
Injunctive norm	0.28	0.18	2.42	1.33	0.93	1.91
Descriptive norm	0.61	0.20	9.61**	1.84	1.25	2.79
Perceived control	-0.05	0.25	0.04	0.95	0.58	1.56
Self-efficacy	0.15	0.20	0.60	1.16	0.79	1.72

Predictor	*B*	SE B	Δχ2	OR	95% CI for OR	
					Lower	Upper
Experiential attitude * value of experiential attitude	-0.15	0.14	1.08	0.86	0.65	1.13
Instrumental attitude * value of instrumental attitude	0.05	0.07	0.60	1.05	0.93	1.20
Injunctive norm * motivation to comply	0.06	0.14	0.18	1.06	0.80	1.40
Descriptive norm * motivation to comply	-0.24	0.14	3.02	0.79	0.60	1.03

Notes: * $p < .05$, ** $p < .01$, $p < .001$, Model $\chi 2 = 151.05$, $df = 11$, $N = 318$, $R^2_L = 0.34$. Null -2 Log Likelihood (-2LL) = 440.63, Model -2LL with predictors = 289.58.

Discussion

To our knowledge this study is the first to quantitatively investigate the theoretical constructs for predicting participation in online challenges using data provided by actual participants. The aim of this study was to investigate the behavioral beliefs of people who have participated in these challenges and compare them to the beliefs of people who did not. By doing so, we believe we can identify potential factors that were critical to their final decision. We found the attitude sub-constructs, the perceived norm sub-constructs, and the

interaction between injunctive norm and motivation to comply to be good predictors of CC participation. We also found the experiential attitude and the descriptive norm to be good predictors of ALS IBC participation.

Cinnamon Challenge

We found the attitude and perceived norm sub-constructs (Hypotheses 2, 5, 6) to be strong predictors of CC participation. This finding is consistent with other studies that used IBM to predict other such behaviors as condom usage, which also found these two constructs to be the strongest predictors (Albarracín, Johnson, Fishbein, & Muellerleile, 2001; Kasprzyk, Montano, & Fishbein, 1998). As seen in the Results section, the relation between instrumental attitude, injunctive norm, and descriptive norm and probability of participating in the CC is proportional. The positive relationship between the instrumental attitude and probability of participation indicates that the more the people perceive enjoyment and rewards involved in the CC, the more they were willing to engage in the challenge. This shows that those people thought the challenge was easy with minimal harmful consequences. In addition, the positive relationship between injunctive norm and probability of participation shows that the more perceived attention paid to the challenge by the public, the higher probability of participants engaging in the CC since they believe their videos will receive more views. In addition, our findings suggest that there is a positive relationship between descriptive norm and probability of participating in the CC. This relationship means the less attention participants received from people around them warning them about participating in the challenge, the higher the chance was that they would engage in the challenge. Consequently, it appears that the more that peers were

engaging in the challenge, the higher the likelihood that participants would engage in the challenge, since they may have believed it's a common behavior that is "okay" to do. Our findings are similar to a previous study on criminal behavior where they suggested that the culture plays a significant role in committing crime or violent behavior (Helfgott, 2015). In other words, in a culture where crimes happen frequently, there is a higher chance of more people committing more crimes and violent behaviors in the future.

In addition, testing Hypothesis 7 showed that there is a significant interaction between injunctive norm and motivation to comply. The interaction implies that there is a positive relationship between injunctive norm and probability of participation in CC. However, this relationship is stronger for those with low motivation to comply scores. This means that people with low motivation to comply with their norms are more likely to participate in CC than those with high motivation to comply. This finding is different than most of the literature on human behavior where they suggest the exact opposite of our finding. This is mainly due to the negative nature of the behavior we are studying which involves self-harm. For example, a person with low motivation to comply to their parents is more likely to commit a self-harm behavior than someone with high motivation to comply to their parents.

Analysis of the change in model fit after removing each of the significant predictors indicated that the injunctive norm explains most of the variability in the probability of CC participation, followed by instrumental attitude, and descriptive norm, in this order. Thus, interventions to reduce participation in similar challenges in the future should focus on these constructs, with greater emphasis on the injunctive norm since it is the stronger

predictor. This could be done by having people adolescents trust send persuasive messages highlighting the consequences of challenge behavior and explaining why they shouldn't engage in these activities (Close & Ham, 2016; Sparks, Perkins, & Buckley, 2013). In addition, since there is a significant interaction between injunctive norm and motivation to comply, intervention development should consider both of these factors simultaneously. Changing only one of these two factors may lead to an undesired or unintended effect on the other's impact on the challenge participation. The intervention should specifically mention the disapproval of such behaviors from those around us even to those who says they do not comply or "care" about what others say.

Ice Bucket Challenge

Unlike CC participation, only the experiential attitude and descriptive norm significantly predicted ALS IBC participation (Hypotheses 2 & 6). In other words, adolescents and young adults primarily participated in this challenge for the following reasons, enjoyment, popularity (getting more views and likes on their social media), and because of the number of people completing the ALS IBC, they felt either obligated to participate or that it was normative to do so (Bearden & Etzel, 1982; Bobo, 2007; Cohen, 2003). We believe the other factors were not significant due to the positive nature of the challenge. For example, even people who did not participate in the challenge generally rated it as easy to perform and believed that they were capable of doing it. These beliefs may explain why perceived control and self-efficacy factors were not found to be significant predictors of the ALS IBC. In addition, since this challenge in particular was very popular, even people who chose not to participate generally indicated that everyone

around them would approve of their doing so, explaining why the injunctive norm factor was not found to be a significant predictor of ALS IBC participation.

Among the significant predictors of ALS IBC participation, the experiential attitude explained the largest amount of variability, followed by descriptive norm. We can use these findings to help develop or market other philanthropic challenges by focusing on making them enjoyable with obvious direct rewards, as well as emphasizing the attention given to them by the public. By developing a challenge that targets these beliefs more than the others in IBM, one could potentially create a philanthropic challenge that goes viral and leaves a health-promoting impact on society with minimal harmful consequences.

Limitations and Future Work

This study is not without limitations. We used two challenges to represent all other similar challenges. This could limit the generalizability of the findings, so future work could investigate the applicability of these findings to other challenges. Moreover, this study was retrospective and cross-sectional in nature, making it hard to draw conclusions about causal relationships between the predictors and outcomes. Future work could study the impact of the constructs in controlled settings by developing interventions and examining their effects on people's willingness to participate in social media challenges.

Conclusion

We used a theoretical framework to guide the study design, and to inform the development of theory-driven intervention efforts to change social media challenge participation intention and behavior. We used the CC to represent challenges with a harmful impact and ALS IBC to represent positive impact challenges, and we identified

the constructs that were critical to the participants' decision to participate. In this study, we provided a good theoretical model to understand the phenomenon of social media challenges. In addition, the findings provide information about which constructs should be the focus of intervention efforts. The content and thrust of those intervention efforts must be based on knowledge of how the specific items making up each construct apply specifically to social media (e.g., the desire to get likes and affirmation; the social norms that are portrayed via media, videos, and images). Following we will discuss how the findings from this chapter can be used to develop interventions.

Recommendations and Interventions

The interventions need to focus on adopting a multifaceted approach, rather than a single aspect to minimize unwanted adolescent behavior. To identify appropriate areas of interventions, we adopted the Intervention Wheel from the public health literature (Minnesota Department of Health, 2016). As seen in Figure 4.3, the Intervention Wheel holds three levels of practice (community, systems, and individual/family) and seventeen different public health interventions called "wedges" (Keller, Strohschein, Lia-Hoagberg, & Schaffer, 2004; Minnesota Department of Health, 2016). The interventions are grouped together based on similarities and the possibility of simultaneous use. For example, health teaching and counseling interventions, shown in the blue wedge, are more similar to each other in the action the intervention requires than health teaching and case management (found in the green wedges). The Intervention Wheel works as a starting point for researchers to consider a wide variety of possible interventions and identify the most appropriate one. Further, the Intervention Wheel is supported by evidence, as it is verified

by sound science and effective practices (Keller et al., 2004; Minnesota Department of Health, 2016). Each intervention on the wheel is clearly defined in a manner that describes the actions directly. Health teaching is a type of intervention that involves creating material to educate a specific population about the targeted behavior either on the system-level, community-level or individual-level. For example, a public health nurse could provide training sessions to pregnant teens on the impact of alcohol use on fetal development (individual level), join a county task force to create and deploy posters to liquor stores (community level), or promote standardized care for pregnant adolescents such as screening for alcohol on the system level (Fertman & Allensworth, 2016; Keller et al., 2004; Minnesota Department of Health, 2016). Other than reducing risk of pregnant adolescents' consumption of alcohol, health teaching interventions have been used in the public health literature to reduce several adolescent behaviors such as alcohol-related injuries (Bright & Williams, 2017), drinking and driving (Vaucher et al., 2016), substance abuse (Schlomer et al., 2019), and HIV prevention (Jewkes et al., 2008). Due to the similarities between social media challenges and the aforementioned behaviors as well as the target population, we believe that health teaching interventions will be effective in reducing participation in harmful challenges.

Health teaching interventions are defined as "sharing information and experiences through educational activities designed to improve health knowledge, attitudes, behaviors (norms), and skills" (Friedman, Cosby, Boyko, Hatton-Bauer, & Turnbull, G., 2011; Friedman, Cosby, Boyko, Hatton-Bauer, & Turnbull, G., 2009). Our specific interventions are driven from our study in which we identified significant factors influencing

participation in harmful challenges and included specific items that make up each of these factors such as attitudes and perceived norms. Specifically, we found that adolescents view the activities in the challenges as enjoyable, value the consequences of such activities, and due to the viral nature of these challenges, perceive participation in these activities as a way to receive approval from peers. In other words, adolescents fail to foresee the negative consequences of these activities, and instead overemphasize and overestimate peer approval to be gained from participation in these challenges. Thus, the interventions we suggest be developed include the factors from our findings mentioned above.

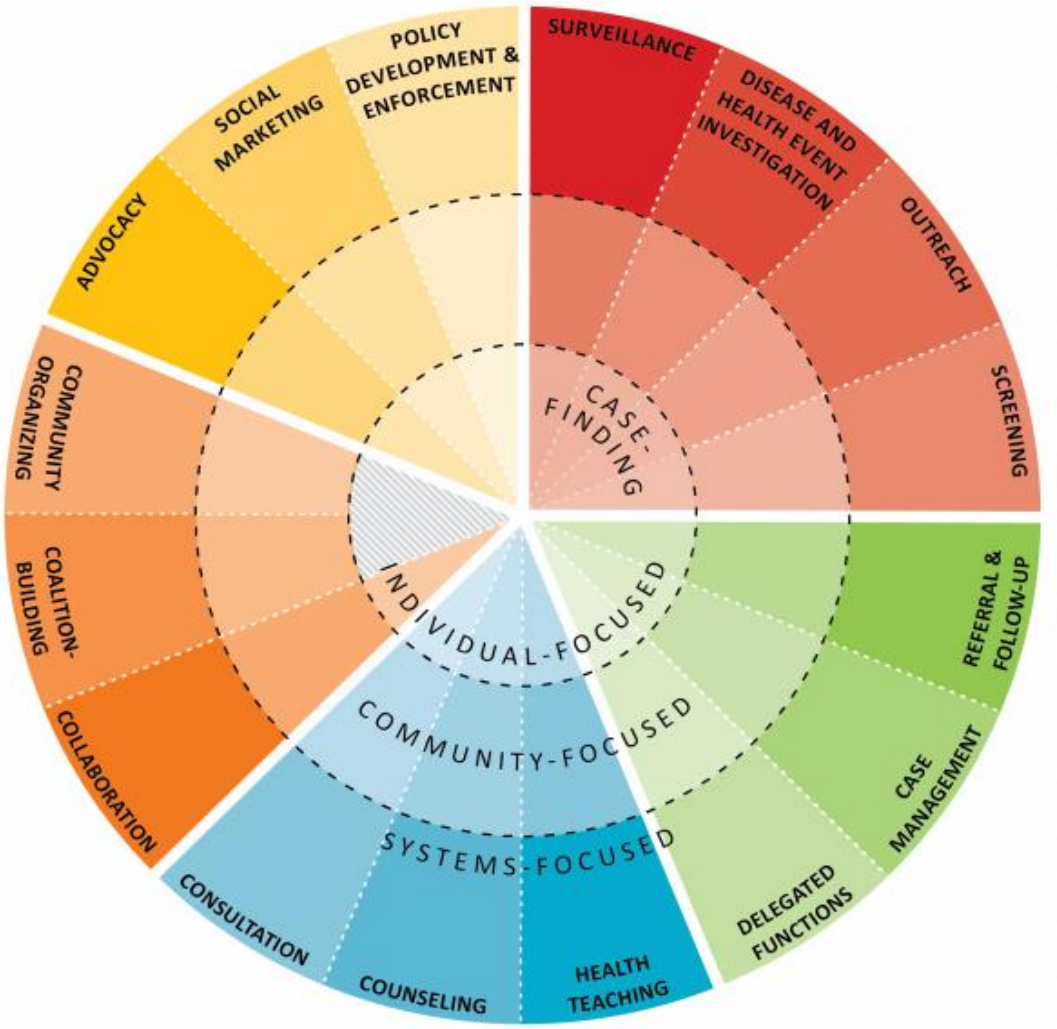

Figure 4.3 Intervention Wheel (Minnesota Department of Health, 2016).

To develop health education interventions, we suggest following the ASSURE Model (Bastable, 2017). The ASSURE Model consists of a six-step guide to develop a targeted educational program for reducing participation in harmful social media challenges. The six steps are: Analyze the learner, State the objectives, Select the instructional methods and materials, Utilize materials, Require learner performance, and Evaluate the

teaching plan and revise as necessary. Following these steps from the ASSURE Model, we suggest the following as an example of an applicable intervention:

- Population of interest: Adolescence
- Problem: Self-harm based social media challenges

Analyze the Learner

To determine the characteristics of the population of interest we suggest using the Learner Readiness Assessment (PEEK), a method recommended by Schoon, Porta, & Schaffer (2018). Below is an example of what this first step could look like when applying the intervention:

- Physical and developmental health status: adolescence, usually between 13 -19 years old, and other characteristics vary.
- Emotional: broad.
- Experiential and social: English is native language, others might speak other languages, diverse race and ethnicity.
- Knowledge: reading level varies, preferred learning style includes visual and kinesthetic learning activities (Rogowsky, Calhoun, & Tallal, 2015).

State the Objectives

According to Bjerke & Renger (2017) stated outcomes should be specific, measurable, achievable, realistic, and timebound (SMART). An example of a SMART outcome following the detailed guidelines mentioned above follows:

- Specific: consequences of participating in harmful social media challenges as well as developing and stating norms of disapproval in regard to them should be provided in

an age-appropriate way. The interventions must change adolescents' attitudes in regard to participation in these challenges and the unfounded benefits that result from participation. In addition, interventions must target their perceived norms by seeking to change the opinions of adolescents' networks - society at large, but most importantly family and close friends. The change should be aimed at creating a negative opinion within the adolescents' networks in regard to the appropriateness of participating in harmful social media challenges.

- Measurable: a significant reduction of at least 0.5 in a 7-point Likert scale in the mean of attitudes and perceived norms toward social media challenges on post-test versus pre-test.
- Attainable: content can be provided as a classroom session along with existing well-known and successful educational programs such as Mothers Against Drunk Driving (MAAD) (Mothers Against Drunk Driving, 2019).
- Realistic: A 0.5 reduction in a 7-point Likert scale in the mean of attitudes and perceived norms is a goal we believe to be realistic if the school/community has multiple resources available - existing educational programs (such as MADD), access to media tools and other sources to utilize for delivering the interventions, financial ability, etc. However, each school/community is unique and thus outcomes should be appropriate and take into account the culture and resources available. As similar interventions showed higher reduction in alcohol and drug use (McNeal, Hansen, Harrington & Giles, 2004; Wu et al., 2003) we believe that our goal of 0.5/7 reduction is attainable.

- Time-bound: A pre-test using a survey similar to the one used in earlier in this chapter about their attitude and perceived norms toward social media challenges, followed by a 30-minutes session. Then a post-test at the end of the educational session to assess the change in their attitudes and perceived norms.

Once the outcome is detailed out following the SMART guidelines, the outcome can be written out in narrative form. We suggest the following as an example:

Upon completion of the post-test on the social media challenges section, we seek a reduction in students' perceived enjoyment and social media fame garnered from participating in these challenges as well as a reduction in positive perceptions or perceived approval of participation in these challenges within their social networks - friends, acquaintances, family and role models. We are targeting an average of at least 0.5 in a 7-point Likert scale significant reduction on their attitudes and perceived norms on a post-test regarding their beliefs about social media challenges.

Select the Instructional Methods and Materials

The instructional methods and materials for adolescents should avoid professional jargon and overwhelming excessive information. The literature suggests that active learning by demonstration and the use of visuals to enhance print and oral messages are the best methods (Schoon, Porta, & Schaffer, 2018). Thus, the educational content should be reviewed carefully to ensure appropriateness for the educational level of the audience. Visuals such as videos, posters, and handouts must be used in a comfortable learning environment such as an arranged classroom to allow active learning activities in small groups. These orientations and sessions should further discuss and present the negative

implications of harmful challenges and present criteria for safely selecting which activities to participate in.

Utilize Materials

Following the recommendations provided by Bond, Glover & Godfrey (2001), typically, this step involves holding a session where the materials are explained and distributed. Sessions are generally 30 minutes, including introduction, visuals and activities. It is important for the schedule to include student discussion or some type of activity to involve the audience. For our purposes, we suggest including the following: a student discussion regarding the effect of a specific harmful social media challenge, a well-developed video focused on communicating the consequences of participating in a specific harmful social media challenge with a few minutes for questions, small group role-playing of peer-to-peer scenarios about the undesired consequences of a specific harmful social media challenge, and a summary of the key learning points about why these types of behaviors are not desired. The approach

The literature suggests that people react differently to intervention messages (Jung & Villegas, 2011; Wong & McMurray, 2002). For example, smokers with high intention to quit smoking showed different trends than those with low intention to quit smoking when given interventions that were framed negatively vs. positively (Wong & McMurray, 2002). Keeping this in mind, we recommend a multifaceted approach for changing adolescents' behaviors regarding harmful challenges. By utilizing different approaches made up of sessions, videos and activities, we seek to target both the attitudes and perceived norms of a wide range of adolescents. In this vein, the message and content remain fairly intact, but

the delivery of the content varies. For example, changing adolescents' attitudes using video visuals could be achieved by showing a video that includes the following: (1) information to educate the audience on harmful consequences of social media challenges (2) communicating the range, forms and functions of the various harmful challenges and how to identify them, (3) displaying methods for coping with peer pressure and how to say 'No' to engaging in potentially harmful behavior. While this method may be effective for some adolescents, it will not be effective for all. Thus, in addition to the video, a session can be held where the video is discussed or a short presentation with similar content shown in the video is given and followed up with a speaker sharing his/her experiences of the consequences for participating in these challenges. This provides an example of the real life-threatening consequences of participating on these harmful social media challenges. Moreover, following the example of many MADD programs, a video in story-form showing an adolescent experiencing peer pressure to participate in social media challenges and subsequently the harmful effects that they can cause, can be another source for delivering the content. These methods have been proven to change people's attitude about other behaviors including self-harm (Patterson, Whittington, & Bogg, 2007), alcohol related harm (Wu et al., 2003), substance use (Wolfe et al., 2009), and pregnant teen drinking (Fertman & Allensworth, 2016; Keller et al., 2004; Minnesota Department of Health, 2016). Therefore, we believe these methods will be effective in changing adolescents' attitudes and perceived norms on harmful social media challenges.

Moreover, to change the perceived norms of adolescents, we recommend a bystander type of intervention. This could be achieved by motivating the adolescents to

intervene when they see a peer wanting to participate in a harmful challenge. That is, educating them on how to intervene in such situations by for example: telling their peers (1) why they shouldn't participate based on what they learned in the educational session (2) their family and role models will disapprove of them participating (3) their peers are more likely going to 'dislike' their post on social media if they posted it and (4) that they are more likely to receive social rewards if they do not participate then if they do. Bystander intervention methods have been proven to be effective in reducing cyberbullying incidents (Brody & Vangelisti, 2016) and violence prevention (Coker et al., 2016), thus, we believe it will also be effective in reducing harmful social media challenges participation. Education on how to intervene could be accomplished in the peer-to-peer activities form. The peers could play the role of a peer intervening to stop their friend from doing a harmful challenge. In addition, they can play the role of a parent confronted with evidence of a child's involvement in a harmful social media challenge and having to communicate their disapproval and negative consequences of participating in the challenge. This type of intervention is commonly known as 'saying-is-believing' or 'self-persuasion' and has been used widely used to change adolescents' behavior about a wide variety of domains (AlMaian, Needy, Walsh, & Alves, 2015; Canning & Harackiewicz, 2015). Therefore, we believe it will work as a persuasive intervention to reduce participation in risky challenges.

Finally, posters and handouts containing storyboards with similar stories as the one shown in the video and highlighting the consequences and reactions of loved ones could also be used to increase awareness at a wider level.

Require Learner Performance

The literature recommends creating content that is "enjoyable, relevant, and helpful to the user", in addition to using interaction and direct feedback (Yardley, Morrison, Bradbury, & Muller, 2015). This could be done by doing the following after showing the video mentioned in the previous step:

- Small group discussions regarding the content of the video and what they have seen or heard in the past about similar challenges.
- Peer-to-peer role-playing activity addressing the consequences of partaking in a harmful social media challenge.

Evaluate the Teaching Plan and Revise as Necessary

A post-test must be designed to measure their attitudes and perceived norms about the social media challenges. The test must include questions about their knowledge on how to identify a harmful challenge, the attitude about doing it including the level of enjoyment and social media fame they will receive after posting about it, and their perceived norm about the peers' best friends 'role models' and parents' approval of doing the challenge. Based on the post-test questions, one can determine if the objective has been accomplished (significant reduction in mean attitudes and perceived norms of at least 0.5 in a 7-point Likert scale), and if not, revise the content and plan accordingly.

According to the Interventions Wheel, the interventions could target three different levels, individual, community, and system levels. We suggest implementing our interventions in three ways that focuses on two levels of the Interventions Wheel, community and individual. First, community-based intervention is on the community level

in the Interventions Wheel. Second, the school and family-based interventions are on the individual level in the Interventions Wheel. Below we provide examples of how to apply these sublevels for our purposes of mitigating social media challenge adoption.

Community based intervention:

Poster and handouts containing storyboards telling a similar story as the video and highlight the unwanted consequences and their norms reaction could be utilized. These posters could be advertised in public places such as parks and malls by county task forces. These methods have the potential of increasing the educational level about a certain behavior but may not be as effective as other more interactive methods (Schoon et al., 2018). The content must be carefully created to avoid any contagion risk of media reporting (Sinyor et al., 2018).

School based:

The small discussion groups, videos, and peer-to-peer role-playing activities can be provided as a session along with existing educational programs such as MAAD (Mothers Against Drunk Driving, 2019).

Family based:

An alternative and potentially more convenient way to implement the interventions is by sending the video to the parents to be played directly by them to their kids.

Limitations and Future Work

While based on science and previous research in regard to interventions appropriate for this work, the impact of our recommended interventions for changing/reducing social media challenge behavior has not been tested. In addition, these interventions have the

potential of further enhancing the contagion effect by presenting the social media challenges details on a larger scale. Therefore, the content of these interventions must be carefully reviewed by an expert to reduce the risk of them further spreading the popularity of these challenges. The content must follow the guidelines to reduce the contagion risk of media reporting such as the ones found in Chang & Freedman (2018) and Sinyor et al. (2018). For example, the educational sessions should not include “excessive detail” about specific challenges nor mention numbers of how many people participated in them. This is because presenting a challenge in such a way might work as evidence that there are people actually doing it and encourage adolescents to partake in them. Therefore, the next step would be to further develop these interventions and conduct a controlled study to measure the impact of such interventions on adolescents' attitudes and perceived norms toward social media challenges.

CHAPTER FIVE

DYNAMIC SIMULATION OF SOCIAL MEDIA CHALLENGES PARTICIPATION TO EXAMINE INTERVENTION STRATEGIES

Introduction and Background

Computational simulation is a feasible, flexible, and collaborative tool for modeling complex systems. One of its most widely used classes is agent-based modeling (ABM), which has been used extensively to investigate human behavior and complex phenomena as well as to explore complex problems in several domains, including the social sciences (Burke et al., 2006; Dray, Mazerolle, Perez, & Ritter, 2008; Epstein, 2002; Furtado, Melo, Coelho, & Menezes, 2008; Gorman, Mezic, Mezic, & Gruenewald, 2006; Groff, 2008; Syouri, Li, Khasawneh, Zhang, & Nagarur, 2016) and healthcare (Erekat, Al-Sheabi, Alhaider, Khasawneh, & Khasawneh 2017; Lee et al., 2011; Lee et al., 2010a; Lee et al., 2010b; Lee et al., 2010c). For example, Epstein (2002) developed an ABM for investigating civil violence and rebellion, and Groff (2008) constructed one for further understanding street robbery crimes. More relevant to the research reported here, it has been used to explore teenager behavior, specifically focusing on investigating the effects of various interventions on younger adults. For example, Yonas et al., (2013) developed a conceptual ABM representing abstract community crime perpetrated by adolescents in addition to exploring the effects of several community-wide interventions on the contagion of these crimes.

Agent-based modeling provides deeper insight and more realistic outcomes about the effect of interventions because it can be modeled to account for the possible consequences of an intervention. For example, it is used extensively in marketing research

to evaluate the effects of a marketing campaign above and beyond the common assumption that only a portion of those who receive the advertisement might be potential customers (Karakaya, Badur, & Aytekin, 2011; Kim, Lee, Cho, & Kim, 2011). Traditionally, the effect of "word of mouth" on potential customers was potentially discounted, which, in turn, inflates the number of potential customers when they recommend the product to their acquaintances. On the other hand, for those customers who switched to another product, the advertisement might trigger them to recommend their new product to their acquaintances (Karakaya et al., 2011; Kim, et al., 2011; Kozinets, De Valck, Wojnicki, & Wilner, 2010). Because ABM offers a unique and cost-effective way to construct, assess, and implement a variety of behavioral interventions in a simulated dynamic environment, it has the potential to enhance our understanding of the contagion effect of social media challenges and provide us with the ability to evaluate potential interventions.

Due to the nature of the interventions recommended in Chapter 4, we expect effects similar to those found in marketing. That is, when some people hear about a challenge, even through an educational program, they might still consider participation. In fact, they might have never heard about the challenge before, but the educational program may trigger them to consider researching it and subsequently participating. This response is referred to as the contagion effect (Christakis & Fowler, 2013; Coviello et al., 2014). On the other hand, these educational programs might have a larger impact than expected due to the word of mouth effect. That is, individuals who were successfully impacted by the education program and chose not to participate in harmful social media challenges are

likely to discuss what they learned with others, in turn discouraging them from participating as well.

As a result, the goal of this study was to develop the first conceptual ABM in the literature representing the contagion dynamics of these social media challenges. This model includes the essential features of adolescents who participate in these challenges informed by the results from the previous study reported in Chapter 4. In addition, this ABM will lay the foundation for future models to further address this phenomenon.

Methodology

The goal of our model is to build an individual-level ABM able to temporarily present the dynamics of the spread of a social media challenge in a small community. Additionally, through this ABM we seek to test the effect of potential interventions and combinations of interventions at several levels including, family, school, and community levels. This section includes (i) the model and how the agents interact with one another (ii) the integration of the data obtained from the survey into the model and how they affect the agent's interaction.

Model Overview and Design

The ABM was developed using Anylogic 8.5.1 University Researcher Edition (AnyLogic, 2019) simulation software, a modeling tool that supports agent-based, discrete event, and systems dynamics methodologies using Java scripts. The abstract community included five agent types: child, father, mother, house, and school. A two-dimensional 100,000 x 100,000 toroidal grid was utilized to represent the community with one or more agents occupying any specific location. Each school and house in the environment were

randomly located in the two-dimensional toroidal grid. Then each child, father, and mother were randomly assigned to and located at one house and together formed a family. Children were connected to the closest school. Next, each child established a close relationship with the nearest child (a "best friend") along with a minimum of 5 and a maximum of 25 other friends from the same school.

The simulation time was set in days, and on each day the agents updated their individual characteristics. Below are descriptions of agent updates based on agent type.

Child: The formation of the child's behavior is motivated by the integrated behavioral model (IBM) (Montano & Kasprzyk, 2015), which has one key element determining the child's decision to participate or not in a challenge: intention to participate. The primary key contributors to the intention to participate include the attitudinal components "attitude," the perceived norm components "norm," the personal agency components "personal agency," and other factors combined as "individual differences." As the model moves forward in time, these components of the children evolve based on their interactions with other agents (including their parents) in their social network and feedback from the environment, described later in this section. The decision criteria are based on the child's (agent's) intention to participate, which must be above a certain threshold before she/he participates in the social media challenge. Figure 5.1 presents the daily time-step of the child agents within the ABM. Each child begins forming beliefs about the challenge once one child in their social network has participated in it. Children are assigned individual initial values of experiential and instrumental attitudes, injunctive and descriptive norms, perceived control, and self-efficacy. Thus, children become more or less

inclined to participate in the challenge depending on other children's experiences with the challenge and their interactions with their school and parents.

Parents (father and mother): Each child is assigned to parents who could intervene and ask the child not to participate in the challenge if they know about it. A portion of the parent population will not know about the challenge and, thus, will not intervene. For those who intervene, if their child has not already participated in the challenge, then the probability of him/her participating will decrease. The value of the reduction in the probability of participation was determined using a trial and error method to establish a model that represents the collected data.

School: Similar to the parent population, schools' officials could also intervene and ask their students (children) not to participate in the challenge if they know about it. Similar to the parent population, a portion of the schools will not know about the challenge and, therefore, will not be able to intervene. For the schools that intervened, the probability of the students participating in the challenge who have not participated yet will decrease. The value of the reduction in the probability of participation was determined using a trial and error method to establish a model represents the collected data.

Home: The homes in the model had no effect on the decision to participate. They were included in the model for the purpose of forming families at one location. The animations of all agent types are presented in Figure 5.2.

Data

The distributions of the attitudinal components "experiential and instrumental attitude," the perceived norm components "injunctive and descriptive norm," the personal

agency components "perceived control and self-efficacy," and other factors "individual differences" from the data provided in Chapter 4 were tested for normality using their skewness and kurtosis values (Henze, 1994; Mardia, 1974). All data were normally distributed. Initial values for these factors were randomly assigned to each child in the model based on the most fitting mean and standard deviation with a minimum value of 1 and a maximum of 7.

To determine the values for intention to participate for each child, we conducted a linear regression using the data collected from the survey in Chapter 4 with the intention to participate in the Cinnamon Challenge measured on a 7-point Likert scale being the dependent variable and the factors introduced previously as the independent variables. The linear regression established that instrumental attitude, injunctive norm, descriptive norm, and impulsivity statistically significantly predicted intention to participate in the Cinnamon Challenge, $F(6, 471) = 153.318$, $p < .001$. The regression equation with the significant predictors only is provided below. In the model we included all the factors, even the non-significant predictors to calculate the intention to participate. However, only the significant ones had high impact on the calculated intervention to participate value as their slopes were significantly higher than the rest of the predictors. For the full list of the predictors used in the equation, see Appendices H and I.

$$Intention = -0.70 + 0.36 \times (instrumental\ attitude) + 0.26 \times (injunctive\ norm) + 0.37 \times (descriptive\ norm) + 0.14 \times (impulsivity)$$

Calibration and Validation

To validate the model, we used a multistage validation technique (Nayani & Mollaghasemi, 1998; Sargent & Balci, 2017). After developing a model based on theory, observations, and knowledge of the behavior, its assumptions must be validated by empirically testing and comparing them to data collected from a real system. To capture trends in our model similar to the survey reported in Chapter 4, we developed parameterized rules and assumptions to change the participation probabilities of the children:

- R1: The child will participate if his/her intention to participate > participation threshold
- R2: The child will discourage others from participating if his/her intention to participate < the discouraging threshold or if they are discouraged to participate by their best friend
- R3: A portion of the children who participated will discourage participation (those who had a negative experience with the challenge) while the rest will encourage participation (those that had a positive experience)
- R4: The child will stop discouraging or encouraging participation after a certain number of days.

The values of the parameters for these rules (participation threshold, discouraging threshold, portion of children having a negative experience, and number of days to stop encouraging/discouraging other children) were calibrated by trial and error so that the resulting behavior of the children in the model matches the sample we collected in Chapter

4. That is, the number of people who participated in the survey falls within the 99% confidence interval of the number of people participated in the model after N runs. A one-sample t-test showed that the number of children who participated over 63 replications of the simulation was not statistically significantly different (M = 144.41, SD = 27.28) than the number of participants from the survey, which was 153 participants, t(63) = -1.625, p = 0.11. In addition, an independent-samples t-test was conducted to determine if there were differences in intention to participate between the survey data and the simulation outputs. The intention to participate was not statistically significant (M = 0.10, 95% CI [-0.14, 0.36], t(926) = 0.82, p = 0.97) between the survey data (M = 3.06, SD = 1.99) and the ABM outputs (M = 2.95, SD = 1.94).

Visualizations and Verification

A verification method widely used in simulation models is animation (Chan, d'Ambrogio, Zacharewicz, & Mustafee, 2017; Kleijnen, 1995; Sargent & Balci, 2017; Xiang, Kennedy, Madey, & Cabaniss, 2005). This Anylogic software provides a dynamic visualization of the model as it's running, providing validation that the computational implementation is in agreement with the conceptual model. A close-up view of the agents' interactions in the model can be seen in Figure 5.2. In addition, we used the structured walkthrough approach (Sargent, 2013) where the developer formally presented the model to two other researchers to determine its correctness. Then the model was analyzed statically by the developer and each of the two researchers individually to determine whether it is correct based on the structured walkthroughs, the correctness proofs, and the examination of its structural properties.

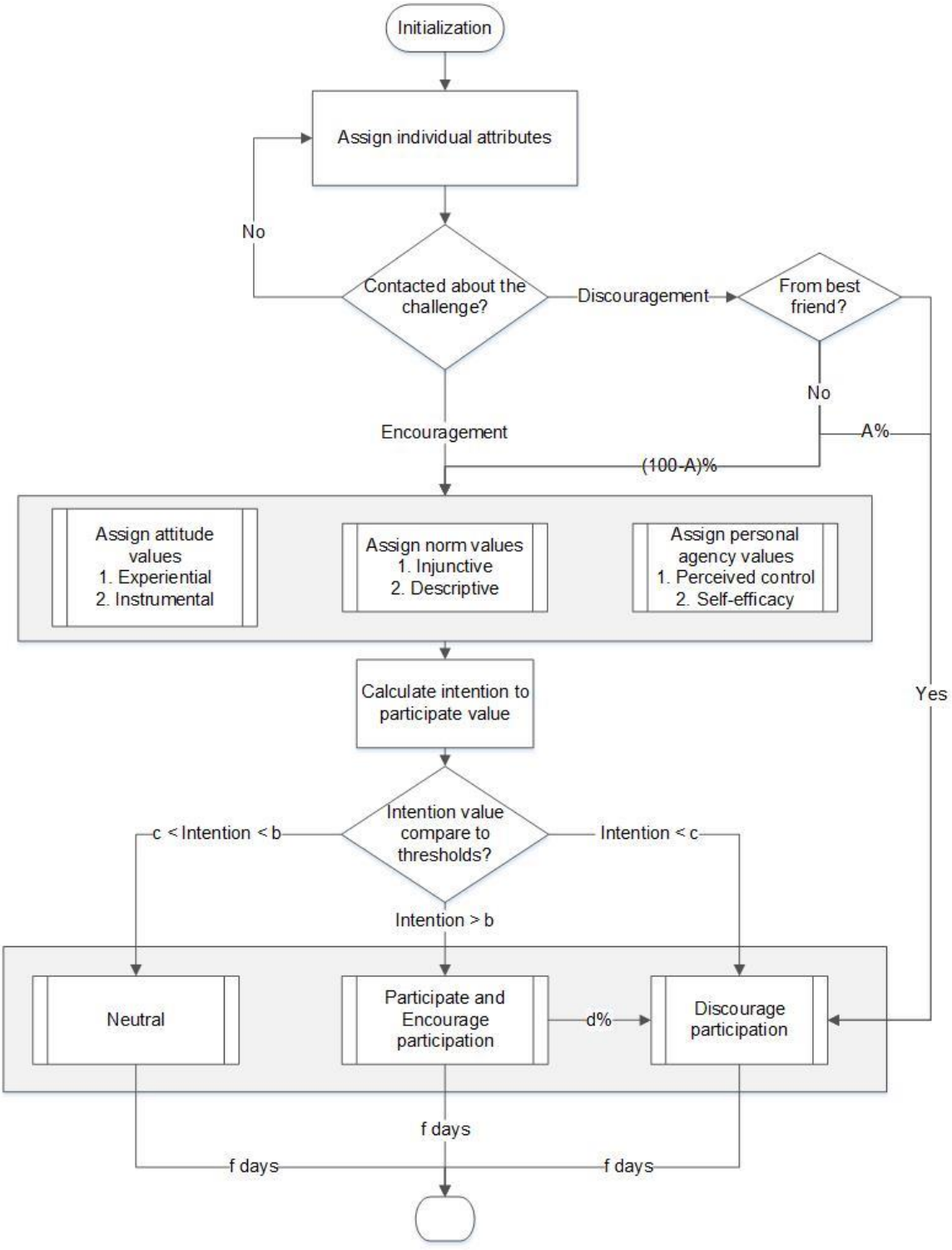

Figure 5.1 The daily time-step of the child agents in the ABM.

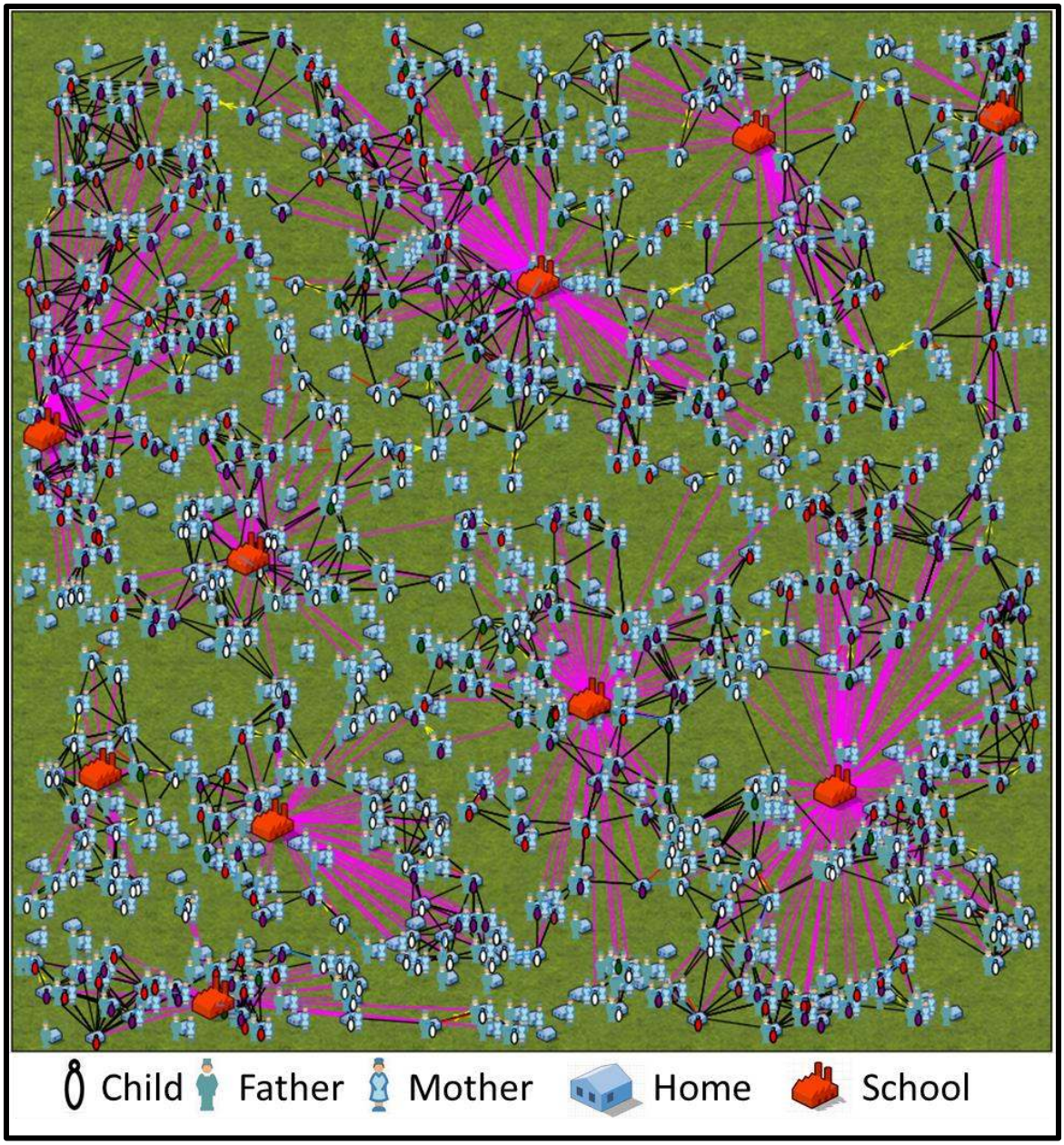

Figure 5.2 A close-up view of the agents in the ABM. The color of a child indicates his/her status: children who have not heard about the challenge are white; those who considered participating are purple; those who participate are red; and those who discourage participation are green. The color of the line indicates the type of relationship between the agents: friends are connected by black lines; best friends are connected by yellow lines; and children are connected to their fathers by blue lines, to their mothers by red lines, and schools by pink lines.

Modeling of Interventions

The interventions in Chapter 4 target three different levels, community school, and family. To determine the impact of each level on the child 's attitude, perceived norm and personal agency values, we conducted a within-subject ANOVA with the motivation to comply factor, described in Chapter 4, as the dependent variable and the relationship to the individual as the independent variable. We used within-subject ANOVA as the motivation to comply with the different norm categories were measured for all the participates. The motivation to comply was significantly different for different relationship types, $F(1.94, 913.54) = 90.17$, $p < .001$, partial $\eta 2 = 0.16$, with motivation to comply decreasing from family ($M = 5.01$, $SD = 1.79$) to most people ($M = 4.49$, $SD = 1.90$) and then to friends ($M = 3.82$, $SD = 1.88$). Post hoc analysis with a Bonferroni adjustment revealed that motivation to comply was significantly decreased from family to most people ($M = 0.52$, 95% CI [0.31, 0.72], $p < .001$), and from family to friends ($M = 1.19$, 95% CI [0.96, 1.42], $p < .001$), and from most people to friends ($M = 0.67$, 95% CI [0.46, 0.87], $p < .001$). The mean and standard deviation for the rest of the relationship types are provided in Appendix J. Based on these findings, we assumed that the family-based interventions will have the highest reduction in children's intentions to participate. As suggested by the literature, we assumed that school-based interventions have higher impact on intention to participate than the community-based ones (McNeal et al, 2004; Minnesota Department of Health, 2016; Wu et al., 2003). We assumed the specific values of the reduction in intention to participate at each intervention level. We also assumed that it takes three days after the simulation

starts for the interventions to be active. Below is a description of how we modeled these interventions in the ABM.

Family level: The intervention targets only parents who did not know about the existence of the challenge and did not intervene at the start of the simulation. We focused on how changes in a specified percentage of parents will affect the overall participation pattern. We assumed that if the parents received an intervention, then they will become active and ask their child not to participate. We assumed that if their child has not participated in the challenge yet, she/he will get attitudinal, perceived norm, and personal agency component values that are on average 0.5 less than those who did not receive the intervention.

School level: Similar to the family level interventions, we assumed that if a school received an intervention, then those students who go to that school will get attitudinal, perceived norm, and personal agency component values that are on average 0.2 less than those who did not receive the intervention.

Community level: A certain percentage of the child population from the entire population was randomly selected to receive the intervention. If the child had not yet participated in the challenge, she/he will receive attitudinal, perceived norm, and personal agency component values that are on average 0.1 less than those who didn't receive intervention.

The ABM we built is a stochastic simulation resulting in different output and observations for each run of the model. Thus, several replications were run to gather statistics and evaluate the various interventions recommended. We used the confidence

interval method recommended by Law (2008) seen in the equation below to calculate the required number of replications per run, where h is the half width of the confidence interval and s is the standard deviation:

$$Number\ of\ replications\ = Z^2_{1-\alpha/2}\frac{s^2}{h^2}$$

To determine the initial standard deviation, we conducted a pilot run of the model for 20 replicates with a population size of 30,000 and calculated the standard deviation for the number of children who participated in each replication and found it to be 103. We specified precision in terms of the half width of the confidence interval to be 25 and an alpha level (α) of 0.05 (Z = 1.96). Using equation above, we found the number of replications required to meet our precision criteria to be 63 replications. We ran the model using Anylogic on a 64-core machine, running a 64-bit Windows 2010 Enterprise with 32GB of RAM and 3 GHz Intel Core i7-9700 processors. We determined the time required for the model to reach the steady state based on the number of children who participated and found it to be ~100 days. Therefore, we determined the stop time for each run to be 200 days as a conservative choice. The total running time for each run with 63 replications and a population of 30,000 was approximately 70 minutes.

Results

In all three intervention levels, we defined the intensity of the intervention as the percentage of each agent type (family, school, or community) that received the intervention. We ran the model four times (each run with 63 replicates) for each intervention type, each with different intensity and compared them to the base model

without interventions. The four intensity levels for the interventions were low = 25%, medium = 50%, high = 75%, and all = 100%. For example, in the low intensity family level intervention, 25% of the families in the model received the intervention. By using fixed intensity levels, we were able to explore the different effects of the types of recommended interventions that require almost the same resources but which deployed them in a different way. In addition, we were able to address the contagion effects resulting from those interventions. That is, at which level of intervention the "word of mouth" effect will help in spreading these interventions further into the community.

The Impact of Individual Interventions

We used a one-way ANOVA to compare the means of the number of children who participated after applying each intervention over 63 replications at each level. There were no outliers, as assessed by boxplot; data were normally distributed for each group, as assessed by the Shapiro-Wilk test ($p > .05$); and there was homogeneity of variances, as assessed by Levene's test of homogeneity of variances. Data are presented as mean ± standard deviation in Table 5.1 and plotted in Figure 5.3. For low intervention levels, the mean decrease from the base model to family-based intervention (419, 95% CI [432, 527]) was statistically significant ($p < .001$), as was the decrease from the base model to the school-based intervention (229, 95% CI [128, 277], $p < .001$), and the difference between the base model and the community-based intervention was statistically significant (128, 95% CI [81, 176], $p < .001$). Moreover, the decrease from community-based intervention to the school-based interventions was statistically significant (101, 95% CI [53, 148], $p <$

.001), as was the decrease from the school-based intervention to the family-based intervention was statistically significant (249, 95% CI [202, 297], $p < .001$).

When comparing the low to medium intervention levels, the mean decrease from the low to the medium family-based intervention (458, 95% CI [411, 506]), the decrease from the low to the medium school-based intervention (199, 95% CI [152, 257]), and the decrease from the low to the medium community-based intervention (149, 95% CI [101, 196]) were statistically significant ($p < .001$). Moreover, the decrease from the medium community-based intervention to the medium school-based intervention (151, 95% CI [104, 198]) and the decrease from the medium school-based intervention to the medium family-based intervention (508, 95% CI [461, 556]) were statistically significant ($p < .001$).

When comparing the low and high intervention levels, the mean decrease from the medium to the high family-based intervention (427, 95% CI [380, 475]), the decrease from the medium to the high school-based intervention (198, 95% CI [151, 246]), and the decrease from the medium to the high community-based intervention (101, 95% CI [54, 149]) were statistically significant ($p < .001$). Moreover, the decrease from the high community-based intervention to the high school-based intervention (248, 95% CI [201, 295]) and the decrease from the high school-based intervention to the high family-based intervention (737, 95% CI [690, 785]) were statistically significant ($p < .001$).

Comparing the case where everyone received intervention to the high intervention level, the mean decrease from the high level to everyone received family-based intervention (327, 95% CI [279, 374]), the decrease from the high level to everyone received school-based intervention (227, 95% CI [180, 274]), and the decrease from high

level to everyone received community-based intervention (121, 95% CI [73, 168]) were statistically significant ($p < .001$). Moreover, the decrease from everyone received community-based intervention to everyone received school-based intervention (354, 95% CI [307, 402]) and the decrease from everyone received school-based intervention to everyone received family-based intervention (837, 95% CI [790, 885]) were statistically significant ($p < .001$).

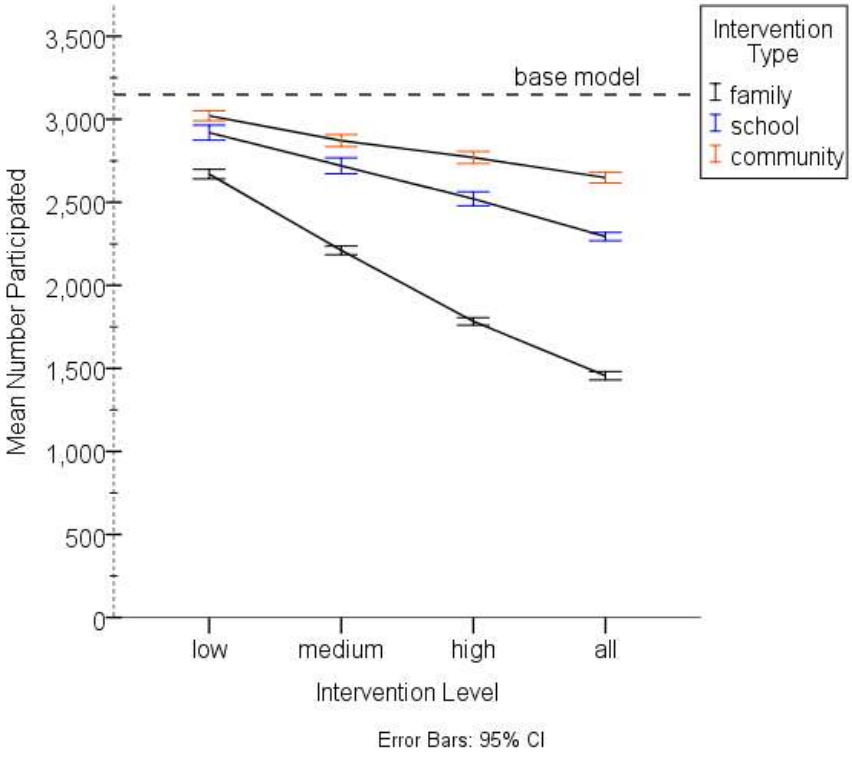

Figure 5.3 Number of children who participated in the challenge after applying each intervention.

Table 5.1 The means and standard deviations of the number of children who participated after applying each intervention.

Intervention Level	Base model	Family level	School level	Community level
Low	3149 (137)	**2669 (114)****	**2919 (177)***	**3020 (119)**
Medium	3136 (134)	***2210 (102)*****	***2719 (189)****	***2871 (144)***
High	3136 (134)	***1783 (88)*****	***2521 (168)****	***2769 (143)***
All	3136 (134)	***1455 (101)*****	***2293 (100)****	***2648 (125)***

Note: In each row, the means and standard deviations for the three types of interventions are presented in boldface if they show a statistically significant ($p < 0.001$) decrease compared to the base model. They are marked with a single asterisk if they show a statistically significant decrease when compared to one alternative intervention and a second asterisk if they show a significant decrease when compared to two alternative interventions. They are italicized if they show a statistically significant decrease when compared to a lower level of the same intervention.

Sensitivity Analysis

We included multiple parameters in our model for which the data are currently unavailable. Therefore, it is necessary to explore the sensitivity of our results to these parameters. One important parameter is the percentage of children initially participating in the social media challenge as it affects the probability of a child hearing about the challenge and considering his/her own participation, thus affecting the final number of children who participated. Furthermore, this value can also affect the probability of a child initially not liking the challenge and, therefore, discouraging other children from participation, resulting in a decrease in the effectiveness of the intervention. To ascertain the sensitivity

of the findings to the percentage of children who initially participated, variations of the models were created with 0.5%, 1%, 2%, 3%, and 4% of the children initially participating. We ran these variations for 63 replications only on three levels (low, medium, and high) of the family, school, and community-based interventions since all the other levels will follow a similar trend. The results are presented in Figures 5.4-5.9. For all models, family-based interventions reduce the number of children who participated more than the school and community-based interventions. Overall, the performance of all types of interventions was consistent with the tested variations in the percentage of children who initially participated.

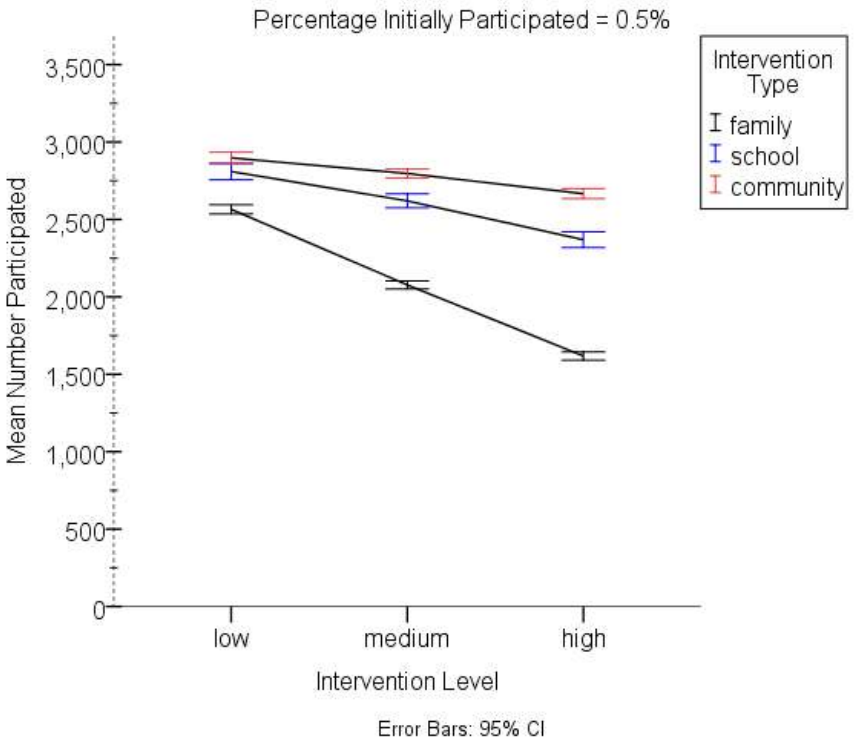

Figure 5.4 Effects of interventions when the percentage of children who initially participated is 0.5%.

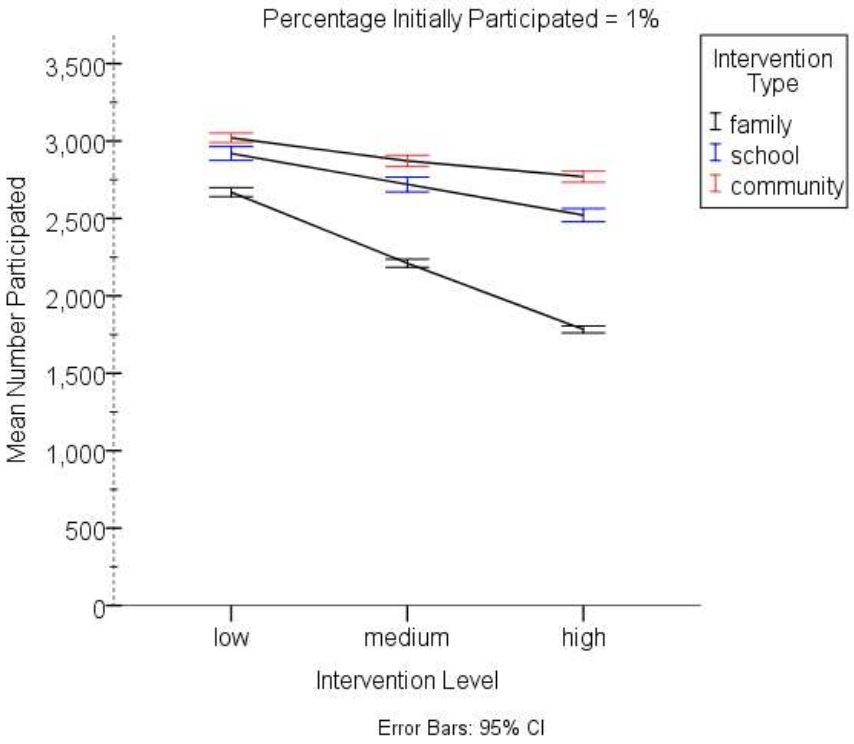

Figure 5.6 Effects of interventions when the percentage of children who initially participated is 1%.

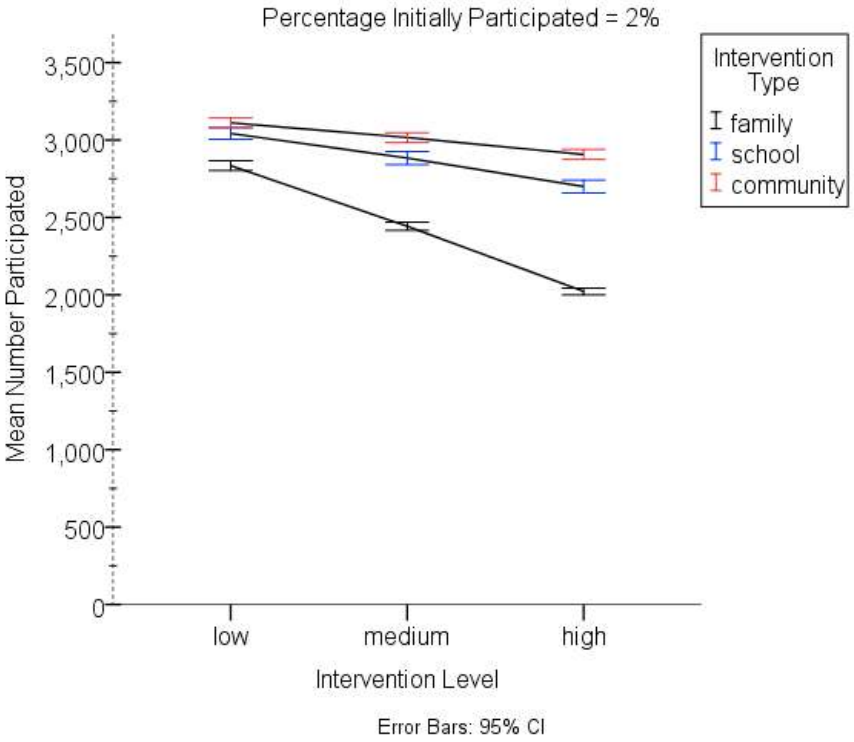

Figure 5.6 Effects of interventions when the percentage of children who initially participated is 2%.

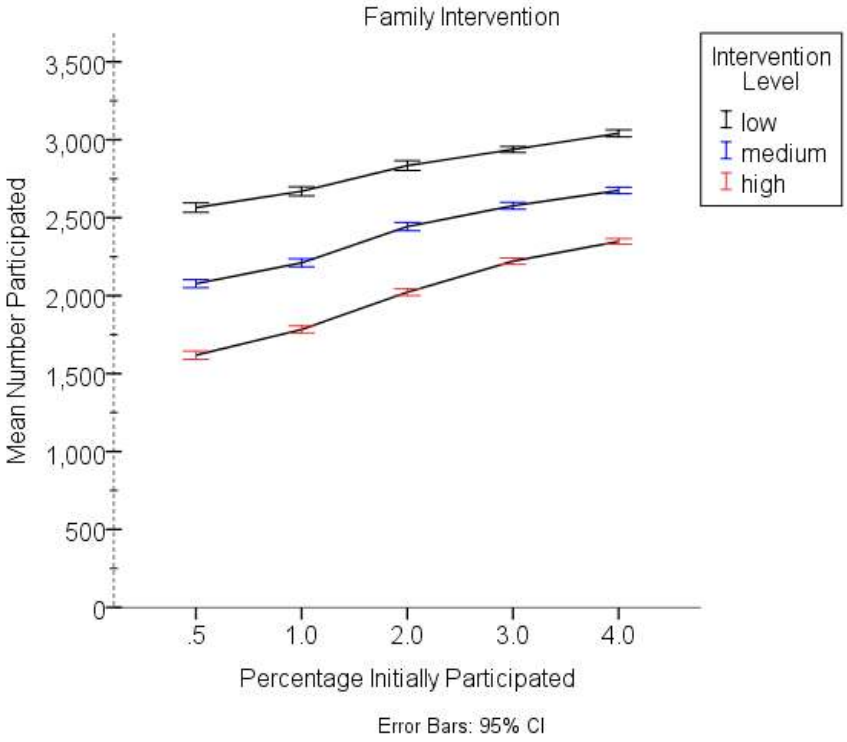

Figure 5.7 The effect of percentage of children who initially participated on family-based intervention.

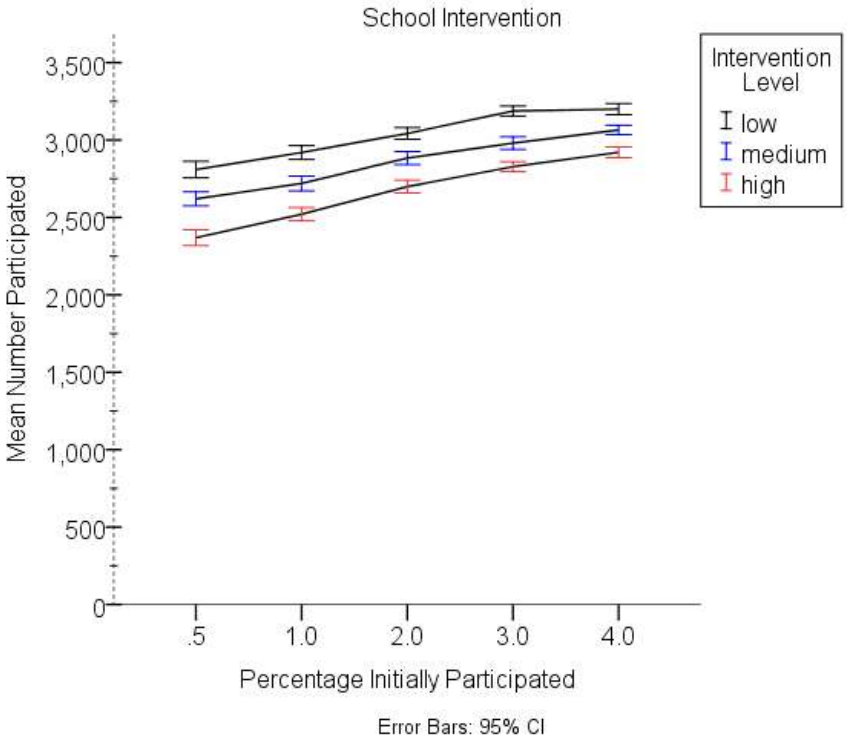

Figure 5.8 The effect of percentage of children who initially participated on school-based intervention.

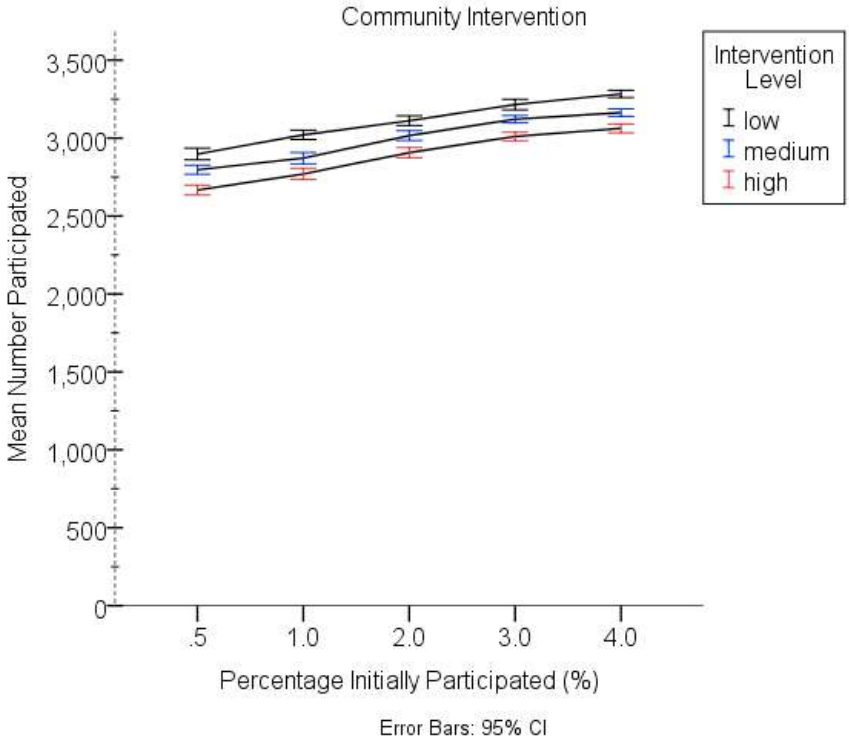

Figure 5.9 The effect of percentage of children who initially participated on community-based intervention.

The Impact of Combinations of Interventions

Because these results indicated that the school-based and family-based interventions showed significantly more reduction in the number of children who participated in a challenge than the community-based intervention, we decided to explore the effect of a combination of family and school-based interventions on the number of participants. To do so, we ran the model 63 times for each combination of the different levels of family-based and school-based interventions, resulting in 16 combinations.

We used a one-way ANOVA to compare the means of the number of children who participated after applying each combination of interventions over 63 replications at each level. Data are presented as mean ± standard deviation in Table 5.2 and plotted in Figure 5.10. For low school intervention level, the mean decrease from the low to the medium

family intervention level (393, 95% CI [311, 476]), the decrease from medium to the high family intervention (416, 95% CI [334, 499]), and the decrease from the high to all family intervention (298, 95% CI [216, 381]) were statistically significant ($p < .001$). When the school intervention was medium, the mean decrease from the low to the medium family intervention level (403, 95% CI [321, 486]), the decrease from the medium to the high family intervention (382, 95% CI [299,464]), and the decrease from the high to all family intervention (285, 95% CI [202, 367]) were statistically significant ($p < .001$). For high school intervention, the mean decrease from the low to the medium family intervention level (343, 95% CI [261, 426]), the decrease from the medium to the high family intervention (347, 95% CI [265,430]), and the decrease from the high to the all family intervention (275, 95% CI [192, 357]) were statistically significant ($p < .001$). When everyone received school intervention, the mean decrease from the low to the medium family intervention level (348, 95% CI [265, 430]), the decrease from the medium to the high family intervention (258, 95% CI [175, 340]), and the decrease from the high to the all family intervention (252, 95% CI [169, 334]) were statistically significant ($p < .001$).

Table 5.2 The means and standard deviations for the number of children who participated after applying combinations of interventions.

Family/School	Low	Medium	High	All
Low	2462 (144)	**2321 (153)***	**2096 (171)***	**1917 (109)***
medium	**2068 (153)***	**1917 (153)***	**1752 (159)***	**1569 (91)***
High	**1651 (113)***	**1535 (139)***	**1404 (114)***	**1311 (84)***
All	**1353 (116)***	**1250 (131)***	**1129 (122)***	**1059 (101)***

Note: In each row, the means and standard deviations for the combination of two types of interventions are presented in boldface if they show a statistically significant ($p < 0.001$) decrease when compared to the model that has one level lower school intervention (the cell on the left of it). They are marked with a single asterisk if they show a statistically significant decrease when compared to the model with one level lower family intervention (the cell on top of it).

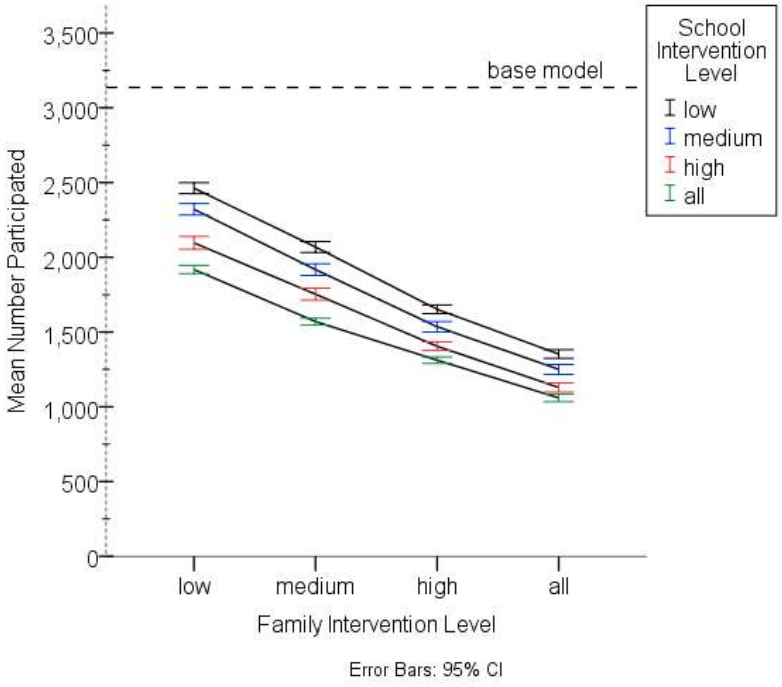

Figure 5.10 Number of children who participated in the challenge after applying combinations of interventions.

Educational Interventions Versus Social Media-based Policy Interventions

Another way of eliminating participation in social media challenges is by detecting videos about those challenges and removing them from social media platforms to reduce the further spread of the challenge. We modeled these interventions in our ABM by reducing the percentage of children who encourage other children to participate. We assumed that this percentage is related to the accuracy of the detection algorithm. For example, if the algorithm exhibits an 80% accuracy, then only 20% of the children who participated and liked the challenge will encourage participation. We tested this policy-based intervention at two levels, 80% and 90% accuracy. Since the most recent algorithms in video detection exhibit accuracies around 90% (Abu-El-Haija et al., 2016; Long et al.,

2018; Yue-Hei Ng et al., 2015), we picked it as a representative value. However frequently, these accuracy values are inflated because of bias in testing the algorithm using data similar to the training data and/or by consistently misclassifying adversarial examples (Goodfellow, Shlens, & Szegedy, 2014). In other words, the performance of these algorithms when applied in the real world are much lower than what is reported in the research (Goodfellow et al., 2014; Nguyen, Yosinski, & Clune, 2015; Papernot et al., 2016). Therefore, we also chose 80% accuracy as a more conservative choice. The results are presented in Figure 5.11. The only combinations of interventions that significantly reduced ($p < .001$) the number of children who participated in the challenge beyond what an algorithm with 80% detection accuracy were (1) the medium level of family-based intervention and the high level of school-based intervention (184, 95% CI [102, 267]) and (2) the medium level of family-based intervention and all schools receive intervention (367, 95% CI [284, 450]).

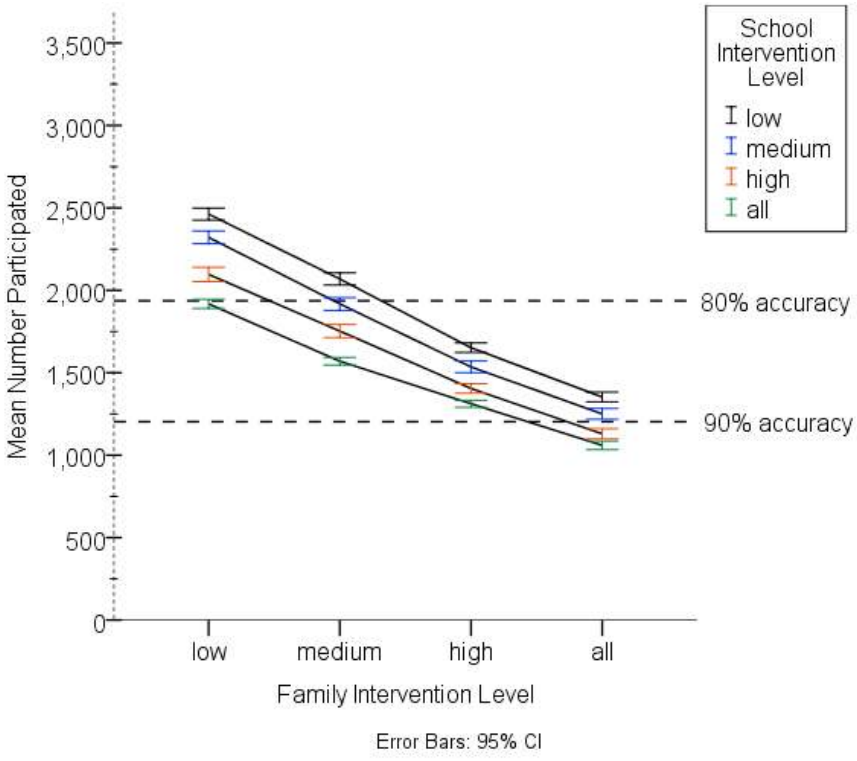

Figure 5.11 Comparing the number of child children who participated in the challenge after applying combinations of interventions with social media-based policy interventions**.**

Discussion

Computational simulation methods such as ABM can help us explore the effects of multiple interventions at varying levels to reduce participation in harmful behaviors. ABM in this research provided an effective means for the conceptual dynamic simulation of participation in harmful social media challenges and the potential impact of various multilevel interventions aimed at decreasing their virality. Although this is an abstract model, it reveals interesting trade-offs between the different interventions. The family-based interventions were the most effective, followed by the school-based interventions, then the community-based ones. When compared to video detection and deletion

algorithms, the combination of family and school-based interventions were better at reducing participation only at high levels of interventions.

In general, the family-based interventions reduced participation more than all the other interventions. This finding is primarily because parents had the largest impact on children's decisions in the model. When the intervention is given to children by their parents, their intention to participate will be reduced more than if the intervention were delivered by anyone else, thus reducing the number of people who participated. Moreover, those who received the intervention from their parents are more likely to exemplify a very low intention to participate, leading them to discourage other children from participating, reducing participation further. This finding is consistent with most of the recent intervention literature that suggests involving families in interventions, especially those for children and adolescents (Ash, Agaronov, Young, Aftosmes-Tobio, & Davison, 2017; Dietz, 2017; Feldman et al., 2018).

In addition to family-based interventions, we found that school-based interventions reduced participation only slightly than community-based interventions when the intervention level was low. However, at higher levels of interventions, school-based interventions were much better at reducing participation than community-based interventions. This finding was primarily due to the way interventions are deployed. When the school-based intervention is low, meaning only a few schools receive the intervention, its main effect and its word of mouth effect are localized to areas surrounding the school. However, the spread of community-based interventions among the children is wider than the school-based intervention when the level is low. The low community-based

intervention will reduce the intention to participate in these challenges for people at different locations and its word of mouth effect will help spread it farther to other locations. On the other hand, when the intervention level is high, most people will receive the direct effect of the intervention, reducing the word of mouth effect as it will most likely get to those who have already received an intervention and developed a low intention to participate. This finding is consistent with earlier literature on the contagion effect of community-wide interventions (Chica & Rand, 2017; Hoge, Ivany, & Adler, 2017; Mønsted, Sapieżyński, Ferrara, & Lehmann, 2017; Prinz & Neger, 2016; Silverman, Hanrahan, Bharathy, Gordon, & Johnson, 2015; Yonas et al., 2013). For example, Yonas et al. (2013) tested the contagion effect of community-wide vs. spatial-focused crime reduction interventions, finding that community-wide interventions are more contagious than spatially focused ones at low levels of interventions.

We ran several combinations of educational interventions at the family and school levels to explore the added effect of additional interventions on reducing participation. We found that adding another intervention type significantly reduced participation. In addition, increasing family-based interventions one level (within the same type of intervention) was more effective than increasing one level of school-based interventions. However, increasing the school-based intervention by two levels had the same impact or better than adding one level of school intervention. Overall, the effect of increasing the level of intervention is reduced as the intervention level increases. For example, if a high percentage of the population receives a family-based intervention, then providing a higher level of a school-based intervention will not be as valuable as when the family-based

intervention is low. This result is primarily due to the increased probability of providing the intervention to children who already received an intervention or have a low intention to participate. This common trend in the literature led to the development of focused interventions, which target only those with a high probability of engaging in a behavior when possible (Elie & Menassa, 2014; Fonagy et al., 2009; Yonas et al., 2013). Therefore, as a future direction, our interventions could focus only on those with higher impulsivity instead of everyone in the community as a more efficient alternative.

Our model could help decision makers assess the availability of resources and decide on which intervention type, combination and level is more appropriate than others. For example, family-based interventions may be more cost-effective than other types as the delivery method relies on parents, thus requiring fewer resources. If this is the case, then it becomes more beneficial to choose family-based interventions over others. The school-based interventions could lead to consistent and sustained reductions in participation in harmful social media challenges if resources are available for high-level interventions and the intervention is provided to many schools. However, when resources are limited, community-based interventions may have a better impact on reducing participation. The added value of a combination of interventions can also be assessed. For instance, if the resources required to increase a family-based intervention is the same as providing the intervention through a few more schools, then the latter option might be more efficient as it is likely to have a greater impact on participation.

We compared the educational-based interventions at the family and school levels with the policy-based interventions by detecting and removing all videos from social media

platforms at two levels of accuracy: 80% and 90%. In general, the policy-based intervention with 80% accuracy reduced participation more than any single intervention by itself. The combination of interventions reduced participation more than the policy-based intervention with 80% accuracy only when there were at least medium-level interventions of both family and school-based or low school-based with high or all family-based interventions. When the detection accuracy was 90%, only combinations of interventions with high levels or more of both family and school-based interventions were more effective at reducing participation. These results highlight interesting tradeoffs on which type of intervention will reduce participation more than others to help decision makers make effective choices about which option to use. While accuracy detection algorithms might seem to be an effective and efficient option in reducing participation, one should consider that most of these algorithms rarely reach 90% accuracy (Abu-El-Haija et al., 2016; Goodfellow et al., 2014; Long et al., 2018; Yue-Hei et al., 2015) when implemented, thus possibly making them less effective than educational methods. In addition, over the long term, the educational-based intervention methods are more efficient as they are more likely to target any type of social media challenge and reduce any future participation in those challenges, while on the other hand, algorithms have to be developed each time a new challenge appears. In other words, educational interventions target the root of the problem while detection algorithms act as a retrospective solution.

ABMs have been used in the literature to explore the dynamics of multiple unwanted behaviors such as drug marketing (Dray et al., 2008), rebellion (Epstein, 2002) and street crimes (Groff, 2008; Groff, Johnson, & Thornton, 2019). In addition, they have

been used to model crime reporting interventions for criminal behaviors focused on the community level (Haque, 2018; Yonas et al., 2013). While this has expanded our understanding of the usability of ABMs, there is a lack of research focused on comparing multiple levels, combinations, and types of interventions. Our model is novel in the application field it used, social media challenges, and its focus on multiple levels of educational interventions, combinations of interventions, and comparison with policy-based intervention. Although interpretation is limited due to the unavailability of certain data, we will evolve the model in the future to be more robust and empirically informed. In addition, the model provides the ability to test the model results in minutes, making it a practical alternative to the much more time-consuming, expensive and resource-consuming traditional methods of testing alternative interventions.

Limitation and Future Work

As with any research study or simulation model, there are a number of limitations we need to mention. This ABM is an early conceptual model that represents abstract dynamic interactions related to social media challenges focused on interactions between children, their peers, schools, and parents. Although this model is partially empirically driven, as noted earlier, there are some limitations related to the unavailability of certain data such as demographics, social networks and the actual effect and cost of varying interventions on the intention to participate. In addition, it is important to make the model more realistic by including the effect of the interaction between adults. For example, parents who knew about a challenge and intervened might inform their neighbors about it. For this reason, we will investigate future versions of the model that integrate actual data

about children and their participation in harmful challenges (e.g. actual population demographics, county boundaries, and participation statistics), types of social media challenges, adults' responses, and intervention costs. Doing so will give us a more accurate representation about the effect of each intervention, in turn assisting decision makers in making more informed decisions on targeting interventions based on cost and the resources available. Future interactions of this model will, therefore, include a baseline for decision-making on targeting interventions for children focused not only on reducing participation in social media challenges but also on reducing any other unwanted behaviors. We will also look into the dynamic of the spread of challenges to determine the appropriate timing of introducing an intervention. Given the current popularity of the social media, more detailed empirically grounded models are needed to model specific levels of participation in the challenges posted on these sites.

Additionally, future directions of this research will seek to investigate the contagion effect of not only social media challenges but also suicide and other means of self-harm. We will test the effect of other social-based policy interventions such as deforming the "social bubbles" of adolescents with suicidal thoughts on reducing the contagion risks of self-harm and suicide. Given the strong correlation between collective and individual diversity, people find themselves inside "social bubbles" when they use social media (Nikolov, Oliveira, Flammini, & Menczer, 2015). This is either due to people's tendency to selectively expose themselves to the opinion of other like-minded individuals (Hart et al., 2009; Kastenmüller, Greitemeyer, Jonas, Fischer, & Frey, 2010) or the effect of the personalized filters (algorithms) implemented by social media platforms, such as

Facebook, to expose the user to posts only by like-minded individuals (Bakshy, Messing, & Adamic, 2015). We believe that deforming the social bubbles of those with suicidal thoughts and expose them to others that are less like-minded will reduce the contagion risks of self-harm and suicide at a societal level. We also believe that doing so will enhance the compliance with the Safe and Effective Messaging Guidelines as the strategy will reduce the vulnerable individuals' exposure to self-harm content and provide them with more help-seeking opportunities (Suicide Prevention Resource Center, 2006).

Conclusion

In this work we showed how ABM might be used to investigate the effect of educational intervention programs to reduce the participation in social media challenges at multiple levels, specifically family, school, and community. In addition, we showed how the effect of these educational-based interventions can be compared to social media-based policy interventions. This model takes into account the word of mouth effect of these interventions, finding that it could either decrease participation in social media challenge further than expected or unintentionally cause others to participate. We suggest that educational interventions at a combined family and school level are the most effective types of intervention in the long run. Future plans include testing the effect of educational interventions on the intention to participate in a quasi-study and incorporating these values into a more sophisticated model that can help inform the design and selection of future interventions programs.

CHAPTER SIX

CONCLUSION

This research collected time-sensitive data to better understand young adults' and adolescents' exposure to viral self-harm online challenges, as well as the determinants of their engagement in such challenges through participating directly in such challenges and/or sharing information online. In an initial study, we investigated the characteristics of YouTube and Twitter posts focusing on the Blue Whale Challenge (BWC) and the features of these posts that make them potentially harmful to vulnerable populations. We found that while most posts on social media attempt to raise awareness about the challenge, they may have unintentionally contributed to self-harm contagion since most violated the Suicide Prevention Resource Center (SPRC) safe messaging guidelines.

Next, this research conducted a systematic study to explore the portrayal of three viral social media-based challenges (i.e. Amyotrophic Lateral Sclerosis (ALS) Ice Bucket Challenge (IBC), Tide Pod Challenge (TPC), and Blue Whale Challenge (BWC)) on YouTube and Twitter and to better understand whether these portrayal patterns are generalizable or unique to a specific challenge through examining publicly provided social media posts. We found that the purpose of posting about an online challenge varies based on the inherent risk involved in the challenge itself. However, previous experience and exposure to the challenges affected the viewers opinion of new challenges.

In a third study, we used a theoretical framework to inform the development of theory-driven intervention efforts to change social media challenge participation intention and behavior. We used the Cinnamon Challenge (CC) to represent challenges with a

harmful impact and ALS IBC to represent positive impact challenges, and we identified the constructs that were critical to the participants' decision to participate in them. In this study, we provided a theoretical model to understand the phenomenon of social media challenges. In addition, we provided information on how the findings from this chapter can be used to develop interventions based on knowledge of how the specific items making up each construct apply specifically to social media (e.g., the desire to get likes and affirmation; the social norms that are portrayed via media, videos, and images).

In a final study, we showed how Agent Based Modeling (ABM) approach might be used to investigate the effect of educational intervention programs to reduce social media challenges participation at multiple levels- family, school, and community. In addition, we showed how the effect of these educational based interventions can be compared to social media-based policy interventions. We suggest that educational interventions at a combined family and school levels is the most efficient type of intervention at the longer run since they target the root of the problem while social media-based policies act as a retrospective solution.

The results of this research suggest two key factors that influence adolescent engagement with the viral social media challenges. They are the portrayal of these challenges on the social media platforms and personal beliefs (attitude and social norms) about them. Hence, allocating more efforts to disseminate and educate the average person on messaging guidelines as well as factors that encourage contagion effects is needed. This can be achieved by developing advanced algorithms and interfaces to highlight information that is safe, accurate, and trustworthy and subsequently providing a link on informational

videos to educate the public on how to identify and respond to unsafe videos. Additionally, adolescents must be educated by their school and/or families on the unwanted consequences and their norms reactions to harmful social media challenges as even a small reduction in their intention to participate leads to a significant reduction in the contagion risks of social media challenges at a societal level.

Limitations and Future Work

The studies reported in this dissertation have limitations. In the first two studies, focusing on the portrayal of the social media challenges on social media platforms, many posts about these challenges are typically private and were not included in the analysis. The third study used only two challenges to represent all other similar challenges which could limit the generalizability of the findings. Lastly, the fourth study has some limitations related to the unavailability of certain data such as: demographics, social networks and the actual effect and cost of varying interventions on the intention to participate in social media challenges.

In this vein, we seek for future versions of the model to be more detailed and empirically grounded to simulate the contagion of not only social media challenges but also suicide and other means of self-harm. Additionally, in the future we will test the effect of other social-based policy interventions including deforming the "social bubbles" of adolescents with suicidal thoughts. We believe that such approach will expose those with suicidal thoughts to others that are less like-minded and subsequently reduce the contagion risks of self-harm and suicide at a societal level.

My Contributions

During my tenure as a doctoral student at Clemson University, I was fortunate to work on multiple research projects and use industrial engineering and human factors approaches in various dominos. In addition to my dissertation research, my applied work covers the entire spectrum of system design: from identifying the user needs, to designing and developing interfaces that inform and motivate user behavior and concluding with empirically evaluating the efficacy of these interventions. For example, I have been involved in research projects where we investigated the sensemaking process of an elderly looking for a new dentist online (Khasawneh et al., 2018; Ponathil, Khasawneh, & Chalil Madathil, 2019), the effect of latency and automation on human-robot interaction (Khasawneh et al., 2019; Rogers, Khasawneh, Bertrand, & Chalil Madathil, 2017; Rogers, Khasawneh, Bertrand & Chalil Madathil, 2019), the sensemaking process of engineers performing windstorm risk survey (Agnisarman et al., 2018), the effectiveness of decision aids on anonymous social media (Ponathil et al., 2017), and patients' perceptions of research consenting methods (Wilson et al., 2019).

Part of my dissertation work has been published as a conference proceeding (Khasawneh et al., 2019) and my goal is to publish the other studies reported in this dissertation in peer-reviewed journals in the future.

APPENDICES

Appendix A. Emergent themes for BWC's YouTube videos in descending order.

Theme	Codes: Description	Percentage (%)
Media Type	**Digital Media:** Slideshows, animations, or videos without people	37%
	Blog/Short Film: Bloggers or short film depicting a victim doing various tasks	35%
	News: News videos, interviews, and chat show panels	23%
	Personal Video: Recorded using personal phones or other personal devices	5%
Purpose of the Video: based on what is mentioned in it	**Inform or Raise Awareness/Warning:** Videos that explained the challenge and how teens were convinced to participate, and provided information about the tasks and the targeted populations	83%
	Sarcastic, Funny, or Prank: Funny videos about the challenge or the video maker sarcastically pretended to participate in the BWC	10%
	Remembering the Victims: Pictured slideshows showing teenagers who allegedly died by playing the game and how	3%
Tone of the Speaker	**Neutral:** Videos did not encourage nor discourage participation or there was no speaker throughout the video	47%
	Negative: Videos expressed sorrow or discouraged people from participating in the challenge	45%
	Positive: Videos encouraged the victims or families of victims	8%
Video Content: media used in the video	**Victims Related:** Included photos before, during, or after self-harm as well as quotes from victims	45%
	Curator: Videos containing pictures or quotes from the curator	15%
	Parents: Contained quotes from or videos of the parents of victims of the BWC	14%

Theme	Codes: Description	Percentage (%)
	Interaction Between Admin and Victim: Mock interactions of how teens are approached to enter the game	11%
Video Topics: topics discussed in the video	**Facts About the Challenge:** Videos discussed how many people have died due to the BWC, who created the BWC, which countries have been affected by it, full descriptions of the tasks, and/or the different names for the game	47%
	Social Media: Videos talked about suicide culture or suicide groups online	25%
	Recommendations: Mentioned some of the interventions by authorities and provided support hotlines as well as recommendations for adults and teens concerning the BWC	22%
Parties Participating in the video: who was involved in the process of making the video	**Anonymous:** Videos had either informants/bloggers, news anchors, or no humans in the video	67%
	Victims Related: Videos included parents of victims, people who saw the victim, or the actual victims themselves	17%
	Specialists: Included psychologists, investigators, or other types of specialists commenting on the BWC	16%

Appendix B. Emergent themes within YouTube comments in descending order.

Theme: Description	Illustrative Quote	Percentage (%)
Criticizing the Game: Comments which disagreed with the game, asked people not to participate, or asked for the game to be banned	*"It seems like every day I find a new thing to hate about social media (sic)."*	22.7%
Sarcastic, Funny, or Prank: Included jokes and sarcastic comments	*"I played this game but I stopped when I was instructed to delete my Minecraft account."*	15.7%
Encouraging the Video/Video Maker: Comments praising the person who posted the video for warning the public about the BWC	*"nice,good,perfect bro!!! (sic)."*	11.1%
Participating: Comments in which users expressed their desire to play the game, agreed with the comments made by the creator of the game, agreed with the game, or asked for links to participate themselves	*"I want to play blue whale game plz give me link (sic)."*	8.6%
Criticizing the Victims: Comments berating those who had played or said they would like to play the game. These comments were often condescending and insensitive to posters who expressed symptoms of depression	*"Your the most sadest human beeing if you kys to 'win the challenge' (sic)."*	8.3%
Expressing Sorrow/Concern: Typically pertained to the victims, the victims' families, or the user's own family and friends	*"My heart started crying watching this."*	8.2%

Theme: Description	Illustrative Quote	Percentage (%)
Personal Experience: Included comments in which users revealed that they had played in the past or were currently playing or that someone they knew was playing the game or had played the game but did or did not survive	*"I already attempted this and I bled and had to go to hospital (sic)."*	7.4%
Intervention/Recommendation: Included a phone number or other information for social support for those affected by the BWC. This code also included encouraging other users to report participation in the BWC to parents or to the authorities	*"Let's do a Get Rich Challenge. We all make each others bank accounts happy, one person is chosen, a bunch of people send them money, and it goes on and on. Something like that. . .someone more intelligent should come up with a formula of some sort that'll work. Let's just send each other money, get rich and help each other grow instead? (sic)."*	5.7%
Criticizing the Video/Video Creator: Contained negative comments about the video quality, content or creator	*"Someone should report these outrageous videos to the authorities."*	5.4%
Other: Related to the BWC but was not summarized by any of the other codes	*"Secret task? That means that they send you something original or what :)) im just courious (sic)."*	4.0%
Encouraging Teens/Parents: The comment praised other teens and encouraged them not to participate or encouraged parents to play a role in their child's safety	*"Love you girl so many people care about you. Depression is a horrible:(stay strong girl!! (sic)."*	3.1%

Appendix C. Emergent themes within Twitter posts in descending order.

Theme: Description	Example	Percentage (%)
Warning/Awareness/Interventions: Warnings about the challenge directed toward parents, teens, the government or the police. This code also included posts that asked for the game and smartphones to be banned and warned against social media use	*"Parents, you need to know about the deadly Blue Whale Challenge."*	34.0%
Information about the Challenge: Posts about the targeted population, the curators, victims, and/or an estimated number of deaths	*"Blue Whale Challenge: Creator Budeikin has aides to help him in his absence."*	31.3%
Sarcastic/Funny/Jokes: Posts that made fun of the challenge or the people who participated in it	*"Engineer downloads Blue whale game: Sorry! But no professionals allowed. *Uninstalls itself* (sic)."*	16.0%
Opinion: Either someone voicing their thoughts about the BWC or calling on others to respond to their comment	*"Apex of misuse of psychology. The blue whale game would have been better if that game maker stressed on social welfare."*	13.3%
Mental Health: Informing others about depression and suicidal thoughts among teens	*"The Blue Whale Challenge: What is the psychology behind it?"*	3.3%
Personal Experience: Posts in which the users expressed either their own experiences with the BWC or the experiences of someone they knew	*"We just had a meeting here at work and this lady told us that her 10-year-old niece committed suicide because of this other Blue Whale Challenge (sic)."*	0.7%
Other: Related to the BWC but did not fit under any of the other codes	*"Understanding BLUE WHALE CHALLENGE can tell us how to deal with TERRORISM. (sic)."*	0.7%

Miscellaneous: Posts that had nothing with the BWC	0.7%

Appendix D. YouTube videos codebook.

Major code	Subcategory	Description		
		BWC	TPC	ALS IBC
Media Type	Digital Media	Videos without people (slideshows or animations).		
	Blog/Short Film	Blogger (presenter) discussing a topic or a short film depicting a victim doing various tasks.		
	News	Videos including clips from the news, interviews, and chat show panels.		
	Personal Video	Videos taken using personal devices.		
Purpose of the Video	Inform or Raise Awareness	Videos explaining the challenge, the methods for convincing teens to participate, descriptions of the tasks in the challenge, discussions about the targeted populations, or letting the public know about the challenge OR Videos discussing the success of the challenge and explaining ALS and how to donate.		
	Sarcastic, Funny, or Prank	Funny or sarcastic videos about the challenge.		
	Remembering the Victims	Videos showing pictures of the challenge's victims and how they died (mainly for BWC).		
Video Content	Participation	Quotes or pictures of the victims before, during, or after self-harm.	Videos contained clips of youth participating in the challenge, see Figure 4 in Appendix G.	Videos of individuals accepting, participating, and inviting others to participate in the challenge, see Figure 7 in Appendix G.
	Curator	Quotes or pictures of the curator, see Figure 1 in Appendix G.	N/A	N/A
	Parents	Quotes or pictures of the victims' parents and families, see Figure 2 in Appendix G.	N/A	N/A

Major code	Subcategory	Description		
		BWC	TPC	ALS IBC
	Interaction Between Admin and Victim	Mock interactions of how teens are approached to enter the game, see Figure 3 in Appendix G.	Videos included a person pretending to eat Tide Pods, see Figure 5 in Appendix G.	Individuals taking the challenge differently (e.g. pouring something else instead of water on their head) or fake participation, see Figure 8 in Appendix G.
	Different Ways to Convey Information	N/A	Videos suggested other uses of Tide Pods, such as doing laundry, shredding them in a paper shredder or putting them in a car engine, see Figure 6 in Appendix G.	Videos comprising a combination of several clips of individuals completing the challenge.
	Famous Person	N/A	Videos including a celebrity asking teens not to accept this challenge.	Videos of celebrities, athletes, or bloggers with more than 100,000 followers completing the challenge.
Video Topics	Facts About the Challenge	Videos mentioning the number of people who have died due to BWC, who created it, what counties have been affected by it, descriptions of the tasks, and the various names for BWC.	Videos that talked about the origin of the challenge, how many poisoning cases have been reported, or how many people have died due to eating Tide Pods.	N/A

Major code	Subcategory	Description		
		BWC	TPC	ALS IBC
	Contribution to the Spread	Videos blamed the social media and discussed suicide cultures and online suicide groups.	Videos that blamed the spread of this challenge on the news, media, parents, or teens.	Individuals who encouraged others to take the challenge or Individuals who encouraged others to donate to ALS.
	Recommendations	Videos discussing intervention by authorities and providing support hotlines for teens with suicidal thoughts and recommendations and advice for teens and parents concerning BWC.	Videos providing recommendations or advice to the Tide manufacturer, parents. authorities, media, or teens.	N/A
	Consequences of the Challenge	N/A	Videos discussing how swallowing Tide Pods will affect your body and explaining Tide Pods' ingredients	N/A
Reasons for Participating (according to the video maker)	Popularity, Views, or Likes	N/A	Videos mentioning that teens participate in the challenge for social media fame	
	Look Tasty	N/A	Videos mentioning that the appearance of Tide Pods is why teens are eating them	N/A

Major code	Subcategory	Description		
		BWC	TPC	ALS IBC
	Peer Pressure	N/A	Individuals who mentioned that they took the challenge due to peer pressure	
	The Cause	N/A	N/A	Individuals who took the challenge for the good cause
	Curiosity	N/A	Videos saying that teens are eating Tide Pods because they are curious about what will happen.	N/A
	Mental health issues	videos included a specialist such as a psychologists, investigators, or other type of specialists commenting on BWC	N/A	N/A

Appendix E. YouTube comments codebook.

Code	BWC		TPC		ALS IBC	
	Description	Example	Description	Example	Description	Example
Criticizing the Challenge	Comments criticized the curator (the creator of the game), disagreed with the game either by asking people not to participate or by asking that the game be banned, or blamed social media for the spread of the challenge.	*"It seems like everyday I find a new thing to hate about social media (sic)"*	N/A	N/A	N/A	N/A
Sarcastic, Funny, or Prank	Includes jokes and sarcastic comments.	*"I played this game but I stopped when I was instructed to delete my Minecraft account"*	Comments that made fun of participants or suggested laughing at the video content.	*"I recommend eating them in cupcake form, savour the flavour (sic)"*	Comments that made fun of or laughed at the people in the video.	*"lol the girl at 4:22 sounds like a bird 😂 (sic)"*

Code	BWC		TPC		ALS IBC	
	Description	Example	Description	Example	Description	Example
Encouraging the Video/Video Maker	Includes those praising the person who posted the video or applauding the video for warning the public about the BWC.	*"nice,good,perfect bro!!! (sic)"*	Any positive or negative comment about the video or the video maker.	*"Love you I like your videos and sorry for saying I love you (sic)"*	Comments admiring a person for participating in the challenge, showed interested in participating in the challenge, or saying something positive about the challenge.	*"Bro, I can see the passion in your eyes. you make a difference with this. I have known what ALS is and it's effects but hearing/seeing you talk about it with first-hand experience shows me just how much damage it can do. Be strong man, and know this video spread a strong message to me*

Code	BWC		TPC		ALS IBC	
	Description	Example	Description	Example	Description	Example
						and I am sure to others. (sic)"
Participating	Comments about the user's intention for playing the game, and those asking for links to participate and/or agreeing with the curator quotes about cleaning the society of people with mental health issues.	*"I want to play blue whale game plz give me link (sic)"*	N/A	N/A	Comments that primarily focused on asking other people to perform the challenge.	*"Johnny depp? Has no one nominated him yet 😡😡 (sic)"*
Criticizing the Victims	Comments scolding those who played the game.	*"Your the most sadest human beeing if you kys to 'win the challenge'(sic)"*	Comments criticizing parents, teenagers, TPC, social media, or people in general.	*"What the hell is this world coming to!?? The Devil is Here on earth!! Sad (sic)"*	Negative comments either about the people in the video or about the challenge, comments primarily criticizing the participants for engaging in the challenge for social	*"how does pouring an ice bucket over yourself gain money?"*

Code	BWC		TPC		ALS IBC	
	Description	Example	Description	Example	Description	Example
					media fame or saying they should donate money instead of wasting water.	
Expressing Sorrow/Concern	Comments pertaining to the victims, their families, and their friends.	*"My heart started crying watching this"*	N/A	N/A	Comments that showed concern about participants who were hurt while doing the challenge.	*"An amazing man with a huge heart, prayers are with him and his family. 😢 (sic)"*
Personal Experience	Users talking about their experiences playing the game or the experiences of someone they knew who had played the game.	*"I already attempted this and I bled and had to go to hospital (sic)"*	Any personal or acquaintance experience with TPC (normally a negative experience).	*"Just challenge has gotten so bad my school sent home a letter about it. like why is this even a trend? (sic)"*	Any negative or positive comment about an experience with the challenge.	*"I'm going to do the als ice bucket challenge in this 2017 (sic)"*
Intervention/	Comments providing some form of social	*"Let's do a Get Rich Challenge.*	Comments that advised parents to	*"LIFE HACK! You*	N/A	N/A

Code	BWC		TPC		ALS IBC	
	Description	Example	Description	Example	Description	Example
Recommendation	support for those with mental health issues such as hotlines or comments that encouraged others to report any participation in the BWC to the authorities.	*We all make each others bank accounts happy, one person is chosen, a bunch of people send them money, and it goes on and on. Something like that....someone more intelligent should come up with a formula of some sort that'll work. Let's just send each other money, get rich and help each other grow instead? (sic)"*	pay more attention to their children's safety.	*can use tide pods to wash clothes (sic)"*		

Code	BWC		TPC		ALS IBC	
	Description	Example	Description	Example	Description	Example
Criticizing the Video/Video Maker	Includes negative comments about the video content or the video maker.	*"Someone should report these outrageous videos to the authorities."*	N/A	N/A	N/A	N/A
Encouraging Teens/Parents	Comments praising teens with mental health issues and encouraging them not to participate or emphasizing the parents' role in their children's safety.	*"Love you girl so many people care about you. Depression is a horrible :(stay strong girl!! (sic)"*	N/A	N/A	N/A	N/A

Appendix F. Twitter posts codebook.

Code	BWC		TPC		**ALS IBC**	
	Description	Example	Description	Example	Description	Example
Opinion or Criticizing	Posts expressing a personal opinion about the challenge or posts asking for other peoples' opinions of the challenge.	*"Apex of misuse of psychology. The blue whale game. Would have been better if that game maker stressed on social welfare."*	Posts from people criticizing the teens who participate in the challenge, social media, or parents.	*"an actual challenge for people to eat a pod with detergent in it. If you partake in this challenge, you are an idiot, and you deserve every bit of what coming to you"*	Posts that disagreed with the game, mentioned that it wastes water, and suggested people should donate money without doing the challenge.	*"Did You Fall for the Ice Bucket Challenge? What We All Should Consider"*
Sarcastic/Funny/Jokes	Posts making fun of the challenge or the people who	*Engineer downloads Blue whale game: Sorry! But no professionals*	Posts that made fun of the challenge or participants.	*"Please tell me it's Trump voters taking the tide pod challenge.*	N/A	N/A

Code	BWC		TPC		**ALS IBC**	
	Description	Example	Description	Example	Description	Example
	participated in it.	*allowed. *Uninstalls itself* (sic)"*		*That would make so much sense, and have fringe benefits"*		
Warning/Awareness or Information About the Challenge	Posts with content primarily directed toward parents, teens, or authorities to warn them about the challenge.	*Parents, you need to know about the deadly Blue Whale Challenge."*	Posts that warned parents about the challenge by providing information on what the teens were doing or how many cases had been reported to the Center for Poison Control due to participation in the challenge.	*"The viral trend on social media, the Tide Pod Challenge, has driven teenagers to biting into (sometimes eating) these poisonous little pods"*	Posts providing information about the purpose of the challenge and how many have participated in it.	*"donors whining that throwing money at problem didn't fix it"*
Recommendation or Encouragement	N/A	*N/A*	Post recommending	*"Hey teenagers,*	Posts encouraging	*"@CharlieBakerMA Just signed the "Ice*

Code	BWC		TPC		**ALS IBC**	
	Description	Example	Description	Example	Description	Example
			that parents pay more attention to their children's safety or that they have their teens to do laundry instead of eating the Tide Pods.	*here's the REAL #Tide pod challenge: put it in the washing machine and do your OWN laundry!!!"*	people to participate in the challenge or saying positive comments about the person who created it.	*Bucket Challenge" bill honoring @PeteFrates3 and his family for their incredible work on ALS"*
Personal Experience	Posts in which someone describes his/her or an acquaintance's experience with BWC.	*"We just had a meeting here at work and this lady told us that her 10 year old niece committed suicide because of this other Blue Whale Challenge."*	Posts from people who participated or knew someone who participated in the challenge.	*"A third teenager in the Phoenix area has been sickened by taking part in the Tide Pod Challenge"*	N/A	*N/A*

Code	BWC		TPC		**ALS IBC**	
	Description	Example	Description	Example	Description	Example
Mental Health or Negative/Positive Outcomes	Posts saying participation in the BWC is due to depression and suicidal thoughts.	*"The Blue Whale Challenge: What is the psychology behind it?"*	Posts that explained the side effects of eating Tide Pods, including the health consequences.	*"Just heard on the radio about the Tide Pod challenge...this is insane! My heart goes out to all the young people who think this is funny & a great way to get attention! The only thing is going to get you is a trip to the ER or worse an early grave!"*	Information about how much money the challenge has raised and the new research it has funded.	*"Ice Bucket Challenge anniversary celebrates gene discovery"*

Appendix G. Chapter 3 figures.

Figure 1. Content about the curator of BWC.

Figure 02. Content about the BWC victims' families.

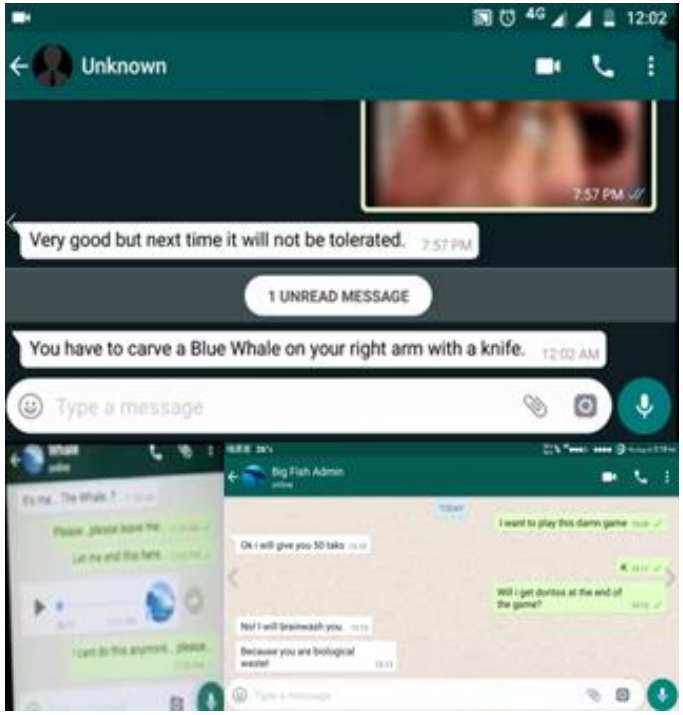

Figure 3. Content about interaction between admin and victim.

Figure 4. Content about participation in TPC.

Figure 5. Content about mimic participation in TPC.

Figure 6. Content about different ways to convey information about TPC.

Figure 7. Content about participation in ALS IBC.

Figure 8. Content about mimic participation in ALS IBC.

Appendix H. Items used to measure research constructs.

Construct	Sub-construct	Items	Scale
Attitude	Experiential attitude	Participating in the Cinnamon Challenge is enjoyable.	Strongly disagree-strongly agree; scored 1 to 7
		Participating in the Cinnamon Challenge makes you feel more confident.	Strongly disagree-strongly agree; scored 1 to 7
		Participating in the Cinnamon Challenge make you feel more pleasant.	Strongly disagree-strongly agree; scored 1 to 7
		Participating in the Cinnamon Challenge is for a good cause.	Strongly disagree-strongly agree; scored 1 to 7
	Vale of experiential attitude	When you are challenged by someone, enjoyment is important to you.	Extremely important-extremely unimportant; scored 1 to 7
		When you are challenged by someone, feeling confident is important to you.	Extremely important-extremely unimportant; scored 1 to 7
		When you are challenged by someone, feeling pleasant is important to you.	Extremely important-extremely unimportant; scored 1 to 7
		Doing an online challenge for a good cause is important to you.	Extremely important-extremely unimportant; scored 1 to 7
	Instrumental attitude	Participating in the Cinnamon Challenge would get you more views than what you normally get on your posts on social media.	Strongly disagree-strongly agree; scored 1 to 7
		Participating the Cinnamon Challenge would get you more likes than what you normally get on your posts on social media.	Strongly disagree-strongly agree; scored 1 to 7
	Value of instrumental attitude	Getting views on your social media posts is important to you.	Extremely important-extremely unimportant; scored 1 to 7

Construct	Sub-construct	Items	Scale
		Getting likes on your social media posts is important to you.	Extremely important-extremely unimportant; scored 1 to 7
Perceived norm	Injunctive	Most people would approve of you participating in the Cinnamon Challenge.	Strongly disagree-strongly agree; scored 1 to 7
		Your family would approve of you participating in the Cinnamon Challenge.	Strongly disagree-strongly agree; scored 1 to 7
		Your best friend would approve of you participating in the Cinnamon Challenge.	Strongly disagree-strongly agree; scored 1 to 7
		Your significant other would approve of you participating in the Cinnamon Challenge.	Strongly disagree-strongly agree; scored 1 to 7
		Your role model would approve of you participating in the Cinnamon Challenge.	Strongly disagree-strongly agree; scored 1 to 7
		Your friends on social media would approve of you participating in the Cinnamon Challenge.	Strongly disagree-strongly agree; scored 1 to 7
	Descriptive	Most people would participate in the Cinnamon Challenge.	Strongly disagree-strongly agree; scored 1 to 7
		Your family would participate in the Cinnamon Challenge.	Strongly disagree-strongly agree; scored 1 to 7
		Your best friend would participate in the Cinnamon Challenge.	Strongly disagree-strongly agree; scored 1 to 7
		Your significant other would participate in the Cinnamon Challenge.	Strongly disagree-strongly agree; scored 1 to 7
		Your role model would participate in the Cinnamon Challenge.	Strongly disagree-strongly agree; scored 1 to 7

Construct	Sub-construct	Items	Scale
		Your social media friends would participate in the Cinnamon Challenge.	Strongly disagree-strongly agree; scored 1 to 7
		Celebrities would participate in the Cinnamon Challenge.	Strongly disagree-strongly agree; scored 1 to 7
	Motivation to comply	You are willing to do what most people think is right.	Extremely likely-extremely unlikely; scored 1 to 7
		You are willing to do what your best friends think is right.	Extremely likely-extremely unlikely; scored 1 to 7
		You are willing to do what your family thinks is right.	Extremely likely-extremely unlikely; scored 1 to 7
		You are willing to do what your significant other thinks is right.	Extremely likely-extremely
		You are willing to do what your role model thinks is right.	unlikely; scored 1 to 7
		You are willing to do what your friends on social media think is right.	Extremely likely-extremely unlikely; scored 1 to 7
		You are willing to do what celebrities think is right.	Extremely likely-extremely unlikely; scored 1 to 7
Personal agency	Perceived control	Participating in the Cinnamon Challenge is easy.	Strongly disagree-strongly agree; scored 1 to 7
		The Cinnamon Challenge is doable.	Strongly disagree-strongly agree; scored 1 to 7
		Getting the tools and materials needed to participate in the Cinnamon Challenge is easy.	Strongly disagree-strongly agree; scored 1 to 7
		Going to a location where you can do the Cinnamon Challenge is easy.	Strongly disagree-strongly agree; scored 1 to 7

Construct	Sub-construct	Items	Scale
		Having the tools and materials needed for the Cinnamon Challenge is important.	Strongly disagree-strongly agree; scored 1 to 7
		Finding a location to do the Cinnamon Challenge is important.	Strongly disagree-strongly agree; scored 1 to 7
	Self-efficacy	Participating in the Cinnamon Challenge is under your control.	Strongly disagree-strongly agree; scored 1 to 7
		You would face barriers participating in the Cinnamon Challenge.	Strongly disagree-strongly agree; scored 1 to 7
		How certain are you that you can perform the Cinnamon Challenge?	Extremely certain-extremely uncertain; scored 1 to 7
		How confident are you that you have everything needed to perform the Cinnamon Challenge?	Extremely confident-extremely not confident; scored 1 to 7

Appendix I. Individual differences survey.

Trauma history (happened to me, witnessed it, learned about it, part of my job, not sure, doesn't apply)

1. Natural disaster (for example, flood, hurricane, tornado, earthquake)
2. Fire or explosion
3. Transportation accident (for example, car accident, boat accident, train wreck, plane crash)
4. Serious accident at work, home, or during recreational activity
5. Exposure to toxic substances (for example, dangerous chemicals, radiation)
6. Physical assault (for example, being attacked, hit, slapped, kicked, beaten up)
7. Assault with a weapon (for example, being shot, stabbed, threatened with a knife, gun, bomb)
8. Sexual assault (rape, attempted rape, made to perform any type of sexual act through force or threat of harm)
9. Other unwanted or uncomfortable sexual experience
10. Comat or exposure to a war-zone (in the military or as a civilian)
11. Captivity (for example, being kidnapped, abducted, held hostage, prisoner of war)
12. Life-threatening illness for injury
13. Severe human suffering
14. Sudden violent death (for example, homicide, suicide)
15. Sudden accidental death
16. Serious injury, harm, or death you caused to someone else
17. Any other very stressful event or experience

Sensation seeking (7-point scale)

1. I would like to explore strange places
2. I would like to take off on a trip with no pre-planned routes or timetables
3. I get restless when I spend too much time at home
4. I prefer friends who are excitingly unpredictable
5. I like to do frightening things
6. I would like to try bungee jumping
7. I like wild parties
8. I would love to have new and exciting experiences, even if they are illegal

Impulsivity (7-point scale)

1. Planning takes the fun out of things.
2. I get into trouble because I do things without thinking.
3. I put down the first answer that comes into my head on a test, and often forget to check it later.
4. I get involved in things that I later wish I could get out of.
5. I sometimes break rules because I do things without thinking.

6. I get so excited about doing new things that I forget to think about problems that might happen.

Risk taking personality (7-point scale)

1. Love dangerous situations.
2. Like to do frightening things.
3. Get a thrill out of doing things that might kill me.
4. Would do anything to get an adrenaline rush
5. Prefer safety over risk.

Social anxiety (7-point scale)

1. I feel relaxed even in unfamiliar social situations
2. I try to avoid situations which force me to be very sociable
3. It is easy for me to relax when I am with strangers
4. I have no particular desire to avoid people
5. I often find social occasions upsetting
6. I usually feel calm and comfortable at social occasions
7. I am usually at ease when talking to someone of the opposite sex
8. I try to avoid talking to people unless I know them well
9. If the chance comes to meet new people, I often take it
10. I often feel nervous or tense in casual get-togethers in which both sexes are present
11. I am usually nervous with people unless I know them well
12. I usually feel relaxed when I am with a group of people
13. I often want to get away from the people
14. I usually feel uncomfortable when I am in a group of people I don't know
15. I usually feel relaxed when I meet someone for the first time
16. Being introduced to people makes me tense and nervous
17. Even though a room full of strangers, I may enter it anyway
18. I would avoid walking up and joining a large group of people
19. When my superiors want to talk with me, I talk willingly
20. I often feel on edge when I am with a group of people
21. I tend to withdraw from people
22. I don't mind talking to people at parties or social gatherings
23. I am seldom at ease in a large group of people
24. I often think up excuses in order to avoid social engagements
25. I sometimes take the responsibility for introducing people to each other
26. I try to avoid formal social occasions
27. I usually go to whatever social engagements I have
28. I find it easy to relax with other people

Emotion regulation (7-point scale)

1. When I'm upset, I feel guilty for feeling that way
2. When I'm upset, I feel ashamed with myself for feeling that way
3. When I'm upset, I become embarrassed for feeling that way

4. When I'm upset, I become angry with myself for feeling that way
5. When I'm upset, I become irritated with myself for feeling that way
6. I have difficulty making sense out of my feelings
7. I have no idea how I am feeling
8. I am confused about how I feel
9. I know exactly how I am feeling
10. I am clear about my feelings
11. When I'm upset, I lose control over my behaviors
12. When I'm upset, I have difficulty controlling my behaviors
13. When I'm upset, I become out of control
14. When I'm upset, I feel out of control
15. I experience my emotions as overwhelming and out of control

Depression (not at all, several days, more than half the days, nearly every day)

1. Little interest or pleasure in doing things
2. Feeling down, depressed, or hopeless
3. Trouble falling or staying asleep, or sleeping too much
4. Feeling tired or having little energy
5. Poor appetite or overeating
6. Feeling bad about yourself- or that you are a failure or have let yourself or your family down
7. Trouble concentrating on things, such as reading the newspaper or watching television
8. Moving or speaking so slowly that other people could have noticed? Or the opposite- being so fidgety or restless that you have been moving around a lot more than usual
9. Thoughts that you would be better off dead or hurting yourself in some way
10. If you checked off any problems, how difficult have these problems made it for you to do your work, take care of things at home, or get along with other people? (not difficult at all, somewhat difficult, very difficult, extremely difficult)

Social support (7-point scale)

When you are feeling down or in a difficult situation . . .

1. My friends/family really try to help me
2. I can count on my friends/family when things go wrong
3. I have friends/family with whom I can share my joys and sorrows
4. I can talk about my problems with my friends/family

Self-esteem (7-point scale)

1. On the whole, I am satisfied with myself
2. I take a positive attitude toward myself
3. I can handle the "ups" and "downs" in life quite well
4. In my relationships to others, I act self-confidently
5. I think that nobody really understands me
6. I have the impression that teachers and classmates treat me like an outsider

7. I have the impression that behind my back teachers and classmates talk dismissively about me
8. I have the impression that many schoolmates tend to avoid contact with me
9. I certainly feel useless at times
10. Oftentimes, I feel unhappy.

Deliberate self-harm inventory (7-point scale)

1. Have urges to cut myself
2. Have thoughts of injuring myself
3. Feel that cutting myself helps me feel better
4. Frequently have thoughts about killing myself
5. Have written a suicide note
6. I have intentionally done myself physical harm
7. I have no will to live

Appendix J. Mean and standard deviation of motivation to comply to different relationship type in descending order.

Relationship type	Mean	Standard deviation
Family	5.01	1.78
Role model	4.71	1.79
Significant other	4.65	1.61
Most people	4.49	1.90
Best friend	4.25	1.83
Friends	3.82	1.88
Celebrities	3.56	1.93

REFERENCES

Abu-El-Haija, S., Kothari, N., Lee, J., Natsev, P., Toderici, G., Varadarajan, B., & Vijayanarasimhan, S. (2016). Youtube-8m: A large-scale video classification benchmark. *arXiv preprint arXiv:1609.08675*.

Agnisarman, S., Khasawneh, A., Ponathil, A., Lopes, S., & Madathil, K. C. (2018). A qualitative study investigating the sensemaking process of engineers performing windstorm risk surveys. In *Proceedings of the Human Factors and Ergonomics Society Annual Meeting* (Vol. 62, No. 1, pp. 1776-1776). Sage CA: Los Angeles, CA: SAGE Publications.

Agnisarman, S., Ponathil, A., Lopes, S., & Chalil Madathil, K. (2018). An investigation of consumer's choice of a healthcare facility when user-generated anecdotal information is integrated into healthcare public reports. *International Journal of Industrial Ergonomics*, *66*, 206–220.

Ajzen, I. (2011). The theory of planned behavior: Reactions and reflections. *Psychology and Health, 26*, 1113–1127.

Albarracín, D., Johnson, B. T., Fishbein, M., & Muellerleile, P. A. (2001). Theories of reasoned action and planned behavior as models of condom use: a meta-analysis. *Psychological Bulletin*, *127*(1), 142–161.

AlMaian, R. Y., Needy, K. L., Walsh, K. D., & Alves, T. D. C. (2015). A qualitative data analysis for supplier quality-management practices for engineer-procure-construct projects. *Journal of Construction Engineering and Management*, *142*(2), 04015061.

AnyLogic (2019). Simulation modeling software tools & solutions for business. Retrieved November 13, 2019, from AnyLogic website: https://www.anylogic.com/

Arendt, F., Scherr, S., Till, B., Prinzellner, Y., Hines, K., & Niederkrotenthaler, T. (2017). Suicide on TV: minimising the risk to vulnerable viewers. *BMJ*, *358*, j3876.

Ash, T., Agaronov, A., Young, T., Aftosmes-Tobio, A., & Davison, K. K. (2017). Family-based childhood obesity prevention interventions: a systematic review and quantitative content analysis. *The International Journal of Behavioral Nutrition and Physical Activity*, *14*(1), 113.

ATLAS.ti (2019). The qualitative data analysis & research software. Retrieved November 6, 2019, from ATLAS.ti website: https://atlasti.com/

Avery, A. H., Rae, L., Summitt, J. B., & Kahn, S. A. (2016). The fire challenge: a case report and analysis of self-inflicted flame injury posted on social media. *Journal of Burn Care & Research*, *37*(2), e161-e165.

Ayers, J. W., Althouse, B. M., Leas, E. C., Dredze, M., & Allem, J. P. (2017). Internet searches for suicide following the release of 13 Reasons Why. *JAMA internal medicine*, *177*(10), 1527-1529.

Baker, D. A., & Algorta, G. P. (2016). The relationship between online social networking and depression: a systematic review of quantitative studies. *Cyberpsychology, Behavior, and Social Networking*, *19*(11), 638-648.

Baker, R. K., & White, K. M. (2010). Predicting adolescents' use of social networking sites from an extended theory of planned behaviour perspective. *Computers in Human Behavior*, *26*(6), 1591–1597.

Bakshy, E., Messing, S., & Adamic, L. A. (2015). Exposure to ideologically diverse news and opinion on Facebook. *Science*, *348*(6239), 1130–1132.

Baldessarini, R. J., Tondo, L., & Hennen, J. (1999). Effects of lithium treatment and its discontinuation on suicidal behavior in bipolar manic-depressive disorders. *The Journal of clinical psychiatry*, *60*, 77-84.

Bastable, S. B. (2017). *Nurse as Educator: Principles of Teaching and Learning for Nursing Practice*. Jones & Bartlett Learning.

Bearden, W. O., & Etzel, M. J. (1982). Reference group influence on product and brand purchase decisions. *Journal of consumer research*, *9*(2), 183-194.

Berrouiguet, S., Larsen, M. E., Mesmeur, C., Gravey, M., Billot, R., Walter, M., … Lenca, P. (2018). Toward mHealth brief contact interventions in suicide prevention: case series from the Suicide Intervention Assisted by Messages (SIAM) randomized controlled trial. *JMIR mHealth and uHealth*, *6*(1), e8.

Berry, N., Bucci, S., & Lobban, F. (2017). Use of the internet and mobile phones for self-management of severe mental health problems: qualitative study of staff views. *JMIR mental health*, *4*(4), e52.

Bjerke, M. B., & Renger, R. (2017). Being smart about writing SMART objectives. *Evaluation and Program Planning*, *61*, 125–127.

Blackwell, L., Hardy, J., Ammari, T., Veinot, T., Lampe, C., & Schoenebeck, S. (2016). LGBT parents and social media: Advocacy, privacy, and disclosure during shifting social movements. In *Proceedings of the 2016 CHI conference on human factors in computing systems* (pp. 610-622). ACM.

Bobo, J. W. (2007). Following the trend: Alabama abandons the duty to retreat and encourages citizens to stand their ground. *Cumb. L. Rev.*, *38*, 339.

Bond, L., Glover, S., Godfrey, C., Butler, H., & Patton, G. C. (2001). Building capacity for system-level change in schools: lessons from the Gatehouse Project. *Health Education & Behavior*, *28*(3), 368-383.

Boyd, D. (2015). *It's Complicated: The Social Lives of Networked Teens*. Yale University Press.

Boyd, D., & Ellison, N. (2010). Social network sites: definition, history, and scholarship. *IEEE Engineering Management Review*, *3*(38), 16–31.

Bright, S. J., & Williams, C. M. (2017). Development of Australia's first older adult-specific early intervention for alcohol-related harm: Feasibility and proof of concept. *Australasian Journal on Ageing*, *36*(1), 52–55.

Brody, N., & Vangelisti, A. L. (2016). Bystander intervention in cyberbullying. *Communication Monographs*, *83*(1), 94-119.

Bromberg, J. E., Augustson, E. M., & Backinger, C. L. (2011). Portrayal of smokeless tobacco in YouTube videos. *Nicotine & Tobacco Research*, *14*(4), 455-462.

Burke, D. S., Epstein, J. M., Cummings, D. A., Parker, J. I., Cline, K. C., Singa, R. M., & Chakravarty, S. (2006). Individual-based computational modeling of smallpox epidemic control strategies. *Academic Emergency Medicine*, *13*(11), 1142-1149.

Canning, E. A., & Harackiewicz, J. M. (2015). Teach it, don't preach it: The differential effects of directly-communicated and self-generated utility–value information. *Motivation Science*, *1*(1), 47–71.

Chalil Madathil, K., Greenstein, J. S., Juang, K. A., Neyens, D. M., & Gramopadhye, A. K. (2013). An investigation of the informational needs of ovarian cancer patients and their supporters. In *Proceedings of the Human Factors and Ergonomics Society Annual Meeting* (Vol. 57, No. 1, pp. 748-752). Sage CA: Los Angeles, CA: SAGE Publications.

Chalil Madathil, K., Rivera-Rodriguez, A. J., Greenstein, J. S., & Gramopadhye, A. K. (2015). Healthcare information on YouTube: A systematic review. *Health Informatics Journal*, *21*(3), 173–194.

Chambers, D. A., Pearson, J. L., Lubell, K., Brandon, S., O'brien, K., & Zinn, J. (2005). The science of public messages for suicide prevention: a workshop summary. *Suicide & Life-Threatening Behavior*, *35*(2), 134–145.

Chang, K. K., & Freedman, E. (2018). WHO's media guidelines in the press and in public perception. *Journal of Media Ethics*, *33*(1), 14–25.

Cheng, Q., Li, H., Silenzio, V., & Caine, E. D. (2014). Suicide contagion: a systematic review of definitions and research utility. *PloS One*, *9*(9), e108724.

Chica, M., & Rand, W. (2017). Building agent-based decision support systems for word-of-mouth programs: a freemium application. *Journal of Marketing Research*, *54*(5), 752-767.

Chopik, W. J. (2016). The benefits of social technology use among older adults are mediated by reduced loneliness. *Cyberpsychology, Behavior, and Social Networking*, *19*(9), 551-556.

Christakis, N. A., & Fowler, J. H. (2013). Social contagion theory: examining dynamic social networks and human behavior. *Statistics in Medicine*, *32*(4), 556–577.

Cialdini, R. B. (2003). Crafting normative messages to protect the environment. *Current Directions in Psychological Science*, *12*(4), 105–109.

Close, J. P., & Ham, J. (2016). Persuasive Communication. In J. P. Close (Ed.), *AiREAS: Sustainocracy for a Healthy City: Phase 3: Civilian Participation – Including the Global Health Deal Proposition*. Cham (CH): Springer.

Cohen, G. L. (2003). Party over policy: The dominating impact of group influence on political beliefs. *Journal of Personality and Social Psychology*, *85*(5), 808–822.

Cohen, P., West, S. G., & Aiken, L. S. (2014). *Applied multiple regression/correlation analysis for the behavioral sciences*. Psychology Press.

Coker, A. L., Bush, H. M., Fisher, B. S., Swan, S. C., Williams, C. M., Clear, E. R., & DeGue, S. (2016). Multi-college bystander intervention evaluation for violence prevention. *American journal of preventive medicine*, *50*(3), 295-302.

Coleman, L. (2004). *The copycat effect: How the media and popular culture trigger the mayhem in tomorrow's headlines*. Simon and Schuster.

Cooper Jr, M. T., Bard, D., Wallace, R., Gillaspy, S., & Deleon, S. (2018). Suicide attempt admissions from a single children's hospital before and after the introduction of Netflix series 13 Reasons Why. *Journal of Adolescent Health*, *63*(6), 688-693.

Coviello, L., Sohn, Y., Kramer, A. D. I., Marlow, C., Franceschetti, M., Christakis, N. A., & Fowler, J. H. (2014). Detecting emotional contagion in massive social networks. *PloS One*, *9*(3), e90315.

Covington, P., Adams, J., & Sargin, E. (2016). Deep neural networks for YouTube recommendations. In *Proceedings of the 10th ACM conference on recommender systems* (pp. 191-198). ACM.

Deklotz, C. M., & Krakowski, A. C. (2013). The eraser challenge among school-age children. *The Journal of clinical and aesthetic dermatology*, *6*(12), 45.

Dietz, L. J. (2017). Family-based interventions for childhood depression. *Journal of the American Academy of Child & Adolescent Psychiatry*, *56*(6), 464-465.

Dobele, A., Lindgreen, A., Beverland, M., Vanhamme, J., & Van Wijk, R. (2007). Why pass on viral messages? Because they connect emotionally. *Business Horizons*, *50*(4), 291-304.

Dray, A., Mazerolle, L., Perez, P., & Ritter, A. (2008). Drug law enforcement in an agent-based model: simulating the disruption to street-level drug markets. In *Artificial crime analysis systems: using computer simulations and geographic information systems* (pp. 352-371). IGI Global.

Ducharme, J. (2018). Tide is telling people to call poison control after doing the Tide Pod challenge. Retrieved November 24, 2019 from Time website: https://time.com/5108478/tide-pod-challenge-poison-control/

Dyson, M. P., Hartling, L., Shulhan, J., Chisholm, A., Milne, A., Sundar, P., ... & Newton, A. S. (2016). A systematic review of social media use to discuss and view deliberate self-harm acts. *PloS one*, *11*(5), e0155813.

Azar, E., & Menassa, C. C. (2013). Framework to evaluate energy-saving potential from occupancy interventions in typical commercial buildings in the United States. *Journal of Computing in Civil Engineering*, *28*(1), 63-78.

Epstein, J. M. (2002). Modeling civil violence: An agent-based computational approach. *Proceedings of the National Academy of Sciences*, *99*(3), 7243-7250.

Erekat, A., Al-Shaebi, A., Alhaider, A., Khasawneh, M., & Khasawneh, A. (2017). Optimizing outpatient access center staffing using discrete event simulation: A case study. In *IIE Annual Conference. Proceedings* (pp. 1918-1924). Institute of Industrial and Systems Engineers (IISE).

Fekete, S., & Macsai, E. (1990). Hungarian suicide models, past and present. *Suicidal Behavior and Risk Factors*, 149–156.

Fekete, S., & Schmidtke, A. (1995). The impact of mass media reports on suicide and attitudes toward self-destruction: Previous studies and some new data from Hungary and Germany. In B. L. Mishara (Ed.), *The impact of suicide*. (pp. 142-155). New York: Springer.

Feldman, M. A., Anderson, L. M., Shapiro, J. B., Jedraszko, A. M., Evans, M., Weil, L. E., ... & Weissberg-Benchell, J. (2018). Family-based interventions targeting improvements in health and family outcomes of children and adolescents with type 1 diabetes: A systematic review. *Current diabetes reports*, *18*(3), 15.

Fertman, C. I., & Allensworth, D. D. (Eds.). (2016). *Health promotion programs: from theory to practice*. John Wiley & Sons.

Fishbein, M., Ajzen, I., Albarracin, D., & Hornik, R. (2007). A reasoned action approach: Some issues, questions, and clarifications. *Prediction and change of health behavior: Applying the reasoned action approach*, 281-295.

Flores-Yeffal, N. Y., Vidales, G., & Martinez, G. (2019). # WakeUpAmerica,# IllegalsAreCriminals: the role of the cyber public sphere in the perpetuation of the Latino cyber-moral panic in the US. *Information, Communication & Society*, *22*(3), 402-419.

Fonagy, P., Twemlow, S. W., Vernberg, E. M., Nelson, J. M., Dill, E. J., Little, T. D., & Sargent, J. A. (2009). A cluster randomized controlled trial of child-focused psychiatric consultation and a school systems-focused intervention to reduce aggression. *Journal of Child Psychology and Psychiatry, and Allied Disciplines*, *50*(5), 607–616.

French, D. P., Sutton, S., Hennings, S. J., Mitchell, J., Wareham, N. J., Griffin, S., ... & Kinmonth, A. L. (2005). The importance of affective beliefs and attitudes in the theory of planned behavior: Predicting intention to increase physical activity 1. *Journal of Applied Social Psychology*, *35*(9), 1824-1848.

Friedman, A. J., Cosby, R., Boyko, S., Hatton-Bauer, J., & Turnbull, G. (2009). Effective teaching strategies and methods of delivery for patient education. *Program in Evidence-Based Care, 2009*, 20-22.

Friedman, A. J., Cosby, R., Boyko, S., Hatton-Bauer, J., & Turnbull, G. (2011). Effective teaching strategies and methods of delivery for patient education: a systematic review and practice guideline recommendations. *Journal of Cancer Education: The Official Journal of the American Association for Cancer Education*, *26*(1), 12–21.

Fritz, N., & Gonzales, A. (2018). Privacy at the margins| Not the normal trans story: negotiating trans narratives while crowdfunding at the margins. *International Journal of Communication Systems*, *12*(0), 20.

Furtado, V., Melo, A., Coelho, A. L., & Menezes, R. (2008). Simulating crime against properties using swarm intelligence and social networks. In *Artificial Crime Analysis Systems: Using Computer Simulations and Geographic Information Systems* (pp. 300-318). IGI Global.

Fusch, P. I., & Ness, L. R. (2015). Are we there yet? Data saturation in qualitative research. *The Qualitative Report*, *20*(9), 1408–1416.

Gearhart, S., & Zhang, W. (2015). "Was it something I said?""No, it was something you posted!" A study of the spiral of silence theory in social media contexts. *Cyberpsychology, Behavior and Social Networking*, *18*(4), 208–213.

Glanz, K., Rimer, B. K., & Viswanath, K. (2008). *Health Behavior and Health Education: Theory, Research, and Practice*. John Wiley & Sons.

Gomez-Rodriguez, M., Leskovec, J., & Krause, A. (2012). Inferring networks of diffusion and influence. *ACM Transactions on Knowledge Discovery from Data*, *5*(4), 21:1–21:37.

Gonzales, A. L. (2017). Disadvantaged minorities' use of the Internet to expand their social networks. *Communication Research*, *44*(4), 467–486.

Goodfellow, I. J., Shlens, J., & Szegedy, C. (2014). Explaining and harnessing adversarial examples. *arXiv preprint arXiv:1412.6572*.

Gorman, D. M., Mezic, J., Mezic, I., & Gruenewald, P. J. (2006). Agent-based modeling of drinking behavior: a preliminary model and potential applications to theory and practice. *American Journal of Public Health*, *96*(11), 2055–2060.

Gould, M., Jamieson, P., & Romer, D. (2003). Media contagion and suicide among the young. *The American Behavioral Scientist*, *46*(9), 1269–1284.

Gould, M. S., Petrie, K., Kleinman, M. H., & Wallenstein, S. (1994). Clustering of attempted suicide: New Zealand national data. *International Journal of Epidemiology*, *23*(6), 1185–1189.

Gould, M. S., & Shaffer, D. (1986). The impact of suicide in television movies. *The New England Journal of Medicine*, *315*(11), 690–694.

Grant-Alfieri, A., Schaechter, J., & Lipshultz, S. E. (2013). Ingesting and aspirating dry cinnamon by children and adolescents: the "cinnamon challenge." *Pediatrics*, *131*(5), 833–835.

Groff, E. (2008). Characterizing the spatio-temporal aspects of routine activities and the geographic distribution of street robbery. In *Artificial crime analysis systems: Using computer simulations and geographic information systems* (pp. 226-251). IGI Global.

Groff, E. R., Johnson, S. D., & Thornton, A. (2019). State of the art in agent-based modeling of urban crime: An overview. *Journal of Quantitative Criminology*, *35*(1), 155-193.

Guan, L., Hao, B., Cheng, Q., Yip, P. S., & Zhu, T. (2015). Identifying Chinese microblog users with high suicide probability using internet-based profile and linguistic features: classification model. *JMIR mental health*, *2*(2), e17.

Gutowski, E., White, A. E., Liang, B., Diamonti, A. J., & Berado, D. (2018). How stress influences purpose development: The importance of social support. *Journal of Adolescent Research*, *33*(5), 571-597.

Haque, K. M. A. (2018). *A Dynamic Policing Simulation Framework* (Doctoral dissertation). Retrieved from: https://rc.library.uta.edu/uta-ir/handle/10106/27758

Harris, I. M., & Roberts, L. M. (2013). Exploring the use and effects of deliberate self-harm websites: An Internet-based study. *Journal of Medical Internet Research*, *15*(12), e285.

Hart, W., Albarracín, D., Eagly, A. H., Brechan, I., Lindberg, M. J., & Merrill, L. (2009). Feeling validated versus being correct: A meta-analysis of selective exposure to information. *Psychological Bulletin*, *135*(4), 555–588.

Hawton, K. K., Townsend, E., Arensman, E., Gunnell, D., Hazell, P., House, A., & van Heeringen, K. (1999). Psychosocial and pharmacological treatments for deliberate self harm. *Cochrane database of systematic reviews*, (4).

Helfgott, J. B. (2015). Criminal behavior and the copycat effect: Literature review and theoretical framework for empirical investigation. *Aggression and Violent Behavior*, *22*, 46–64.

Henze, N. (1994). On Mardia's kurtosis test for multivariate normality. *Communications in Statistics-Theory and Methods*, *23*(4), 1031–1045.

Hider, A. (2018). The Tide Pod Challenge has prompted 86 calls to poison control centers in 2018. Retrieved October 29, 2018, from Newsnet5 website: https://www.news5cleveland.com/news/national/the-tide-pod-challenge-has-prompted-86-calls-to-poison-control-centers-in-2018

Hilton, E.C. (2017). Unveiling self-harm behaviour: what can social media site Twitter tell us about self-harm? A qualitative exploration. *Journal of Clinical Nursing*, *26*(11-12), 1690–1704.

Hilton, E.C. (2018). "It's the symptom of the problem, not the problem itself": A qualitative exploration of the role of pro-anorexia websites in users' disordered eating. *Issues in Mental Health Nursing*, *39*(10), 865–875.

Hinduja, S., & Patchin, J. W. (2010). Bullying, cyberbullying, and suicide. *Archives of suicide research*, *14*(3), 206-221.

Hoge, C. W., Ivany, C. G., & Adler, A. B. (2017). Suicidal behaviors within army units: Contagion and implications for public health interventions. *JAMA psychiatry*, *74*(9), 871-872.

Ho, J. Y. C., & Dempsey, M. (2010). Viral marketing: Motivations to forward online content. *Journal of Business Research*, *63*(9), 1000–1006.

Hong, V., Ewell Foster, C. J., Magness, C. S., McGuire, T. C., Smith, P. K., & King, C. A. (2018). 13 Reasons Why: viewing patterns and perceived impact among youths at risk of suicide. *Psychiatric services*, *70*(2), 107-114.

Insel, B. J., & Gould, M. S. (2008). Impact of modeling on adolescent suicidal behavior. *The Psychiatric Clinics of North America*, *31*(2), 293–316.

Jackson, S. J., Bailey, M., & Foucault Welles, B. (2018). # GirlsLikeUs: Trans advocacy and community building online. *New Media & Society*, *20*(5), 1868–1888.

Jacobs, D. G. (1999). *The Harvard Medical School guide to suicide assessment and intervention*. Jossey-Bass.

Jarvi, S., Jackson, B., Swenson, L., & Crawford, H. (2013). The impact of social contagion on non-suicidal self-injury: A review of the literature. *Archives of Suicide Research*, *17*(1), 1-19.

Jewkes, R., Nduna, M., Levin, J., Jama, N., Dunkle, K., Puren, A., & Duvvury, N. (2008). Impact of stepping stones on incidence of HIV and HSV-2 and sexual behaviour in rural South Africa: cluster randomised controlled trial. *BMJ, 337*, a506.

Joffe, H., & Yardley, L. (2004). Content and thematic analysis. *Research Methods for Clinical and Health Psychology*, *56*, 68.

Jung, W. S., & Villegas, J. (2011). The effects of message framing, involvement, and nicotine dependence on anti-smoking public service announcements. *Health Marketing Quarterly*, *28*(3), 219–231.

Karakaya, Ç., Badur, B., & Aytekin, C. (2011). Analyzing the effectiveness of marketing strategies in the presence of word of mouth: Agent-based modeling approach. *Journal of Marketing Research and Case Studies*, *2011*, 1–17.

Kasprzyk, D., Montaño, D. E., & Fishbein, M. (1998). Application of an integrated behavioral model to predict condom use: A prospective study among high HIV risk groups 1. *Journal of Applied Social Psychology*, *28*(17), 1557-1583.

Kastenmüller, A., Greitemeyer, T., Jonas, E., Fischer, P., & Frey, D. (2010). Selective exposure: The impact of collectivism and individualism. *British Journal of Social Psychology*, *49*(4), 745-763.

Keller, L. O., Strohschein, S., Lia-Hoagberg, B., & Schaffer, M. A. (2004). Population-based public health interventions: practice-based and evidence-supported. Part I. *Public Health Nursing*, *21*(5), 453–468.

Khasawneh, A. N. (2016). *Production and supply models of single and multiple facility supply chains for demand surge in pandemics (Master's thesis)*. Retrieved from: https://search.proquest.com/docview/1839330344?accountid=6167

Khasawneh, A., Chalil Madathil, K., Dixon, E., Wisniewski, P., Zinzow, H., & Roth, R. (2019). An investigation on the portrayal of blue whale challenge on YouTube and Twitter. In *Proceedings of the Human Factors and Ergonomics Society Annual Meeting* (Vol. 63, No. 1, pp. 887-888). Sage CA: Los Angeles, CA: SAGE Publications.

Khasawneh, A., Ponathil, A., Firat Ozkan, N., & Chalil Madathil, K. (2018). How should I choose my dentist? A preliminary study investigating the effectiveness of decision aids on healthcare online review portals. In *Proceedings of the Human Factors and Ergonomics Society Annual Meeting* (Vol. 62, No. 1, pp. 1694-1698). Sage CA: Los Angeles, CA: SAGE Publications.

Khasawneh, A., Rogers, H., Bertrand, J., Chalil Madathil, K., & Gramopadhye, A. (2019). Human adaptation to latency in teleoperated multi-robot human-agent search and rescue teams. *Automation in Construction*, *99*, 265–277.

Khasawneh, K. N., Abu-Ghazaleh, N., Ponomarev, D., & Yu, L. (2017). RHMD: evasion-resilient hardware malware detectors. In *2017 50th Annual IEEE/ACM International Symposium on Microarchitecture (MICRO)* (pp. 315-327). IEEE.

Khasawneh, K. N., Abu-Ghazaleh, N. B., Ponomarev, D., & Yu, L. (2018). Adversarial evasion-resilient hardware malware detectors. In *2018 IEEE/ACM International Conference on Computer-Aided Design (ICCAD)* (pp. 1-6). IEEE.

Khattar, A., Dabas, K., Gupta, K., Chopra, S., & Kumaraguru, P. (2018). White or blue, the whale gets its vengeance: A social media analysis of the blue whale challenge. *arXiv preprint arXiv:1801.05588*.

Kim, S., Lee, K., Cho, J. K., & Kim, C. O. (2011). Agent-based diffusion model for an automobile market with fuzzy TOPSIS-based product adoption process. *Expert Systems with Applications*, *38*(6), 7270–7276.

Klein, G., Moon, B., & Hoffman, R. R. (2006). Making sense of sensemaking 1: Alternative perspectives. *IEEE Intelligent Systems*, *21*(4), 70–73.

Klein, G., Ross, K., Moon, B., Klein, D., Hoffman, R., & Hollnagel, E. (2003). Macrocognition. *IEEE Intelligent Systems*, *18*(3), 81–85.

Klingle, K. E., & Van Vliet, K. J. (2019). Self-compassion from the adolescent perspective: A qualitative study. *Journal of Adolescent Research*, *34*(3), 323–346.

Kozinets, R. V., De Valck, K., Wojnicki, A. C., & Wilner, S. J. (2010). Networked narratives: Understanding word-of-mouth marketing in online communities. *Journal of marketing*, *74*(2), 71-89.

Kramer, A. D. I., Guillory, J. E., & Hancock, J. T. (2014). Experimental evidence of massive-scale emotional contagion through social networks. *Proceedings of the National Academy of Sciences*, *111*(24), 8788–8790.

Lachmar, E. M., Wittenborn, A. K., Bogen, K. W., & McCauley, H. L. (2017). # MyDepressionLooksLike: examining public discourse about depression on twitter. *JMIR Mental Health*, *4*(4), e43.

Laine, M. O., & Frühwirth, C. (2010). Monitoring social media: tools, characteristics and implications. In *International Conference of Software Business* (pp. 193-198). Springer, Berlin, Heidelberg.

Law, A. M. (2008, December). How to build valid and credible simulation models. In *2008 Winter Simulation Conference* (pp. 39-47). IEEE.

Lawson, C. E. (2018). Platform vulnerabilities: harassment and misogynoir in the digital attack on Leslie Jones. *Information, Communication and Society*, *21*(6), 818–833.

Lee, B. Y., Brown, S. T., Bailey, R. R., Zimmerman, R. K., Potter, M. A., McGlone, S. M., … Burke, D. S. (2011). The benefits to all of ensuring equal and timely access to influenza vaccines in poor communities. *Health Affairs, 30*(6), 1141–1150.

Lee, B. Y., Brown, S. T., Cooley, P. C., Zimmerman, R. K., Wheaton, W. D., Zimmer, S. M., … Burke, D. S. (2010). A computer simulation of employee vaccination to mitigate an influenza epidemic. *American Journal of Preventive Medicine*, *38*(3), 247–257.

Lee, B. Y., Brown, S. T., Cooley, P., Potter, M. A., Wheaton, W. D., Voorhees, R. E., … Burke, D. S. (2010). Simulating school closure strategies to mitigate an influenza epidemic. *Journal of Public Health Management and Practice: JPHMP*, *16*(3), 252–261.

Lee, B. Y., Brown, S. T., Korch, G. W., Cooley, P. C., Zimmerman, R. K., Wheaton, W. D., … Burke, D. S. (2010). A computer simulation of vaccine prioritization, allocation, and rationing during the 2009 H1N1 influenza pandemic. *Vaccine*, *28*(31), 4875–4879.

Lenhart, A., Duggan, M., Perrin, A., Stepler, R., Rainie, H., & Parker, K. (2015). *Teens, social media & technology overview 2015* (pp. 04-09). Pew Research Center [Internet & American Life Project].

Lenhart, A., Madden, M., Smith, A., & Macgill, A. R. (2009). Teens and social media: An overview. *Washington, DC: Pew Internet and American Life*, 97-119.

Lerman, B. I., Lewis, S. P., Lumley, M., Grogan, G. J., Hudson, C. C., & Johnson, E. (2017). Teen depression groups on Facebook: A content analysis. *Journal of Adolescent Research*, *32*(6), 719–741.

Lewis, S. P., & Seko, Y. (2016). A double-edged sword: A review of benefits and risks of online nonsuicidal self-injury activities. *Journal of Clinical Psychology*, *72*(3), 249–262.

Linabary, J. R., & Corple, D. J. (2018). Privacy for whom?: A feminist intervention in online research practice. *Information, Communication and Society*, 1–17.

Livingstone, S., & Helsper, E. (2010). Balancing opportunities and risks in teenagers' use of the internet: The role of online skills and internet self-efficacy. *New Media & Society*, *12*(2), 309–329.

Livingstone, S., & Smith, P. K. (2014). Annual research review: Harms experienced by child users of online and mobile technologies: The nature, prevalence and management of sexual and aggressive risks in the digital age. *Journal of Child Psychology and Psychiatry, and Allied Disciplines*, *55*(6), 635–654.

Long, X., Gan, C., De Melo, G., Wu, J., Liu, X., & Wen, S. (2018). Attention clusters: Purely attention based local feature integration for video classification. In *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition* (pp. 7834-7843).

Luo, C., Zheng, X., Zeng, D. D., & Leischow, S. (2014). Portrayal of electronic cigarettes on YouTube. *BMC Public Health*, *14*, 1028.

Luxton, D. D., June, J. D., & Fairall, J. M. (2012). Social media and suicide: a public health perspective. *American Journal of Public Health*, *102 Suppl 2*, S195–S200.

MacCallum J and Beltman S (2002). *Role models for young people: What makes an effective role model program.* Hobart, TAS, Australia: National Youth Affairs Scheme.

Mothers Against Drunk Driving (2019). Retrieved November 15, 2019, from MADD website: https://www.madd.org/

Mahadevaiah, M., & Nayak, R. B. (2018). Blue whale challenge: Perceptions of first responders in medical profession. *Indian Journal of Psychological Medicine*, *40*(2), 178–182.

Maina, A. (2018). 20 Popular social media sites right now - small business trends. Retrieved November 28, 2018, from Small Business Trends website: https://smallbiztrends.com/2016/05/popular-social-media-sites.html

Mardia, K. V. (1974). Applications of some measures of multivariate skewness and kurtosis in testing normality and robustness studies. *Sankhyā: The Indian Journal of Statistics, Series B*, 115-128.

Martinez, M. (2017). Parents and cops are worried about this chilling "48-hour challenge." Should they be? Retrieved October 29, 2018, from Miamiherald website: https://www.miamiherald.com/news/nation-world/national/article180181516.html

McNeal Jr, R. B., Hansen, W. B., Harrington, N. G., & Giles, S. M. (2004). How All Stars works: An examination of program effects on mediating variables. *Health Education & Behavior*, *31*(2), 165-178.

Mitchell, K. J., Wells, M., Priebe, G., & Ybarra, M. L. (2014). Exposure to websites that encourage self-harm and suicide: prevalence rates and association with actual thoughts of self-harm and thoughts of suicide in the United States. *Journal of Adolescence*, *37*(8), 1335–1344.

Mønsted, B., Sapieżyński, P., Ferrara, E., & Lehmann, S. (2017). Evidence of complex contagion of information in social media: An experiment using Twitter bots. *PloS One*, *12*(9), e0184148.

Montano, D. E., & Kasprzyk, D. (2015). Theory of reasoned action, theory of planned behavior, and the integrated behavioral model. *Health Behavior: Theory, Research and Practice*, 95–124.

Moore, K. S., Gomer, J. A., Pagano, C. C., & Moore, D. D. (2009). Perception of robot passability with direct line of sight and teleoperation. *Human Factors*, *51*(4), 557–570.

Muhle, H., Ernst, H., & Bellmann, B. (1997). Investigation of the durability of cellulose fibres in rat lungs. *The Annals of Occupational Hygiene*, *41*, 184–188.

Mukhra, R., Baryah, N., Krishan, K., & Kanchan, T. (2019). 'Blue Whale Challenge': A game or crime?. *Science and engineering ethics*, *25*(1), 285-291.

Muñoz-Sánchez, J.-L., Delgado, C., Parra-Vidales, E., & Franco-Martín, M. (2018). Facilitating factors and barriers to the use of emerging technologies for suicide prevention in Europe: Multicountry exploratory study. *JMIR Mental Health*, *5*(1), e7.

Nayani, N., & Mollaghasemi, M. (1998). Validation and verification of the simulation model of a photolithography process in semiconductor manufacturing. In *1998 Winter Simulation Conference. Proceedings (Cat. No. 98CH36274)* (Vol. 2, pp. 1017-1022). IEEE.

Nguyen, A., Yosinski, J., & Clune, J. (2015). Deep neural networks are easily fooled: High confidence predictions for unrecognizable images. In *Proceedings of the IEEE conference on computer vision and pattern recognition* (pp. 427-436).

Nikolov, D., Oliveira, D. F. M., Flammini, A., & Menczer, F. (2015). Measuring online social bubbles. *PeerJ Computer Science*, *1*, e38.

Noble-Carr, D., & Woodman, E. (2018). Considering identity and meaning constructions for vulnerable young people. *Journal of Adolescent Research*, *33*(6), 672-698.

Nock, M. K., Borges, G., Bromet, E. J., Cha, C. B., Kessler, R. C., & Lee, S. (2008). Suicide and suicidal behavior. *Epidemiologic Reviews*, *30*, 133–154.

Minnesota Department of Health of Health (2016). *Publications Database-Center for Public Health Practice-Minnesota Dept. of Health*. Retrieved from http://www.health.state.mn.us/communities/practice/resources/publications/

Ortiz, P., & Khin Khin, E. (2018). Traditional and new media's influence on suicidal behavior and contagion. *Behavioral Sciences & the Law*, *36*(2), 245–256.

Padgett, D. K. (2011). *Qualitative and Mixed Methods in Public Health*. SAGE Publications.

Page, X., Wisniewski, P., Knijnenburg, B. P., & Namara, M. (2018). Social media's have-nots: an era of social disenfranchisement. *Internet Research*, *28*(5), 1253–1274.

Papernot, N., McDaniel, P., Jha, S., Fredrikson, M., Celik, Z. B., & Swami, A. (2016). The limitations of deep learning in adversarial settings. In *2016 IEEE European Symposium on Security and Privacy (EuroS&P)* (pp. 372-387). IEEE.

Pater, J. A., Haimson, O. L., Andalibi, N., & Mynatt, E. D. (2016). "Hunger hurts but starving works": Characterizing the presentation of eating disorders online. *Proceedings of the 19th ACM Conference on Computer-Supported Cooperative Work & Social Computing*, 1185–1200. ACM.

Pater, J. A., Miller, A. D., & Mynatt, E. D. (2015). This digital life: A neighborhood-based study of adolescents' lives online. In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems* (pp. 2305-2314). ACM.

Pater, J., & Mynatt, E. (2017). Defining digital self-harm. In *Proceedings of the 2017 ACM Conference on Computer Supported Cooperative Work and Social Computing* (pp. 1501-1513). ACM.

Patterson, P., Whittington, R., & Bogg, J. (2007). Testing the effectiveness of an educational intervention aimed at changing attitudes to self-harm. *Journal of Psychiatric and Mental Health Nursing*, *14*(1), 100–105.

Patton, G. C., Coffey, C., Romaniuk, H., Mackinnon, A., Carlin, J. B., Degenhardt, L., … Moran, P. (2014). The prognosis of common mental disorders in adolescents: a 14-year prospective cohort study. *The Lancet*, *383*(9926), 1404–1411.

Phillips, D. P. (1974). The influence of suggestion on suicide: substantive and theoretical implications of the Werther effect. *American Sociological Review*, *39*(3), 340–354.

Phing, N. M., & Rashad Yazdanifard, A. (2014). How does ALS Ice bucket challenge achieve its viral outcome through marketing via social media? *Global Journal of Management and Business Research, 14*(7), 56–63.

Pinsky, D., Young, S. M., & Stern, J. (2009). *The mirror effect: How celebrity narcissism is seducing America*. Harper Collins Publishers.

Ponathil, A., Agnisarman, S., Khasawneh, A., Narasimha, S., & Chalil Madathil, K. (2017). An empirical study investigating the effectiveness of decision aids in supporting the sensemaking process on anonymous social media. In *Proceedings of the Human Factors and Ergonomics Society Annual Meeting* (Vol. 61, No. 1, pp. 798-802). Sage CA: Los Angeles, CA: SAGE Publications.

Ponathil, A., Khasawneh, A., & Chalil Madathil, K. (2019). *Investigating the factors affecting an older adult's dental care provider choice.* Retrieved from https://tigerprints.clemson.edu/cgi/viewcontent.cgi?article=1236&context=grads_symposium

Prinz, R. J., & Neger, E. N. (2016). Risk reduction via a community-wide approach. *Preventing Crime and Violence*, 205.

Purington, A., & Whitlock, J. (2010). Non-suicidal self-injury in the media. *The Prevention Researcher*, *17*(1), 11–14.

Queinec, R., Beitz, C., Contrand, B., Jougla, E., Leffondré, K., Lagarde, E., & Encrenaz, G. (2011). Copycat effect after celebrity suicides: results from the French national death register. *Psychological Medicine*, *41*(3), 668–671.

Radian6 (2019). Radian6 Overview. Retrieved November 28, 2019, from Radian6 website https://www.webanalyticsworld.net/analytics-measurement-and-management-tools/radian-6-overview

Recupero, P. R., Harms, S. E., & Noble, J. M. (2008). Googling suicide: surfing for suicide information on the Internet. *The Journal of Clinical Psychiatry*, *69*(6), 878–888.

Richardson, A., & Vallone, D. M. (2014). YouTube: a promotional vehicle for little cigars and cigarillos?. *Tobacco Control*, *23*(1), 21–26.

Robert, A., Suelves, J. M., Armayones, M., & Ashley, S. (2015). Internet use and suicidal behaviors: internet as a threat or opportunity?. *Telemedicine and e-Health*, *21*(4), 306-311.

Rogers, H., Khasawneh, A., Bertrand, J., & Chalil Madathil, K. (2017). An investigation of the effect of latency on the operator's trust and performance for manual multi-robot teleoperated tasks. In *Proceedings of the Human Factors and Ergonomics Society Annual Meeting* (Vol. 61, No. 1, pp. 390-394). Sage CA: Los Angeles, CA: SAGE Publications.

Rogers, H., Khasawneh, A., Bertrand, J., & Chalil Madathil, K. (2019). Understanding reliance and trust in decision aids for UAV target identification. In *Proceedings of the Human Factors and Ergonomics Society Annual Meeting* (Vol. 63, No. 1, pp. 1953-1954). Sage CA: Los Angeles, CA: SAGE Publications.

Rogowsky, B. A., Calhoun, B. M., & Tallal, P. (2015). Matching learning style to instructional method: Effects on comprehension. *Journal of Educational Psychology*, *107*(1), 64–78.

Rosenthal, S. R., Cha, Y., & Clark, M. A. (2018). The internet addiction test in a young adult US population. *Cyberpsychology, Behavior and Social Networking*, *21*(10), 661–666.

Saldana, J. (2015). *The Coding Manual for Qualitative Researchers*. SAGE.

Saldivar, J., Daniel, F., Cernuzzi, L., & Casati, F. (2019). Online Idea Management for Civic Engagement: A Study on the Benefits of Integration with Social Networking. *ACM Transactions on Social Computing*, *2*(1), 1:1–1:29.

Sargent, R. G., & Balci, O. (2017). History of verification and validation of simulation models. In *Proceedings of the 2017 Winter Simulation Conference* (p. 17). IEEE Press.

Saunders, B., Sim, J., Kingstone, T., Baker, S., Waterfield, J., Bartlam, B., ... & Jinks, C. (2018). Saturation in qualitative research: exploring its conceptualization and operationalization. *Quality & Quantity*, *52*(4), 1893-1907.

Scharett, E., Chalil Madathil, K., Lopes, S., Rogers, H., Agnisarman, S., Narasimha, S., ... & Dye, C. (2017). An investigation of the information sought by caregivers of Alzheimer's patients on online peer support groups. *Cyberpsychology, Behavior, and Social Networking*, *20*(10), 640-657.

Schlichthorst, M., King, K., Turnure, J., Sukunesan, S., Phelps, A., & Pirkis, J. (2018). Influencing the conversation about masculinity and suicide: evaluation of the Man Up Multimedia Campaign using Twitter data. *JMIR mental health*, *5*(1), e14.

Schlomer, G. L., Cleveland, H. H., Deutsch, A. R., Vandenbergh, D. J., Feinberg, M. E., Greenberg, M. T., ... & Redmond, C. (2019). Developmental change in adolescent delinquency: modeling time-varying effects of a preventative intervention and GABRA2 halpotype linked to alcohol use. *Journal of youth and adolescence*, *48*(1), 71-85.

Schoon, P. M., Porta, C. M., & Schaffer, M. A. (2018). *Population-Based Public Health Clinical Manual, Third Edition: The Henry Street Model for Nurses*. Sigma.

Silverman, B. G., Hanrahan, N., Bharathy, G., Gordon, K., & Johnson, D. (2015). A systems approach to healthcare: agent-based modeling, community mental health, and population well-being. *Artificial Intelligence in Medicine*, *63*(2), 61–71.

Sinyor, M., Schaffer, A., Heisel, M. J., Picard, A., Adamson, G., Cheung, C. P., ... & Sareen, J. (2018). Media guidelines for reporting on suicide: 2017 update of the Canadian Psychiatric Association policy paper. *The Canadian Journal of Psychiatry*, *63*(3), 182-196.

Skegg, K. (2005). Self-harm. *The Lancet*, *366*(9495), 1471–1483.

Song, P. (2014). The Ice Bucket Challenge: The public sector should get ready to promptly promote the sustained development of a system of medical care for and research into rare diseases. *Intractable & Rare Diseases Research*, *3*(3), 94–96.

Sonneck, G., Etzersdorfer, E., & Nagel-Kuess, S. (1994). Imitative suicide on the Viennese subway. *Social Science & Medicine*, *38*(3), 453–457.

Sparks, B. A., Perkins, H. E., & Buckley, R. (2013). Online travel reviews as persuasive communication: The effects of content type, source, and certification logos on consumer behavior. *Tourism Management*, *39*, 1–9.

Stack, S. (1993). The media and suicide: A nonadditive model, 1968–1980. *Suicide & Life-Threatening Behavior*, *23*(1), 63–66.

Stack, S. (1996). The effect of the media on suicide: Evidence from Japan, 1955–1985. *Suicide & Life-Threatening Behavior*, *26*(2), 132–142.

Stanford, K. H. (2016). Social media contests: A timeline of viral challenges. Retrieved October 29, 2018, from Growing Social Media website: http://growingsocialmedia.com/social-media-contests-a-timeline-of-viral-challenges/

Stone, D. M., Simon, T. R., Fowler, K. A., Kegler, S. R., Yuan, K., Holland, K. M., ... & Crosby, A. E. (2018). Vital signs: trends in state suicide rates—United States, 1999–2016 and circumstances contributing to suicide—27 states, 2015. *Morbidity and Mortality Weekly Report*, *67*(22), 617.

Subrahmanyam, K., & Lin, G. (2007). Adolescents on the Net: Internet use and well-being. *Adolescence*, *42*(168).

Suicide Prevention Resource Center (2006). *Safe and effective messaging for suicide prevention*. Suicide Prevention Resource Center. Newton, MA.

Swannell, S. V., Martin, G. E., Page, A., Hasking, P., & John, N. J. (2014). Prevalence of nonsuicidal self-injury in nonclinical samples: Systematic review, meta-analysis and meta-regression. *Suicide & Life-Threatening Behavior*, *44*(3), 273–303.

Swendeman, D., Arnold, E. M., Harris, D., Fournier, J., Comulada, W. S., Reback, C., ... & Fernández, M. I. (2019). Text-messaging, online peer support group, and coaching strategies to optimize the HIV prevention continuum for youth: Protocol for a randomized controlled trial. *JMIR research protocols*, *8*(8), e11165.

Syouri, S. A., Li, Y., Khasawneh, A. N., Zhang, Q., & Nagarur, N. N (2016). Robust-optimization models of buyer-vendor inventory for supply chain coordination. In the *Proceedings of the 2016 Industrial and Systems Engineering Research Conference.*

Tahmasbi, N., & Rastegari, E. (2018). A socio-contextual approach in automated detection of public cyberbullying on Twitter. *ACM Transactions on Social Computing*, *1*(4), 15.

Tanner, M. A., Murray, J. A., & Phillips, D. P. (1988). The impact of televised movies about suicide. *The New England Journal of Medicine*, *318*(11), 707–708.

Tatrai, E., Adamis, Z., & Ungvary, G. (1995). The pulmonary toxicity of cinnamon dust in rats. *The Indian Journal of Medical Research*, *102*, 287–292.

Tátrai, E., & Ungváry, G. (1992). The aetiology of experimental fibrosing alveobronchiolitis induced in rats by paprika dust. *Occupational and Environmental Medicine*, *49*(7), 494–498.

Tellis, G. J., MacInnis, D. J., Tirunillai, S., & Zhang, Y. (2019). What drives virality (sharing) of online digital content? The critical role of information, emotion, and brand prominence. *Journal of Marketing*, *83*(4), 1–20.

Thaploo, M. (2017). Blue Whale: Jammu techie has decoded the mystery – 5 Important Points. Retrieved October 17, 2018, from U4UVoice website: https://u4uvoice.com/blue-whale-jammu-techie-has-decoded-the-mystery-5-important-points/

The ALS Association (2019). ALS Ice Bucket Challenge Commitments. Retrieved July 8, 2019, from ALS Association website: http://www.alsa.org/fight-als/ice-bucket-challenge-spending.html

Triandis, H. C. (1980). Values, attitudes, and interpersonal behavior. *Nebraska Symposium on Motivation. Nebraska Symposium on Motivation*, *27*, 195–259.

Twenge, J. M., Joiner, T. E., Rogers, M. L., & Martin, G. N. (2018). Increases in depressive symptoms, suicide-related outcomes, and suicide rates among US adolescents after 2010 and links to increased new media screen time. *Clinical Psychological Science*, *6*(1), 3–17.

U.S. Department of Health and Human Services (HHS) Office of the Surgeon General and National Action Alliance for Suicide Prevention. (2012). *2012 National strategy for suicide prevention: Goals and objectives for action*. Washington, DC: Author

Vaterlaus, J. M., Tulane, S., Porter, B. D., & Beckert, T. E. (2018). The perceived influence of media and technology on adolescent romantic relationships. *Journal of Adolescent Research*, *33*(6), 651–671.

Vaucher, P., Michiels, W., Joris Lambert, S., Favre, N., Perez, B., Baertschi, A., … Gache, P. (2016). Benefits of short educational programmes in preventing drink-driving recidivism: A ten-year follow-up randomised controlled trial. *The International Journal on Drug Policy*, *32*, 70–76.

Wilson, M. K., Khasawneh, A., Ponathil, A., Narasimha, S., Agnisarman, S., Welch, B., & Chalil Madathil, K. (2019). A preliminary study investigating patients' perceptions of research consenting methods. In *Proceedings of the Human Factors and Ergonomics Society Annual Meeting* (Vol. 63, No. 1, pp. 1931-1935). Sage CA: Los Angeles, CA: SAGE Publications.

Wolfe, D. A., Crooks, C., Jaffe, P., Chiodo, D., Hughes, R., Ellis, W., … Donner, A. (2009). A school-based program to prevent adolescent dating violence: a cluster randomized trial. *Archives of Pediatrics & Adolescent Medicine*, *163*(8), 692–699.

Wong, C. O., & McMurray, N. E. (2002). Framing communication: Communicating the antismoking message effectively to all smokers. *Journal of Community Psychology*, *30*(4), 433–447.

Wong, Q. J., Werner-Seidler, A., Torok, M., Van Spijker, B., Calear, A. L., & Christensen, H. (2019). Service use history of individuals enrolling in a web-based suicidal ideation treatment trial: analysis of baseline data. *JMIR mental health*, *6*(4), e11521.

Wood, M., Rose, E., & Thompson, C. (2018). Viral justice? Online justice-seeking, intimate partner violence and affective contagion. *Theoretical Criminology*, 1362480617750507.

Wu, Y., Stanton, B. F., Galbraith, J., Kaljee, L., Cottrell, L., Li, X., … Burns, J. M. (2003). Sustaining and broadening intervention impact: a longitudinal randomized trial of 3 adolescent risk reduction approaches. *Pediatrics*, *111*(1), e32–e38.

Yardley, L., Morrison, L., Bradbury, K., & Muller, I. (2015). The person-based approach to intervention development: application to digital health-related behavior change interventions. *Journal of Medical Internet Research*, *17*(1), e30.

Yonas, M. A., Burke, J. G., Brown, S. T., Borrebach, J. D., Garland, R., Burke, D. S., & Grefenstette, J. J. (2013). Dynamic simulation of crime perpetration and reporting to examine community intervention strategies. *Health Education & Behavior*, *40*(1), 87S-97S.

Young, R., Subramanian, R., Miles, S., Hinnant, A., & Andsager, J. L. (2017). social representation of cyberbullying and adolescent suicide: A mixed-method analysis of news stories. *Health Communication*, *32*(9), 1082–1092.

Yue-Hei Ng, J., Hausknecht, M., Vijayanarasimhan, S., Vinyals, O., Monga, R., & Toderici, G. (2015). Beyond short snippets: Deep networks for video classification. In *Proceedings of the IEEE conference on computer vision and pattern recognition* (pp. 4694-4702).

YouTube Creator Acadimy (2019). Retrieved November 6, 2019, from YouTube creator academy website: https://creatoracademy.youtube.com/page/lesson/discovery

Zhu, L., Westers, N. J., Horton, S. E., King, J. D., Diederich, A., Stewart, S. M., & Kennard, B. D. (2016). Frequency of exposure to and engagement in nonsuicidal self-injury among inpatient adolescents. *Archives of suicide research*, *20*(4), 580-590.

Zimerman, A., Caye, A., Salum, G. A., Passos, I. C., & Kieling, C. (2018). Revisiting the Werther effect in the 21st century: bullying and suicidality among adolescents who watched 13 Reasons Why. *Journal of the American Academy of Child and Adolescent Psychiatry*, *57*(8), 610-613.