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Raising Concussion Awareness among Amateur Athletes: An Examination of the Centers for Disease Control and Prevention's (CDC) *Heads Up* Campaign

Brian L. Quick[a], Elizabeth M. Glowacki[b], Lauren A. Kriss[c], and Daniel E. Hartman[a]

[a]Department of Communication, Carle Illinois College of Medicine, University of Illinois at Urbana-Champaign; [b]Department of Health Sciences, Bouvé College of Health Sciences, Northeastern University; [c]School of Journalism and Mass Communication at the University of Wisconsin-Madison

ABSTRACT
Attention to concussion prevention and management has grown in recent years due to the potentially long-term, debilitating effects a head injury can have on an individual. Although multiple campaigns have been designed to target this issue, there remains a need to evaluate the persuasive principles used to advocate for safety measures and protocols, specifically within youth sports. With this in mind, we applied the health belief model (HBM) in our content analysis of the Centers for Disease Control and Prevention's (CDC) *Heads Up* concussion awareness campaign. Campaign videos (N = 35) were coded for threat severity, threat susceptibility, benefits, barriers, self-efficacy, and cues to action. The majority of videos communicated the seriousness of concussions and attempts to communicate concussion susceptibility were driven by personal stories, rather than facts and statistics demonstrating concussion prevalence. Less than half of the videos communicated the benefits of following concussion protocols and only a third of the messages described barriers to following recommended protocols. The majority of videos aimed to elevate self-efficacy among athletes and parents, but not coaches, by focusing on identifying symptoms and concussion avoidance. The implications for concussion prevention and management among athletes, parents, and coaches are discussed.

Sports communication research has grown rapidly as scholars continue to focus on how message design principles can be used to enhance the effectiveness of educational campaigns aimed at harm reduction (Adame & Corman, 2019; Woolsey et al., 2010) and coordinate communication efforts among players, parents, coaches, and school officials (Heyer et al., 2015). Specifically, work on traumatic brain injuries and concussion prevention has gained traction due to the recent emphasis placed on athlete susceptibility to the short- and long-term, even debilitating, consequences that may accompany concussions, particularly if they are left untreated (Schallmo et al., 2017; VanItallie, 2019). According to the Centers for Disease Control and Prevention (2019), a concussion is a mild traumatic brain injury (TBI) resulting from a hit to the head or body causing the brain to move back and forth quickly. Nearly a decade ago, Harmon et al. (2013) estimated as many as 3.8 million concussions occur in the U.S. annually during competitive sports and other recreational activities with nearly half of these accidents going unreported. In 2019, the CDC found that 3.2 million high school students alone reported having at least one concussion due to their sports participation. Clearly, the prevalence of concussions among athletes of all ages constitutes a serious societal health problem.

A considerable amount of research is underway to improve the prevention, detection, diagnosis, and treatment of concussions among athletes (Adame & Corman, 2019). After all, efforts to improve detection require effective communication from athletes to their coach, trainer, or parent (Corman et al., 2019). Persuasive principles must be employed to advocate for safety measures and protocols preventing harm to young athletes (Centers for Disease Control and Prevention, 2019). These persuasive strategies are more likely to be effective when players, teammates, coaches, trainers, and families are all on board. Using a comprehensive approach that includes an athlete's social network is more effective at eliciting compliance than targeting the athlete alone (Keegan et al., 2010; Smoll et al., 2007). The CDC's *Heads Up* campaign aims to demonstrate the dangers of concussions. The campaign aims to educate audiences about concussion harm reduction strategies (e.g., helmets), as well as concussion symptoms, consequences, and recovery management (Centers for Disease Control and Prevention, 2020b). Despite the efforts of this educational campaign, a deeper dive into the campaign's content is warranted for three reasons. First, recent evaluations of the *Heads Up* campaign report concussion knowledge gaps regarding proper concussion protocol among parents (Rice & Curtis, 2019) and coaches (R. W. Turner et al., 2017). In fact, research suggests many coaches are unaware of the *Heads Up* campaign suggesting either there is inadequate exposure to the campaign or that the memorability of these messages is deficient (Stead et al., 2016). Second, concussion prevalence rates remain high among high school athletes. Specifically, in 2020, findings from the Youth Risk Behavior Surveillance System (YRBSS; Centers for Disease Control and Prevention, 2020b) indicate that 2.5 million high school students experienced at least one concussion from participating in physical activity or sports while nearly half of high school athletes, with concussions, reported

CONTACT Brian L. Quick bquick@illinois.edu Professor of Communication and Medicine 3001 Lincoln Hall, MC-456 702 S Wright Street Urbana IL 61801, USA

that their coaches were unaware of their symptoms (DePadilla et al., 2018). Third, the Youth Risk Behavior Survey (YRBS) (2020) also discovered that high school students sustaining at least one concussion were likely to report feelings of prolonged negative emotions (i.e., sadness). This latter findings suggests a need to identify and manage concussions in order to mitigate negative outcomes to athletes' well-being (Sarmiento et al., 2020).

With a better understanding of the message features employed in the *Heads Up* educational campaign, health practitioners will be better situated to create improved concussion prevention campaigns in the future. Given this, the goal of the current study is to apply the health belief model (HBM) (Rosenstock, 1966) to understand the message strategies employed in the CDC's *Heads Up* campaign. Before introducing the HBM and subsequent research questions, we begin with a brief overview of current concussion education approaches.

Concussion education

Concussions can lead to permanent changes in mental status; an afflicted individual can experience a plethora of both short- and long-term consequences including headache, loss of consciousness, ear ringing, dizziness, vomiting, seizures, blurred vision, personality changes, chronic traumatic encephalopathy (CTE), memory problems, trouble sleeping, anger, depression, and declines in academic performance (Centers for Disease Control and Prevention, 2019). According to the same report, in 2014 alone, there were over 830,000 TBI episodes resulting in hospitalizations and/or death among children. Nearly 30% of TBI-related emergency department visits for children are caused by being hit on the head (Centers for Disease Control and Prevention, 2019); recreational activities and sports are responsible for approximately 21% of TBIs for children (American Association of Neurological Surgeons, 2020). Negative concussion outcomes can be mitigated if the proper steps are taken as soon as an individual is believed to have experienced a concussion. These steps include resting and avoiding physical activity, avoiding mentally strenuous activity, avoiding audio and visual stimuli, and undergoing proper testing including a computerized tomography (CT) scan or magnetic resonance imaging (MRI) (Mayo Clinic, 2020). Some initiatives have advocated for the use of helmets and enhanced helmet design to prevent concussions (Rowson et al., 2014); however, there are mixed findings on helmet efficacy and their ability to improve clinical outcomes (Sone et al., 2017). It is critical that a concussion is properly managed and that the brain has time to heal before an athlete returns to play. However, barriers stand in the way of effective concussion management, including loss of playing time, disappointing teammates and coaches, loss of scholarships, medical costs, stigma from coaches and teammates, and uncertainty about or a lack of concussion awareness, among others (Sarmiento et al., 2019).

Many concussion education studies have focused on raising concussion awareness among college student athletes, including treatment guidelines (Conway et al., 2018; Fedor & Gunstad, 2015). These studies have addressed the consequences of competing while symptomatic (Kroshus et al., 2017), concussion knowledge among coaches (Kroshus et al., 2015), the role of athletic trainers in concussion management (Kasamatsu et al., 2016), and how concussions affect academic performance (McGrath, 2010). Although these findings are insightful, concussion education campaigns should target younger athletes along with their families and coaches since these groups are the least likely to have access to state-of-the-art facilities and medical staff available to collegiate athletes. Those involved in youth sports might lack a basic understanding of concussion symptoms, treatment protocol, and both short- and long-term consequences of (un)treated concussions.

The goal of the *Heads Up* campaign is to generate awareness of concussion prevention, signs, symptoms, and recovery for youth athletes (Centers for Disease Control and Prevention, 2020b). These materials address the basics of brain injuries, helmet safety, sports risks, concussion danger signs, recovery expectations, and guidelines for returning to the classroom and sport (Centers for Disease Control and Prevention, 2020b). In the campaign videos, parents, athletes (professional and amateur), and experts describe their experiences with concussions and share recommendations for identifying and treating symptoms. In the current study, we applied the HBM to code *Heads Up* videos designed for parents, coaches, school administrators, and health care providers of youth athletes (Centers for Disease Control and Prevention, 2020b).

Recent evaluations of the *Heads Up* campaign have found that there are still gaps in concussion knowledge among parents, which is worsened by a lack of concussion laws and state legislation (Rice & Curtis, 2019) and although knowledge about concussion symptoms may have increased over the past few years, many coaches still do not enact proper protocol immediately after a concussion episode (R. W. Turner et al., 2017). School coaches rated the *Heads Up* materials as visually appealing and user friendly (Sawyer et al., 2010) and showed improvements in concussion knowledge and responding to concussions after completing a *Heads Up* training (Daugherty et al., 2019). Additionally, youth sports coaches who worked with the *Heads Up* materials for six months were better able to prevent and identify concussions (Covassin et al., 2012). Although there is evidence to suggest that *Heads Up* can promote concussion awareness among audiences that receive these campaign materials, further work is warranted to evaluate the reach of the campaign and to identify the extent to which youth sports groups are even aware of *Heads Up*. For example, Stead et al. (2016) found that only half of their surveyed pediatric sports coaches were aware of the *Heads Up* campaign. Those who were familiar with the campaign were more likely to call the parent of an injured athlete and perceive youth concussions as severe. Stead et al. (2016) also showed that higher income predicted awareness of the campaign, which should raise questions about disparate diffusion of campaign materials.

Further, findings from the YRBSS (Centers for Disease Control and Prevention, 2020b; DePadilla et al., 2018) indicate that 2.5 million high school students experienced at least one concussion from participating in physical activity or sports and 40% of high school athletes with concussions reported that coaches were unaware of symptoms. Concussions occurred more frequently among those who played multiple sports. These researchers conclude that messages should better target athletes who play on more than one sports team and that Hispanic and black students were more likely to experience at least four concussions when compared with white students. Additionally, findings from the YRBSS also suggest that high school students who sustained at least one concussion were more likely to report feelings of prolonged hopelessness and sadness, highlighting the mental health consequences of failing to manage concussion prevention and recovery (Sarmiento et al., 2020).

Health belief model

The HBM (Rosenstock, 1974) was developed to explain and predict preventative behavior by focusing on a health threat, the pros and cons of performing a behavior, performance confidence, and behavioral outcomes. The HBM has been employed across a host of educational injury prevention campaigns (e.g., Patel & Trowbridge, 2017; Wang et al., 2014) aimed at adolescents as they face various hazards in school, bus transportation, playgrounds, and on athletic fields (Sleet et al., 2010). The sheer number of these interventions is unsurprising considering the relative cost of an educational campaign vis-à-vis treating injuries (Kılınç & Gür, 2020). The HBM is comprised of six central constructs: severity, susceptibility, benefits and barriers to taking action, self-efficacy, and cues to action (Glanz & Bishop, 2010). As has been demonstrated by more than a half of century of research, these constructs serve as primary predictors of past, current, and future behavior (for a review, see Skinner et al., 2015). Within the context of the current study, the *Heads Up* campaign serves as the external cue to action under investigation. Below, attention is given to each of the HBM constructs with a particular focus on their application within the context of concussion or other serious brain injury.

A health threat is comprised of threat severity and susceptibility. Severity speaks to the magnitude of the threat whereas susceptibility refers to the likelihood of experiencing the health threat (Janz & Becker, 1984). More specifically, severity refers to a person's belief regarding the consequences an injury would have on their overall health (Cao et al., 2014). The seriousness and consequences of concussion and brain injury have become a growing public health threat in recent years (Adame & Corman, 2019; Schallmo et al., 2017; VanItallie, 2019). For instance, research suggests concussions and other brain injuries can lead to a plethora of both short- and long-term health consequences ranging from pain and discomfort (e.g., dizziness, fatigue, headache, and a loss of consciousness) to impaired memory, depression, and suicide (Centers for Disease Control and Prevention, 2019). The seriousness of a concussion, and TBIs broadly is well documented.

Susceptibility refers to the perceived likelihood of experiencing severe consequences or harmed by a particular thing. Susceptibility to experience a concussion is becoming more apparent as clinicians, trainers, and coaches are becoming better at recognizing the symptoms of these head injuries (Zuckerman et al., 2015). Between 2010 and 2016, the Centers for Disease Control and Prevention (2019) found that approximately 2 million children visited the hospital emergency departments for TBIs. Nearly half of these visits were from boys between the ages of 5 and 9 (13.1%) as well as 10 and 14 (32.6%). In 2014 alone, approximately 830,000 TBIs resulted in hospitalization and even death among children (Centers for Disease Control and Prevention, 2020b). Given the rising concern galvanized by concussions, the National Collegiate Athletic Association (NCAA) investigated and found that 1.6 to 3.8 million concussions occur each year due to sports participation (Zuckerman et al., 2015). As alarming as these numbers appear, they are likely conservative estimates as concussion injuries frequently go unreported (Centers for Disease Control and Prevention, 2019). Participating in popular youth sports increases the likelihood of experiencing a sport-related concussion (American Association of Neurological Surgeons, n.d.). The current study is interested in the presentation of the health threat of youth sports within the *Heads Up* campaign. In this spirit, the first research question is advanced.

> *RQ1: How much attention is given to the health threat of concussions and TBIs by the Heads Up campaign?*

Once a threat is realized by an audience, then the perceived benefits and barriers of performing a recommended action are considered (Janz & Becker, 1984). The HBM posits that individuals are more likely to engage in a recommended action if the benefits of performing a behavior outweigh the barriers (Rosenstock, 1966). Benefits refer to the positive features resulting from performing the recommended behavior (Glanz & Bishop, 2010). Limiting the short- and long-term consequences of a head injury represents the primary benefit of following concussion prevention protocols. Prevention and health researchers routinely highlight the opportunity to mitigate the harms of TBIs, like concussions, before and after they occur. The strategies often promote the benefits of employing the recommended concussion protocol by adopting specific behaviors when participating in physical activity (e.g., helmets, proper tackling), and when head injuries do occur: maintaining proper rest, avoiding physical activity, audio and visual stimuli, and strenuous mental activity, as well as undergoing proper testing following a head injury (Mayo Clinic, 2020). In addition to emphasizing the benefits of using proper fundamentals and equipment while playing sports, recent research highlights the benefits of proper communication among players and teammates as well. For instance, research by Zanin et al. (2020) have argued for more coverage of athletes adopting a *Need-for-Safety* narrative to encourage other athletes to report concussion-like symptoms to prioritize the health and safety of athletes. For example, Ruston et al. (2019) referenced an event where Green Bay Packers wideout Donald Driver encouraged quarterback, Aaron Rodgers, to sit out after taking a violent hit to the head. After sitting out a game, Rodgers returned to the football field and led the Packers to a Super Bowl championship. In addition to protecting himself from further injury, Rodgers' decision could have played a central role in his teams Super Bowl run. Coaches and members of the media should capitalize on stories such as these to more effectively highlight the benefits of reporting concussion-like symptoms. The benefits of the aforementioned actions will reduce the short- and long-term consequences of a head injury on an athlete.

Conversely, barriers refer to any obstacle making it more difficult for an individual to perform an advocated behavior (Rosenstock, 1974). That is, a preventative behavior may be inconvenient, unpleasant, or upsetting, thereby limiting adoption rates among a priority audience. Within the context of concussions, several barriers reduce athletes' adoption of injury prevention strategies, including medical costs, loss of playing time, and a negative stigma from important others (e.g., coach, family, and teammates) (Chrisman et al., 2013; R. W. Turner et al., 2017). In a recent focus group of parents conducted by Sarmiento et al. (2019), parents revealed that youth players were reluctant to report concussions due to a fear of disappointing the team. Similarly, another parent reported their child did not want to let down their coach. Likewise, Ruston et al. (2019) discovered college athletes make sense of concussion events through a variety of narratives including a *Play-Through-Pain* and a *Masculine Warrior* narrative. Athletes adopting these narratives will be more likely to play through pain as opposed to sitting out. As a result, player perceptions of bravery, perseverance, and toughness can stand in the way of athletes reporting their concussion symptoms to a coach, trainer, parent, or teammate. Pressures such as these constitute barriers to reporting concussion-like symptoms among youth athletes. The persuasiveness of benefits and barriers in performing a recommended behavior is well established as evidenced by Carpenter's (2010) meta-analysis (N = 18), which showed benefits and barriers are the strongest predictors of performing a preventative behavior. In this spirit,

RQ2: How frequently does the Heads Up campaign portray the benefits associated with adopting the recommended behaviors?

RQ3: How frequently does the Heads Up campaign combat the barriers associated with adopting the recommended behaviors?

Borrowed from Bandura's (1977) social cognitive theory, self-efficacy refers to an individual's confidence toward successfully performing a behavior. Within the context of concussions and TBIs, attempts to enhance self-efficacy has focused on raising awareness of signs, symptoms, and the recovery process for athletes themselves and awareness of guidelines for treating athletes with concussion-like symptoms (Conway et al., 2018). Self-efficacy plays an important role in the behavioral adoption process and these interventions appear to be working in collegiate sports. Adame and Corman (2019) showed that self-efficacy was positively associated with higher levels of concussion education among college athletes from a Power-5 NCAA conference. Despite these efforts, a recent study revealed caregivers of youth athletes lacked confidence in their ability to correctly identify concussion symptoms in their child (Patel & Trowbridge, 2017). Within the same study, caregivers observed their older child's desire to hide symptoms, thereby making it more difficult to recognize concussion symptoms. Moreover, messaging designed to elevate perceptions of self-efficacy regarding proper technique and equipment (Patel & Trowbridge, 2019) as well as effective communication (Corman et al., 2019) to reduce the risk of experiencing a concussion or TBI would be effective. Given the effectiveness of interventions at increasing self-efficacy among collegiate athletes, directing attention to the mention of self-efficacy within the *Heads Up* campaign is warranted. Given the importance of self-efficacy in influencing individuals to adopt a recommended action, the fourth research question is advanced.

RQ4: Does the Heads Up campaign model the various ways an individual can reduce the likelihood of experiencing a concussion or TBI?

Cues to action serve as the final HBM variable of interest within the current investigation (Janz & Becker, 1984). The HBM recognizes the important role of cues to action in galvanizing actions in response to suasory messages. Cues to action refer to any stimulus, internal (e.g., physical symptoms) or external (e.g., advice from a friend, medical provider), triggering the decision-making process of an individual toward adopting or rejecting an action (Rosenstock, 1974). Within the current study, the *Heads Up* campaign video messages in and of themselves are external cues; however, we investigate if the videos point viewers to additional sources for concussion harm reduction strategies, symptoms, consequences, and recovery management related information. In this spirit,

RQ5: Does the Heads Up campaign direct viewers to additional concussion related cues to action?

Method

Sample and coder reliability

Given our research questions, we conducted a content analysis of *Heads Up* campaign videos (N = 35) pulled directly from the campaign site. All the video content of *Heads Up* was examined for message elements conveying threat severity, threat susceptibility, benefits, barriers, self-efficacy, and cues to action.

Two authors led the coding process (i.e., developed the codebook, trained the two coders). The coding team worked to revise the codebook so that definitions and codes were clearer and more illustrative of their respective HBM constructs. After revising the codebook and training the coders, two trained coders reviewed an initial subset of (n = 5) videos. They then met and discussed disagreements and made slight modifications to the codebook. Once discrepancies were resolved, the coders independently coded 11 more videos to make up the sample for intercoder reliability (n = 16). Intercoder reliability was assessed using Krippendorff's α using the KALPHA macro for SPSS (Hayes & Krippendorff, 2007). Krippendorff (2004) suggests that reliability values above α = .80 are reliable, whereas values between α = .67 and α = .80 should be used "only for drawing tentative conclusions," and that values below α = .67 are not acceptable (pp. 241–242). Once acceptable reliability was demonstrated, the remaining videos (n = 19) were divided among the two coders (See Table 1).

Measurement

Threat severity

In the context of concussion safety, threat severity was operationalized as health consequences resulting from the health threat (Rosenstock, 1966); these included physical, emotional, and intellectual consequences of brain injury. Coders reliably

Table 1. Intercoder Reliability.

Coded Variables	Simple Agreement (SA)	Krippendorff's α
Severity	1.0	1.0
Short-term	.94	.87
Long-term	1.0	1.0
Specific symptoms (no time-span):		
Headache	1.0	1.0
Loss of consciousness	1.0	1.0
Dizziness	1.0	1.0
*Blurred vision**	1.0	1.0
Light sensitivity	1.0	1.0
Hearing issues	1.0	1.0
Nausea and vomiting	1.0	1.0
Fatigue	1.0	1.0
*Sleep trouble**	1.0	1.0
*Seizure**	1.0	1.0
Memory issues	1.0	1.0
Academic performance issues	1.0	1.0
Trouble concentrating	1.0	1.0
*Depression**	1.0	1.0
*Anger**	1.0	1.0
*Personality changes**	1.0	1.0
*CTE**	1.0	1.0
Susceptibility	1.0	1.0
*Statistical evidence**	1.0	1.0
Visual diagram, graph or model	1.0	1.0
Real-life stories of concussions	1.0	1.0
*Hypothetical example**	1.0	1.0
Metaphor	1.0	1.0
Susceptibility- Messenger Characteristics		
Athlete	1.0	1.0
Medical expert	1.0	1.0
Professional/celebrity athlete	1.0	1.0
Parent	1.0	1.0
Coach	1.0	1.0
Unidentified narrator	.94	.77
Age Group		
Child	1.0	1.0
Adolescent/teenager	1.0	1.0
Adult	1.0	1.0
Gender		
Male	1.0	1.0
Female	1.0	1.0
Race		
White	1.0	1.0
Black	1.0	1.0
Latin	1.0	1.0
Asian	1.0	1.0
*Native**	1.0	1.0
Sport		
Baseball and softball	1.0	1.0
Basketball	1.0	1.0
Bicycling	1.0	1.0
*Boxing and martial arts**	1.0	1.0
*Cheer**	1.0	1.0
*Drill team**	1.0	1.0
*General exercise**	1.0	1.0
Football	1.0	1.0
*Golf**	1.0	1.0
Gymnastics	1.0	1.0
Hockey	1.0	1.0
Lacrosse	1.0	1.0
Swimming and water sports	1.0	1.0
Snow sports	1.0	1.0
Soccer	1.0	1.0
*Track and field**	1.0	1.0
*Wrestling**	1.0	1.0
BMX	1.0	1.0
Equestrian	1.0	1.0
Benefits	1.0	1.0
*Better emotional health outcomes**	1.0	1.0
Better physical health outcomes	1.0	1.0
Better academic benefits	1.0	1.0
Return to sports	1.0	1.0
Barriers	.88	.74

(Continued)

Table 1. (Continued).

Coded Variables	Simple Agreement (SA)	Krippendorff's α
*Uncertainty about avoiding concussions**	1.0	1.0
Uncertainty about concussion symptoms	1.0	1.0
*Lack of concussion awareness**	1.0	1.0
*Medical costs of treatment**	1.0	1.0
*Loss of (potential) scholarship**	1.0	1.0
Loss of playing time	.94	.82
Being made fun of for injury/sitting out	1.0	1.0
*Hurting team success by sitting out**	1.0	1.0
*Missing school to recover**	1.0	1.0
Self-efficacy	1.0	1.0
Player	.88	.74
Skills to avoid concussion	1.0	1.0
Proper helmet use	1.0	1.0
Notice concussions	1.0	1.0
Identify symptoms	.94	.77
Tell someone	1.0	1.0
Parent	.94	.64
Coach	1.0	1.0
*Teammate**	1.0	1.0
See a medical professional	1.0	1.0
Manage concussion treatment	1.0	1.0
Resting	1.0	1.0
Avoiding physical activity	1.0	1.0
*Avoiding mental activity**	1.0	1.0
*Avoiding audiovisual stimuli**	1.0	1.0
*Avoid injury-related stigma**	1.0	1.0
*Glasclow coma scale**	1.0	1.0
*CT Scan/MRI**	1.0	1.0
Parent	1.0	1.0
Skills to avoid concussion	1.0	1.0
Enforce proper helmet use	1.0	1.0
Notice concussions	1.0	1.0
Identify symptoms	1.0	1.0
Tell someone	1.0	1.0
*Coach**	1.0	1.0
*Teammate parent**	1.0	1.0
Take child to a medical professional	1.0	1.0
Check-in on child	1.0	1.0
Manage child's concussion treatment	1.0	1.0
Enforce resting	1.0	1.0
Enforce avoiding physical activity	1.0	1.0
Enforce avoiding mental activity	1.0	1.0
*Enforce avoiding audiovisual stimuli**	1.0	1.0
*Discourage injury-related stigma**	1.0	1.0
*Enforce Glasclow coma scale**	1.0	1.0
*Enforce CT Scan/MRI**	1.0	1.0
Coach	1.0	1.0
*Skills to avoid concussion**	1.0	1.0
*Enforce proper helmet use**	1.0	1.0
*Notice concussions**	1.0	1.0
*Identify symptoms**	1.0	1.0
*Tell someone**	1.0	1.0
*Take player to a medical professional**	1.0	1.0
Adopt concussion protocols	1.0	1.0
*Check-in on player**	1.0	1.0
*Manage player's concussion treatment**	1.0	1.0
*Enforce resting**	1.0	1.0
*Enforce avoiding physical activity**	1.0	1.0
*Enforce avoiding mental activity**	1.0	1.0
*Enforce avoiding audiovisual stimuli**	1.0	1.0
*Discourage injury-related stigma**	1.0	1.0
*Enforce Glasclow coma scale**	1.0	1.0
*Enforce CT Scan/MRI**	1.0	1.0
Cues to Action	1.0	1.0
Step-by-step guidelines ("How to")	1.0	1.0
Campaign website/landing page	.94	.87
Main CDC website	1.0	1.0
CDC Facebook	1.0	1.0
CDC Twitter	1.0	1.0
CDC Hotline	1.0	1.0

**Variables never identified in the intercoder reliability sample (n = 16)* identified any mention of health consequences, which took the form of specific symptoms and side effects, or in a more general statements about severity (e.g., "Concussions are serious.") consistently (SA = 1.0, α = 1.0), while also successfully distinguishing between short- (SA = .94, α = .87) and long-term consequences (SA = 1.0, α = 1.0). The following symptoms were reliably identified: headaches (SA = 1.0, α = 1.0), loss of consciousness (SA = 1.0, α = 1.0), dizziness (SA = 1.0, α = 1.0), light sensitivity (SA = 1.0, α = 1.0), hearing issues (SA = 1.0, α = 1.0), nausea (SA = 1.0, α = 1.0), fatigue (SA = 1.0, α = 1.0), memory issues (SA = 1.0, α = 1.0), concentration issues (SA = 1.0, α = 1.0), and reduced academic performance (SA = 1.0, α = 1.0). Many severity categories included in the codebook were never identified in the coding sample (SA = 1.0, α = 1.0): blurred vision, seizure, sleeping trouble, depression, anger, personality change, and CTE. An "other" category (SA = .88, α = .72) and write-in box were also included.

Threat susceptibility

Susceptibility was conceptualized as the likelihood of experiencing the health threat (Rosenstock, 1966). The coders achieved a respectable intercoder reliability score for threat susceptibility (SA = 1.0, α = 1.0). The operationalization of threat susceptibility breaks down into two categories, types of evidence and messenger characteristics. Several types of susceptibility evidence were reliably identified: narratives (SA = 1.0, α = 1.0), visuals (SA = 1.0, α = 1.0), and metaphors (SA = 1.0, α = 1.0). None of the videos in the reliability sample contained statistical evidence and hypothetical examples (SA = 1.0, α = 1.0).

To evaluate messenger characteristics, we first identified several types of messengers: athletes (SA = 1.0, α = 1.0), professional/celebrity athletes (SA = 1.0, α = 1.0), parents (SA = 1.0, α = 1.0), and coaches (SA = 1.0, α = 1.0). There were also unidentified narrations and voiceovers (SA = .94, α = .77). Many sports were reliably identified: baseball/softball (SA = 1.0, α = 1.0), basketball (SA = 1.0, α = 1.0), bicycling (SA = 1.0, α = 1.0), football (SA = 1.0, α = 1.0), gymnastics (SA = 1.0, α = 1.0), hockey (SA = 1.0, α = 1.0), lacrosse (SA = 1.0, α = 1.0), snowboarding/skiing (SA = 1.0, α = 1.0), soccer (SA = 1.0, α = 1.0), BMX (SA = 1.0, α = 1.0) and equestrian (SA = 1.0, α = 1.0).

We also coded the demographics of the messengers in the videos. Messenger gender was reliably identified as male (SA = 1.0, α = 1.0) and female (SA = 1.0, α = 1.0), none of the messengers were gender non-conforming. General age categories of child (SA = 1.0, α = 1.0), teen/adolescent (SA = 1.0, α = 1.0), and adult (SA = 1.0, α = 1.0) were also coded reliably. Lastly, racial categories were coded for: White (SA = 1.0, α = 1.0), Asian (SA = 1.0, α = 1.0), Black (SA = 1.0, α = 1.0), and Latinx (SA = 1.0, α = 1.0). There were no Native messengers (SA = 1.0, α = 1.0).

Benefits

Benefits were operationalized as identifying positive outcomes from following concussion recommendations (Rosenstock, 1966) and were coded reliably (SA = 1.0, α = 1.0). Benefits in this context included: better physical health outcomes (SA = 1.0, α = 1.0), academic benefits (SA = 1.0, α = 1.0), and the ability to return to playing sports (SA = 1.0, α = 1.0). The research team intentionally looked for the mention of better emotional and mental health outcomes of concussion management, but none were identified in the sample (SA = 1.0, α = 1.0). An "other" category (SA = .88, α = .45) and write-in box were also included.

Barriers

This study looked for messaging elements that acknowledged and overcame barriers to following concussion safety guidelines. Barriers refer to any obstacle that makes performing the advocated behavior more difficult (Rosenstock, 1966). As a general category, barriers were somewhat less reliably identified than the other major categories, but intercoder agreement was still sufficient (SA = .88, α = .74). Several specific barriers were reliably identified: uncertainty about concussion symptoms (SA = 1.0, α = 1.0), loss of playing time (SA = .94, α = .82), and teammates not approving, judging or making fun of concussed players (SA = 1.0, α = 1.0). The following barriers were not referenced in the videos: lack of concussion awareness, uncertainty about how to avoid concussions, loss of scholarship potential from sitting out, hindering team success from sitting out, missing classes during recovery, and medical costs related to concussion diagnosis and management (SA = 1.0, α = 1.0).

Self-efficacy

Self-efficacy was conceptualized as the degree to which performing a behavior is easy or difficult (Bandura, 1977). Because of the highly contextual nature of self-efficacy and the complicated nature of addressing youth injuries, the coding scheme for self-efficacy in this study was broken down into a major category (present/absent), and then sub-categories for players, parents, and coaches. The presence of self-efficacy messages in general was coded reliably (SA = 1.0, α = 1.0). The self-efficacy messages tailored by role in the concussion management process were coded reliably: players (SA = .88, α = .74), parents (SA = 1.0, α = 1.0), and coaches (SA = 1.0, α = 1.0). We also coded for efficacy messages within each role category (player, parent, and coach).

Among messaging directed toward players, several self-efficacy messages were reliably identified: skills to avoid concussion (SA = 1.0, α = 1.0), helmet use (SA = 1.0, α = 1.0), ability to notice concussions (SA = 1.0, α = 1.0), identify symptoms (SA = .94, α = .77), tell someone (SA = 1.0, α = 1.0), tell a coach (SA = 1.0, α = 1.0), and see a doctor (SA = 1.0, α = 1.0). The message to tell a parent was not coded reliably (SA = .94, α = .64). Also, messages for increasing efficacy in management of concussions were also reliably coded (SA = 1.0, α = 1.0), specifically avoiding physical activity (SA = 1.0, α = 1.0) and rest (SA = 1.0, α = 1.0). Other efficacy messages in the codebook were never identified in the intercoder reliability sample (SA = 1.0, α = 1.0): telling a teammate, modeling of a behavioral recommendations, using the Glasgow coma scale, avoiding mental activity and audiovisual stimuli, or how to avoid injury related stigma.

Among messaging directed toward parents, several self-efficacy messages were reliably identified: skills to avoid concussions (SA = 1.0, α = 1.0), helmet use (SA = 1.0, α = 1.0), ability to notice concussions (SA = 1.0, α = 1.0), identify symptoms (SA = 1.0, α = 1.0), tell someone (SA = 1.0, α = 1.0), see a doctor (SA = 1.0, α = 1.0), and to check in with their child (SA = 1.0, α = 1.0). Also, messages for increasing self-efficacy in management of concussions were reliably coded (SA = 1.0, α = 1.0), specifically the importance of their child avoiding physical activity (SA = 1.0, α = 1.0), avoiding mental activity (SA = 1.0, α = 1.0) and resting (SA = 1.0, α = 1.0) if they suffer a concussion. The following were not identified in the reliability sample: telling the coach, telling another team parent, using the Glasgow coma scale, avoiding audiovisual stimuli, or how to avoid injury related stigma and make sure their child doesn't stigmatize other injured players (SA = 1.0, α = 1.0).

Lastly, messaging directed toward coaches was examined. Only one self-efficacy message was reliably identified: the importance of having a concussion protocol (SA = 1.0, α = 1.0). All other potential efficacy messages were not identified in the intercoder reliability sample (SA = 1.0, α = 1.0): skills to avoid concussion, helmet use, ability to notice concussions, identify symptoms, tell someone (including parents), see a doctor, or the need to check in with their players. No messages for increasing coaches' self-efficacy in management of concussions were identified in the intercoder reliability sample (SA = 1.0, α = 1.0).

Cues to action

Cues to action represent an internal or external stimulus which primes a behavior (Rosenstock, 1974). For the current investigation, we focused on external cues within the *Heads Up* videos. Coders achieved a high intercoder reliability score for cues to action, (SA = 1.0, α = 1.0). Cues to action in this context were characterized as additional platforms directed toward viewers at the end of the videos: telephone number (SA = 1.0, α = 1.0), campaign website (SA = .94, α = .87), CDC website (SA = 1.0, α = 1.0), CDC Facebook (SA = 1.0, α = 1.0), CDC Twitter (SA = 1.0, α = 1.0).

Results

RQ1: Heads up portrayal of concussion severity and susceptibility

The first research question examined the *Heads Up* campaign's portrayal of the severity of and susceptibility to experiencing a concussion. Overall, results reveal the majority of videos communicated the seriousness of concussions (n = 25), χ^2 (1, N = 35) = 6.43, p = .01. With respect to conveying the seriousness of concussions, a Cochran's Q test found that the majority of the videos communicated the short- (n = 19) as opposed to the long-term (n = 12) consequences of concussions, Q(1, N = 35) = 4.46, p < .05. Among the symptoms identified in the videos, a loss of consciousness (n = 6) was identified most often followed by memory problems (n = 5), blurred vision (n = 4), dizziness (n = 4), headaches (n = 4), academic problems (n = 3), light sensitivity (n = 3), and nausea (n = 3). The story of pro snowboarder Kevin Pearce illustrates the severity of traumatic brain injuries.

> *Practicing for an Olympic qualifier, snowboarder Kevin Pearce crashed during an advanced stunt and hit his face on the bottom of the frozen halfpipe. Speaking two years after the "pretty gnarly" incident, Pearce says "there's still so much wrong with me," and laments struggling with an invisible disability. He ends on a note that he expects to keep making progress, although it's slower than he would like.*

The story of Tracy, a young, female basketball player, provides a cautionary tale for the consequences of leaving concussions untreated and returning to play too early.

> *Teenage varsity basketball player Tracy collided heads with another player during a rebound. Tracy knew she had a concussion but chose not to tell anyone. She plays a game the next night and loses consciousness after the game. During her six months long recovery process, Tracy suffered severe mobility and balance issues, along with symptoms of nausea and sensitivity to light. She states that she hid her injury trying to "suck it up," but regrets that "instead of missing a game, I missed the season, I miss sports for the rest of my life and I miss out on a great life that I could've had."*

Similarly, the majority of campaign videos (n = 23) conveyed the susceptibility of experiencing a concussion while competing in athletics, χ^2 (1, N = 35) = 3.46, p = .06. A Cochran's Q test revealed susceptibility was conveyed most often via stories of individuals affected by concussions (n = 17) followed by visual presentations (e.g., diagram, graph, and model) (n = 4), Q(2, N = 35) = 22.57, p < .001. Interesting, there was no mention of statistical evidence to convey susceptibility across the videos. McNemar tests revealed stories were featured significantly more than visual presentations (p < .01) and statistics (p < .001). No differences emerged between visual presentations and statistical evidence. One of the best explanations of concussion susceptibility came from video testimony of several experts and athletes: Julie Gilchrist, MD, Gerard A. Gioia, PhD, Margot Putukian, MD, FASCM, pro basketball player Luc Mbah A Moute, and pro baseball player, Justin Morneau. To further enhance key messages, diagrams and text call outs were mixed in with verbal explanations.

> *The video starts with Dr. Gilchrist stating "a concussion is a change in how the brain functions," and then "when the body or head is struck, the brain will slosh around inside the head and change how the brain works," while a visual of an animated skull moving plays. Morneau also emphasizes that concussions can result from body hits as well, using the example of whiplash from car accidents. During a voiceover by Dr. Gioia, the text "youth are more at-risk for concussion," appears alongside a clip of a boy playing baseball. Dr. Putukian clarifies that most concussions do not result in loss of consciousness, implying that other factors must be considered. Moute emphasizes how many ways there are to get a concussion, saying "sometimes it might just be like an elbow to the head or just a tap of somebody coming down from a rebound."*

In addition to examining the presentation of susceptibility, attention was also given to the featured sports and messenger of the videos. Concussions were referenced across several sports with basketball (n = 9) and football (n = 9) cited most often followed by baseball/softball (n = 8), soccer (n = 8), lacrosse (n = 7), bicycling (n = 4), snow sports (n = 3), hockey (n = 2), gymnastics (n = 1), and equestrian (n = 1). Across the *Heads Up* campaign videos, messengers ranged from celebrity athletes (n = 18), medical experts (n =9), non-celebrity athletes (n = 5), unidentifiable narrator (n = 4), parents (n = 3), and coaches (n = 2), Q(5, N = 35) = 28.39, p < .001. Pairwise comparisons revealed celebrity athletes appeared significantly more than other messengers (p < .001) and approached a significant difference with medical experts (p = .06); however, no other messenger differences emerged. McNemar tests revealed the majority of messengers were male (n = 18) compared to female (n = 8), χ^2 (1, N = 35) = 9.10, p< .01. A Cochran's Q test exhibited the vast majority of messengers were White (n = 28) followed by Black (n = 6), Asian Americans (n = 1), and Latinx Americans (n = 1), Q(3, N = 35) = 64.96, p < .001. McNemar tests demonstrated White messengers were featured significantly more than the other racial groups (p < .001). No other racial messenger differences were observed. Lastly, the majority of messengers were adults (n = 30) followed by teenagers (n = 3) and children (n = 1), Q(2, N = 35) = 46.29, p < .001. Pairwise comparisons determined adults were featured significantly more than teens and children (p < .001). No other differences emerged.

RQ2: Heads up portrayal of the benefits of following concussion protocol

The second research question assessed whether the *Heads Up* videos adequately communicated the benefits of following the recommended concussion protocol. Results revealed less than half of the videos communicated the benefits of following the recommended protocol (n = 15), χ^2 (1, N = 35) = 0.71, p = .40. Differences among the benefits cited were significant, Q(3, N = 35) = 11.00, p = .01. The benefits most often cited were better physical health outcomes (n = 8) followed by a return to sports (n = 4). McNemar tests revealed a significant difference between reference to the physical health benefits and both the emotional (p < .01) and academic improvement (p < .01), which were each cited once across the videos. An example of how perceived benefits of following concussion protocol were highlighted occurred in a video of Pro Football Hall of Fame quarterback Kurt Warner telling the story of his 13-year old son reporting concussion symptoms.

"Hey, you're gonna sit out next week. It's not your decision, it's dad's decision." Warner stated he takes this approach to his son and other players he coaches that are experiencing concussion symptoms because "I want to make sure that I'm protecting them for their future so they can accomplish everything they want to."

RQ3: Heads up portrayal of the barriers to following concussion protocol

RQ3 examined the degree to which the *Heads Up* videos identified the barriers to following the recommended concussion protocol. The results demonstrate few videos presented the barriers to following the recommended protocol (n = 12), χ^2 (1, N = 35) = 3.46, p = .06. Leading the way was loss of playing time (n= 5) and an uncertainty about concussion symptoms (n = 5). Teammate stigmatization (n = 2) and hurting the team (n = 1) were also referenced in the videos. A great example of the barriers to following concussion protocol were portrayed in a short story about a mother's account of her son Gary's experience with a concussion. According to his mother, Gary felt like his relationship with his teammates and coaches was hurting due to concussion protocol preventing him from playing.

"It's not easy when your peers are giving you a bad time and even when your coaches are." Gary's mom recalled her son came home from practice one day feeling that he was not a part of the team because of his injury.

RQ4: Heads up portrayal of concussion self-efficacy

The fourth research question examined the *Heads Up* videos' portrayal of self-efficacy with respect to following the recommended concussion protocol. In general, results reveal the majority of videos elevated perceptions of self-efficacy (n = 27), χ^2 (1, N = 35) = 10.31, p < .001. With respect to self-efficacy, the *Heads Up* campaign communicated *parent* (n = 17) and *player* (n = 15) self-efficacy in nearly half of the videos whereas *coach* self-efficacy was significantly less visible (n = 7), Q(2, N = 35) = 7.00, p < .05. With respect to *parent* self-efficacy, the most common strategy to elevate their self-efficacy was identifying symptoms (n = 6), followed by knowing proper fundamentals to avoid concussions (n = 3) and telling others (e.g., coach, parent, and teammate) (n = 2). With respect to *player* self-efficacy, videos identifying concussion symptoms (n = 5) followed by knowing proper fundamentals and equipment usage (n = 4) and telling someone (e.g., coach, parent, or another player) (n = 4) were used to bolster perceptions of self-efficacy among players. Finally, with respect to *coach* self-efficacy, videos identifying concussion symptoms (n = 2), followed by knowing proper fundamentals and equipment usage (n = 1) as well as being encouraged to tell someone (e.g., coach, parent, or another player) (n = 1) were used to bolster perceptions of self-efficacy among players.

Approximately 20% of the *Heads Up* videos informed parents (n = 8), players (n = 7), and coaches (n = 1) on how to manage a concussion. More specifically, *parents* were encouraged to have their child see a doctor/trainer (n = 6), avoid physical activity (n = 6), and to rest (n = 5), Q(2, N = 35) = 0.25, p = .82. Similarly, players were recommended to rest (n = 6), avoid physical activity (n = 5), and to see a doctor/trainer (n = 3), Q(2, N = 35) = 2.80, p = .25. With respect to coaches, they were urged to have their athletes avoid physical activity (n = 2), rest (n = 2), and to see a doctor/trainer (n = 1), Q(2, N = 35) = 2.00, p = .37.

RQ5: Cues to action

The final research question addressed the presence of cues to action within the *Heads Up* videos. Among the collection of videos, the majority featured a cue to act (n = 20). Significant differences emerged among the cues featured with the *Heads Up* campaign website (n = 15) receiving the most frequent attention followed by the CDC's Facebook page (n = 5), the CDC's Twitter feed (n = 2), a hotline (n = 2), and the CDC's website (n = 1), Q(4, N = 35) = 36.22, p < .001. McNemar tests revealed the *Heads Up* website received significantly more mention than the Facebook page (p < .05) as well as the other remaining cues (p < .001). No other differences were observed.

Discussion

This study provides a detailed description of how the *Heads Up* campaign incorporates the HBM into its video messages about concussion awareness and prevention. The rise of concussions among amateur athletes across the United States has elevated public awareness of these accidents into a societal concern (Centers for Disease Control and Prevention, 2020b). Given the increased attention to the signs, symptoms, and the recovery process, as well as the sheer prevalence of concussions, the *Heads Up* campaign continues to serve as an important educational resource aimed at informing athletes, coaches, and parents about the dangers of TBIs. Despite its longstanding existence, until the current investigation, we are aware of no content analysis examining the *Heads Up* campaign video messages. Below, attention is devoted to the theoretical and practical implications of the current study as well as direction for future work.

The HBM was employed to gain greater insight into the central message components of the *Heads Up* video messages. For more than a half of century, the HBM constructs have provided researchers and practitioners with five reliable predictors of behavior (Skinner et al., 2015). Among the five constructs, the health threat, comprised of both severity and susceptibility (Becker & Janz, 1987), was frequently communicated across the campaign video messages. Previous research identifying best practices of communicating concussion awareness and proper protocol routinely identify the effectiveness of communicating concussion seriousness (Adame & Corman, 2019; Schallmo et al., 2017; VanItallie, 2019). Severity was communicated by highlighting both the short- and long-term consequences of concussions with an emphasis placed on the former. Emphasizing the short-term consequences of concussions is a reasonable choice considering this campaign was aimed at amateur athletes. This is a helpful strategy for communicating about concussion severity since the target audience (young athletes and their families and coaches) might be more likely to think about the short-term impact of a concussion (i.e., the immediate safety of the child and the child's brain development) instead of consequences down the line. A similar approach to highlighting short-term costs has proven effective within the context of tobacco prevention (i.e., The Real Cost) messages delivered to teens (e.g., Duke et al., 2019). Alternatively, the lack of attention on long-term consequences may lead to under-estimations of concussion severity and the life-altering consequences of untreated concussions.

Susceptibility was conveyed using stories of athletes representing a range of sports; however, the over-representation of White male athletes affected by concussions is worth mentioning. Specifically, male athletes were featured in the video messages at a 2 to 1 ratio compared to female athletes. There is a parallel between women being erased in sports health messaging to female sports being underprioritized relative to male sports more generally. In her review of gendered exclusion in public life, Perez (2019) showed how the design of parks and sports facilities as well as sports funding all privilege males without conscientious intervention. Similarly, gender parity lags in (sports) medicine as well due to women being excluded from clinical trials based on "concerns" about menstruation and hormone fluctuations (Bruinvels et al., 2017; Perez, 2019). Costello et al. (2014) showed significant underrepresentation of women in sports and exercise medicine, warning that "practitioners should be cognizant of sexual dimorphism and gender disparity in the current literature," (p. 847). In particular to this study, research suggests women may be at an increased risk for experiencing concussions and experience different outcomes following concussion (Brown et al., 2015; Covassin et al., 2016; Dick, 2009). In a preliminary study examining emergency room patients, Wunderle et al. (2014) found support for menstruation affecting concussion outcomes, specifically the "withdrawal hypothesis" which suggests that "TBI occurring in the setting of high progesterone (which is neuroprotective) results in a sudden progesterone decrease and worse outcomes," (p. 4). Considering the potentially heightened risk of concussions for women, it is particularly concerning that women's' under representation in the *Heads Up* campaign may make female athletes, their coaches and their parents feel *less* susceptible to concussion.

Moreover, approximately 4 out of 5 featured athletes were White. Obviously, concussions do not discriminate based on gender or race. Therefore, promotional messages enhancing awareness and proper protocols should more accurately represent the athletes engaging in concussion-risk sports to enhance susceptibility across the population and give a more representative picture of who is actually at risk. Narratives can influence viewers' real-world attitudes (Appel & Richter, 2007) and employing narratives for persuasive purposes has been successfully utilized in the health communication literature (Green, 2006). Specifically, the association between audience similarity to narrative characters and related health beliefs is well established (Green, 2004; Pinkleton et al., 2010). For example, De Graaf (2014) found that participants who read a version of a narrative about cancer with a similar protagonist perceived greater risk and higher efficacy in dealing with symptoms than those who read a version of the narrative with a dissimilar protagonist. Thus, it would be beneficial for *Heads Up* to include a diverse cast of characters in their videos in order to maximize perceived similarity among their audience. In addition to diversifying their cast of characters in *Heads Up*, electing to rely on statistical evidence to convey the scope and frequency of concussion occurrences is a promising strategy to enhance the effectiveness of the campaign. Surprisingly, the *Heads Up* videos did not utilize statistical evidence to demonstrate the seriousness of concussions (i.e., concussion prevalence and brain injury rates).

Decisional balance, commonly referred to as the benefits-to-barriers ratio of performing a behavior, is an important feature of the HBM (Becker & Janz, 1987; Rosenstock, 1974). Results from the current investigation revealed modest mention of the benefits of and barriers to following concussion protocols. This finding is concerning given the persuasive utility benefits and barriers play in influencing preventative behavior performance (see Carpenter, 2010; Skinner et al., 2015). With less than half of the video messages communicating the benefits and/or barriers, unfortunately athletes, coaches, and parents may not fully comprehend the reasons for and against following the Centers for Disease Control and Prevention's (2020a) recommendations for concussion protocol. The cognitive, emotional, and physical benefits of following this protocol is well established (Zanin et al., 2020). Therefore, it is imperative for everyone involved to fully understand the benefits of taking these steps seriously. Recent research suggests the most common barrier to following concussion protocol is a fear of losing playing time or being stigmatized by others for not having the team's best interest (e.g., winning) in mind (Ruston et al., 2019; Sarmiento et al., 2019; R. W. Turner et al., 2017). The *Heads Up* videos scratch the surface by occasionally mentioning these barriers but much more attention is needed for athletes, coaches, and parents to adequately address this barrier head on.

The *Heads Up* campaign successfully delivered messages designed to bolster perceptions of self-efficacy among athletes, coaches, and parents when it comes to recognizing and adhering to concussion protocol. Within the context of concussion education, the importance of enhancing self-efficacy beliefs among individuals cannot be overstated (Adame & Corman, 2019). The majority of these messages were geared to players and parents with considerably less attention devoted to coaches. More specifically, the videos prioritized communication about concussions between parents and their children. Although this is important, concussion messaging should also emphasize the need for communication and symptom awareness between athletes and coaches since coaches are typically the first person to encounter the athlete after an injury. Moreover, research suggests coaches play a pivotal role in whether or not athletes feel comfortable talking to the coach about concussion recognition (Chrisman et al., 2013). More attention should be given to modeling these coach-player conversations. These can be difficult conversations to initiate and conduct. For this reason, future messages should aim to offer guidance to coaches by presenting appropriate coach-athlete conversations regarding concussions and TBIs. Arguably, coaches carefully monitoring player concussion occurrences will be faced with choosing between two competing interests – player health versus team success. These decisions could be made easier for coaches by emphasizing the short- and long-term benefits of following the recommended concussion protocols in concussion messaging (Centers for Disease Control and Prevention, 2020b).

The cues to action highlighted throughout the video messages most often directed viewers to the CDC's *Heads Up* website followed by the CDC's Facebook page, Twitter feed, phone hotline number, and the CDC general website. The decision to drive viewers to the *Heads Up* website is strategic considering the additional information available to interested individuals. Providing an opportunity for athletes, coaches, and parents to take a pledge to recognize concussion symptoms and to report them through appropriate channels represents a promising strategy for the CDC to employ in future iterations of the campaign in order to enhance behavioral adoption.

Despite the current study's contributions, it is not without its limitations. This study is limited in that we only evaluated video messages from the *Heads Up* campaign. Future studies would benefit from comparing concussion messaging from a variety of campaigns produced by international, national, and local groups. It would be beneficial to do a more comprehensive analysis that includes various messages on social media and in schools, especially since younger athletes are likely to encounter messages on social media platforms and while in school. Future studies can build from this work by measuring audiences' reactions to and perceptions of the messages. Are audiences engaged with these video messages and do they resonate with their target audience are just a few of the questions to ask. Future research would also benefit from conducting a survey to assess youth athletes', coaches', and parents' perceptions of concussions and other TBIs utilizing HBM constructs. These survey results would provide valuable insight into the development of future campaign messages, particularly with respect to gender imbalance. It might be that male athletes are not as concerned about concussions compared to female athletes, thereby providing a justification for educational efforts targeted at male athletes.

These findings have important implications for health communicators, educators, athletes, as well as parents and coaches working with amateur athletes. Namely, health education campaigns focusing on concussion awareness, prevention, and management need to 1) emphasize the scope of head injuries and prevalence rates, 2) be more inclusive about depicting severity and susceptibility for female players and sports along with striving for equal representation of racial groups, and 3) target coaches with recommendations for coach-player concussion communication. The current study offers an assessment of the *Heads Up* videos through the lens of the HBM. Overall, the campaign video messages routinely portrayed HBM concepts but their frequency and variability in presentation could be strengthened in future messages. The need for increased attention by health communication researchers and practitioners to the nature of concussions and TBIs among athletes of all ages would be a welcomed undertaking.

References

Adame, B. J., & Corman, S. R. (2019). Vested interests and perceived risk of concussion consequences among Power-5 college athletes. *Health Communication*, *34*(13), 1673–1682. https://doi.org/10.1080/10410236.2018.1517707

Agarwal, N., Thakkar, R., & Than, K. (n.d.). *Sports-related head injury*. American Association of Neurological Surgeons. https://www.aans.org/en/Patients/Neurosurgical-Conditions-and-Treatments/Sports-related-Head-Injury

Appel, M., & Richter, T. (2007). Persuasive effects of fictional narratives increase over time. *Media Psychology*, *10*(1), 113–134. https://doi.org/10.1080/15213260701301194

Bandura, A. (1977). *Social learning theory*. Prentice–Hall.

Becker, M. H., & Janz, N. K. (1987). Behavioral science perspectives on health hazard/health risk appraisal. *Health Services Research*, *22*(4), 537–551. http://www.ncbi.nlm.nih.gov/pubmed/3679842

Brown, D. A., Elsass, J. A., Miller, A. J., Reed, L. E., & Reneker, J. C. (2015). Differences in symptom reporting between males and females at baseline and after a sports-related concussion: A systematic review and meta-analysis. *Sports Medicine*, *45*(7), 1027–1040. https://doi.org/10.1007/s40279-015-0335-6

Bruinvels, G., Burden, R. J., McGregor, A. J., Ackerman, K. E., Dooley, M., Richards, T., & Pedlar, C. (2017). Sport, exercise and the menstrual cycle: Where is the research? *British Journal of Sports Medicine*, *51*(6), 487–488. https://doi.org/10.1136/bjsports-2016-096279

Cao, Z.-J., Chen, Y., & Wang, S.-M. (2014). Health belief model based evaluation of school health education programme for injury prevention among high school students in the community context. *BMC Public Health,14*(1), 26. https://doi.org/10.1186/1471-2458-14-26

Carpenter, C. J. (2010). A meta-analysis of the effectiveness of health belief model variables in predicting behavior. *Health Communication*, *25*(8), 661–669. https://doi.org/10.1080/10410236.2010.521906

Centers for Disease Control and Prevention. (March 11, 2019). TBI: Get the facts. https://www.cdc.gov/traumaticbraininjury/get_the_facts.html

Centers for Disease Control and Prevention. (August 20, 2020a). *YRBSS data and documentation*. https://www.cdc.gov/healthyyouth/data/yrbs/data.htm

Centers for Disease Control and Prevention. (August 31, 2020b). Heads up. https://www.cdc.gov/headsup/index.html

Chrisman, S. P., Quitiquit, C., & Rivara, F. P. (2013). Qualitative study of barriers to concussive symptom reporting in high school athletics. *Journal of Adolescent Health*, *52*(3), 330–335.e3. https://doi.org/10.1016/j.jadohealth.2012.10.271

Conway, F. N., Domingues, M., Monaco, R., Lesnewich, L. M., Ray, A. E., Alderman, B. L., Todaro, S. M., & Buckman, J. F. (2018). Concussion symptom underreporting among incoming National Collegiate Athletic Association Division I college athletes. *Clinical Journal of Sport Medicine*, *30*(3), 203–209. https://doi.org/10.1097/JSM.0000000000000557

Corman, S. R., Adame, B. J., Ruston, S. W., & TSAI, J. (2019) Changing the culture of concussion reporting among college athletes: The role of vested interests, organizational culture, and cultural narrative. *Inter-university Consortium for Political and Social Research* [distributor]. https://doi.org/10.3886/E109184V1

Costello, J. T., Bieuzen, F., & Bleakley, C. M. (2014). Where are all the female participants in sports and exercise medicine research? *European Journal of Sport Science*, *14*(8), 847–851. https://doi.org/10.1080/17461391.2014.911354

Covassin, T., Elbin, R. J., & Sarmiento, K. (2012). Educating coaches about concussion in sports: Evaluation of the CDC's "Heads Up: Concussion in youth sports" initiative. *Journal of School Health*, *82*(5), 233–238. https://doi.org/10.1111/j.1746-1561.2012.00692.x

Covassin, T., Moran, R., & Elbin, R. J. (2016). Sex differences in reported concussion injury rates and time loss from participation: An update of the National Collegiate Athletic Association injury surveillance program from 2004-2005 through 2008-2009. *Journal of Athletic Training*, *51*(3), 189–194. https://doi.org/10.4085/1062-6050-51.3.05

Daugherty, J., DePadilla, L., & Sarmiento, K. (2019). Effectiveness of the US centers for disease control and prevention HEADS UP coaches' online training as an educational intervention. *Health Education Journal*, *78*(7), 784–797. https://doi.org/10.1177/0017896919846185

de Graaf, A. (2014). The effectiveness of adaptation of the protagonist in narrative impact: Similarity influences health beliefs through self-referencing. *Human Communication Research*, *40*(1), 73–90. https://doi.org/10.1111/hcre.12015

DePadilla, L., Miller, G. F., Jones, S. E., Peterson, A. B., & Breiding, M. J. (2018). Self-reported concussions from playing a sport or being physically active among high school students — United States, 2017. *MMWR. Morbidity and Mortality Weekly Report*, *67*(24), 682–685. https://doi.org/10.15585/mmwr.mm6724a3

Dick, R. W. (2009). Is there a gender difference in concussion incidence and outcomes? *British Journal of Sports Medicine*, *43*, i46–i50. https://doi.org/10.1136/bjsm.2009.058172

Duke, J. C., MacMonegle, A. J., Nonnemaker, J. M., Farrelly, M. C., Delahanty, J. C., Zhao, X., Smith, A. A., Rao, P., & Allen, J. A. (2019). Impact of the real cost media campaign on youth smoking initiation. *American Journal of Preventive Medicine*, *57*(5), 645–651. https://doi.org/10.1016/j.amepre.2019.06.011

Fedor, A., & Gunstad, J. (2015). Limited knowledge of concussion symptoms in college athletes. *Applied Neuropsychology: Adult*, *22*(2), 108–113. https://doi.org/10.1080/23279095.2013.860604

Glanz, K., & Bishop, D. (2010). The role of behavioral science theory in development and implementation of public health interventions. *Annual Review of Public Health*, *31*(1), 399–418. https://doi.org/10.1146/annurev.publhealth.012809.103604

Green, M. C. (2004). Transportation into narrative worlds: The role of prior knowledge and perceived realism. *Discourse Processes*, *38*(2), 247–266. https://doi.org/10.1207/s15326950dp3802_5

Green, M. C. (2006). Narratives and cancer communication. *Journal of Communication*, *56*(supplement), S163–S183. https://doi.org/10.1111/j.1460-2466.2006.00288.x

Harmon, K. G., Drezner, J., Gammons, M., Guskiewicz, K., Halstead, M., Herring, S., & Roberts, W. (2013). American medical society for sports medicine position statement: Concussion in sport. *Clinical Journal of Sport Medicine*, *23*(1), 1–18. https://doi.org/10.1136/bjsports-2012-091941

Hayes, A. F., & Krippendorff, K. (2007). Answering the call for a standard reliability measure for coding data. *Communication Methods and Measures*, *1*(1), 77–89. https://doi.org/10.1080/19312450709336664

Heyer, G. L., Weber, K. D., Rose, S. C., Perkins, S. Q., & Schmittauer, C. E. (2015). High school principals' resources, knowledge, and practices regarding the returning student with concussion. *The Journal of Pediatrics*, *166*(3), 594–599. https://doi.org/10.1016/j.jpeds.2014.09.038

Janz, N. K., & Becker, M. H. (1984). The health belief model: A decade later. *Health Education Quarterly*, *11*(1), 1–47. https://doi.org/10.1177/109019818401100101

Kasamatsu, T., Cleary, M., Bennett, J., Howard, K., & McLeod, T. V. (2016). Examining academic support after concussion for the adolescent student-athlete: Perspectives of the athletic trainer. *Journal of Athletic Training*, *51*(2), 153–161. https://doi.org/10.4085/1062-6050-51.4.02

Keegan, R., Spray, C., Harwood, C., & Lavallee, D. (2010). The motivational atmosphere in youth sport: Coach, parent, and peer influences on motivation in specializing sport participants. *Journal of Applied Sport Psychology*, *22*(1), 87–105. https://doi.org/10.1080/10413200903421267

Kılınç, E., & Gür, K. (2020). Behaviours of adolescents towards safety measures at school and in traffic and their health beliefs for injuries. *International Journal of Nursing Practice*, *26*(5), 1–11. https://doi.org/10.1111/ijn.12861

Krippendorff, K. (2004). *Content analysis: An introduction to its methodology* (2nd ed.). Sage.

Kroshus, E., Baugh, C. M., Hawrilenko, M. J., & Daneshvar, D. H. (2015). Determinants of coach communication about concussion safety in US collegiate sport. *Annals of Behavioral Medicine*, *49*(4), 532–541. https://doi.org/10.1007/s12160-014-9683-y

Kroshus, E., Kerr, Z. Y., DeFreese, J. D., & Parsons, J. T. (2017). Concussion knowledge and communication behaviors of collegiate wrestling coaches. *Health Communication*, *32*(8), 963–969. https://doi.org/10.1080/10410236.2016.1196417

Mayo Clinic. (2020). Concussion. https://www.mayoclinic.org/diseases-conditions/concussion/diagnosis-treatment/drc-20355600

McGrath, N. (2010). Supporting the student-athlete's return to the classroom after a sport-related concussion. *Journal of Athletic Training*, *45*(5), 492–498. https://doi.org/10.4085/1062-6050-45.5.492

Patel, S. J., & Trowbridge, C. A. (2017). Caregivers of youth athletes: Developing a theory-based health communication intervention for concussion education. *Journal of Applied Biobehavioral Research*, *22*(4), e12098. https://doi.org/10.1111/jabr.12098

Perez, C. C. (2019). *Invisible women: Exposing data bias in a world designed for men*. Random House.

Pinkleton, B. E., Austin, E. W., & Van de Vord, R. (2010). The role of realism, similarity, and expectancies in adolescents' interpretation of abuse-prevention messages. *Health Communication*, *25*(3), 258–265. https://doi.org/10.1080/10410231003698937

Rice, T., & Curtis, R. (2019). Parental knowledge of concussion: Evaluation of the CDC's "Heads up to parents" educational initiative. *Journal of Safety Research*, *69*, 85–93. https://doi.org/10.1016/j.jsr.2019.02.007

Rosenstock, I. M. (1966). Why people use health services. *The Milbank Quarterly*, *44*(3), 1–32. https://doi.org/10.1111/j.1468-0009.2005.00425.x

Rosenstock, I. M. (1974). Historical origins of the health belief model. *Health Education Monographs*, *2*(4), 328–335. https://doi.org/10.1177/109019817400200403

Rowson, S., Duma, S. M., Greenwald, R. M., Beckwith, J. G., Chu, J. J., Guskiewicz, K. M., Mihalik, J. P., Crisco, J. J., Wilcox, B. J., McAllister, T. W., Maerlender, A. C., Broglio, S. P., Schnebel, B., Anderson, S., & Brolinson, P. G. (2014). Can helmet design reduce the risk of concussion in football? *Journal of Neurosurgery*, *120*(4), 919–922. https://doi.org/10.3171/2014.1.JNS13916

Ruston, S. W., Kamrath, J. K., Zanin, A. C., Posteher, K., & Corman, S. R. (2019). Performance versus safety: Understanding the logics of cultural narratives influencing concussion reporting behaviors. *Communication & Sport*, *7*(4), 529–548. https://doi.org/10.1177/2167479518786709

Sarmiento, K., Donnell, Z., Bell, E., Tennant, B., & Hoffman, R. (2019). A qualitative study of barriers and opportunities for concussion communication and management among parents of youth sports athletes. *Journal of Concussion*, *3*, 1–7. https://doi.org/10.1177/2059700219861863

Sarmiento, K., Miller, G. F., & Jones, S. E. (2020). Sports- or physical activity–related concussions and feelings of sadness or hopelessness among U.S. high school students: Results from the 2017 youth behavior risk survey. *The Journal of School Nursing*, 1–7. https://doi.org/10.1177/1059840520945389

Sawyer, R. J., Hamdallah, M., White, D., Pruzan, M., Mitchko, J., & Huitric, M. (2010). High school coaches' assessments, intentions to use, and use of a concussion prevention toolkit: Centers for disease control and prevention's heads up: Concussion in high school sports. *Health Promotion Practice*, *11*(1), 34–43. https://doi.org/10.1177/1524839907309377

Schallmo, M. S., Weiner, J. A., & Hsu, W. K. (2017). Sport and sex-specific reporting trends in the epidemiology of concussions sustained by high school athletes. *The Journal of Bone and Joint Surgery*, *99*(15), 1314–1320. https://doi.org/10.2106/JBJS.16.01573

Skinner, C. S., Tiro, J., & Champion, V. L. (2015). The health belief model. In B. K. Rimer & K. Viswanath (Eds.), *Health behavior: Theory, research, and practice* (5th ed., pp. 75–94). Wiley.

Sleet, D. A., Carlson Gielen, A., Diekman, S., & Ikeda, R. (2010). Preventing unintentional injury: A review of behavior change theories for primary care. *American Journal of Lifestyle Medicine*, *4*(1), 25–31. https://doi.org/10.1177/1559827609349573

Smoll, F. L., Smith, R. E., & Cumming, S. P. (2007). Effects of coach and parent training on performance anxiety in young athletes: A systemic approach. *Journal of Youth Development*, *2*(1), 19–36. https://doi.org/10.5195/JYD.2007.358

Sone, J. Y., Kondziolka, D., Huang, J. H., & Samadani, U. (2017). Helmet efficacy against concussion and traumatic brain injury: A review. *Journal of Neurosurgery*, *126*(3), 768–781. https://doi.org/10.3171/2016.2.JNS151972

Stead, T. S., Rastogi, V., Hedna, V. S., & Ganti, L. (2016). Awareness of the CDC "Heads Up!" to youth sports campaign among pediatric sports coaches: A pilot survey study. *Cureus*, *8*(8), e755. https://doi.org/10.7759/cureus.755

Turner, R. W., Lucas, J. W., Margolis, L. H., & Corwell, B. N. (2017). A preliminary study of youth sport concussions: Parents' health literacy and knowledge of return-to-play protocol criteria. *Brain Injury*, *31*(8), 1124–1130. https://doi.org/10.1080/02699052.2017.1298003

VanItallie, T. B. (2019). Traumatic brain injury (TBI) in collision sports: Possible mechanisms of transformation into chronic traumatic encephalopathy (CTE). *Metabolism*, *100*(Supplement), 1–6. https://doi.org/10.1016/j.metabol.2019.07.007

Wang, W. L., Hsu, S. D., Wang, J. H., Huang, L. C., & Hsu, W. L. (2014). Survey of breast cancer mammography screening behaviors in Eastern Taiwan based on a health belief model. *The Kaohsiung Journal of Medical Sciences*, *30*(8), 422–427. https://doi.org/10.1016/j.kjms.2014.04.007

Woolsey, C., Waigandt, A., & Beck, N. C. (2010). Athletes and energy drinks: Reported risk-taking and consequences from the combined use of alcohol and energy drinks. *Journal of Applied Sport Psychology*, *22*(1), 65–71. https://doi.org/10.1080/10413200903403224

Wunderle, K., Hoeger, K. M., Wasserman, E., & Bazarian, J. J. (2014). Menstrual phase as predictor of outcome after mild traumatic brain injury in women. *Journal of Head Trauma Rehabilitation*, *29*(5), E1–E8. https://doi.org/10.1097/HTR.0000000000000006

Youth Risk Behavior Survey (YRBS) (August, 20, 2020). *YRBSS data & documentation*. Centers for Disease Control and Prevention. https://www.cdc.gov/healthyyouth/data/yrbs/data.htm

Zanin, A. C., Kamrath, J. K., & Corman, S. R. (2020). Agentic denial: How athletic teams sustain divergent structures during concussion events. *Small Group Research*, *51*(3), 342–374. https://doi.org/10.1177/1046496419883948

Zuckerman, S. L., Kerr, Z. Y., Yengo-Kahn, A., Wasserman, E., Covassin, T., & Solomon, G. S. (2015). Epidemiology of sports-related concussion in NCAA athletes from 2009-2010 to 2013-2014. *The American Journal of Sports Medicine*, *43*(11), 2654–2662. https://doi.org/10.1177/0363546515599634