Using the Integrated Behavioral Model to Determine Sport-Related Concussion Reporting Intentions Among Collegiate Athletes

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Abstract:

Purpose: A significant proportion of sport-related concussions goes unreported among adolescents, which can result in irreversible brain damage. It is critical to identify and intervene on factors that significantly impact concussion reporting. **Methods:** This study tests factors associated with collegiate athletes' intentions to (1) self-report concussion symptoms; (2) report another athlete's concussion symptoms; and (3) encourage others to report. Drawing on the Integrated Behavioral Model, predictors at the athlete level included perceived norms (bystander descriptive norms, injunctive norms, and subjective norms), attitudes (positive and negative expectancies about reporting and playing through a concussion and concussion reporting attitudes), personal agency (self-efficacy to recognize symptoms and communicate), and perceived coach communication. At the team level, coaches' self-reported communication was also included. Athletes (N = 1,858) and coaches (N = 254) at 16 colleges and universities completed Web-based surveys in 2016. Multilevel modeling accounted for the nesting of athletes within athletic team. **Results:** Bystander descriptive norms, positive reporting expectancies, concussion reporting attitudes, self-efficacy to communicate about a concussion, and athletes' perceptions of their coach's communication were positively associated with all three outcomes. By contrast, subjective norms were only positively associated with intentions to self-report and bystander reporting intentions, negative reporting expectancies were only associated with intentions to self-report, and positive and negative expectancies for playing through a concussion were only associated with intentions to self-report and bystander encouragement. **Conclusions:** In sum, multiple factors within the Integrated Behavioral Model predict reporting intentions and underscore the complexity of athletes' concussion reporting behaviors and offer guidance for the development of prevention strategies.

Keywords: Concussion | Concussion reporting | Brain injury | Athlete | Sport

Article:

Implications and Contribution

The Integrated Behavioral Model includes important factors related to concussion reporting. Interventions promoting concussion reporting should target important factors such as reporting expectancies, expectancies of playing through concussion symptoms, reporting attitudes, and self-efficacy to communicate. Future research should investigate further the role of coach–athlete communication and concussion safety.

Adolescent athletes frequently do not report concussion symptoms; thus, it is critical to identify factors that facilitate reporting. Going forward, health care providers and program developers should attempt to correct normative beliefs, challenge negative expectancies, promote positive expectancies, and help athlete develop communication skills regarding concussion reporting.

Annually, nearly four million sport-related concussions are reported in the U.S. [1,2]. This number drastically underestimates the number of actual concussions that occur. Among high school and college athletes, more than 50% of potential sport-related concussions go unreported [3]. Not reporting a concussion is particularly problematic, as concussions can result in irreversible damage to developing adolescent brains [4,5] and have been linked to serious long-term neurological deficits [6,7]. A potential reason for high rates of underreporting is that concussion identification relies heavily on self-report, as many symptoms are internal (e.g., dizziness and confusion) and not visible to observers [[8], [9], [10]]. It is critical to identify and target through intervention, factors that significantly impact concussion reporting.

Integrated Behavioral Model

Intentions are related to future athlete concussion reporting; therefore, determining why some athletes do not report concussion symptoms requires first identifying factors that lower intentions to report. This study draws on the IBM [11] to identify and test several predictors of concussion reporting intentions among a sample of collegiate athletes and includes parts of the Theory of Reasoned Action and Theory of Planned Behavior. We selected the IBM because it allowed for the inclusion of external factors (e.g., coach) that may affect intentions. According to IBM, intentions are the strongest predictor of behavior, and there are three components that directly lead to intentions: (1) perceived norms; (2) attitudes; and (3) personal agency. Given the potential importance of bystander behaviors, we included them subsumed under perceived norms (see Environmental constraints section). Finally, we also included Coach Communication as a main factor related to athlete reporting intentions.

Perceived norms

The IBM divides perceived norms into two factors: (1) descriptive norms (perceptions about the prevalence of a given behavior); and (2) injunctive norms (perceptions about others' approval of a given behavior). We included a third type of perceived norm, subjective norms (perceptions about others' expectations of a given behavior). We expected that athletes who believe that others typically report their concussion symptoms (descriptive) would be more likely to report their own concussion symptoms. Likewise, athletes who believe that other important individuals (e.g.,

teammates, parents, and coaches) approve of (injunctive) and expect (subjective) them to report their concussion symptoms will be more likely to do so. Previous research has documented athlete normative perceptions as an important factor for concussion reporting [12]. Therefore, our *first hypothesis* was that athlete norms related to concussion symptom reporting would be positively associated with reporting intentions (Figure 1, Box 1).

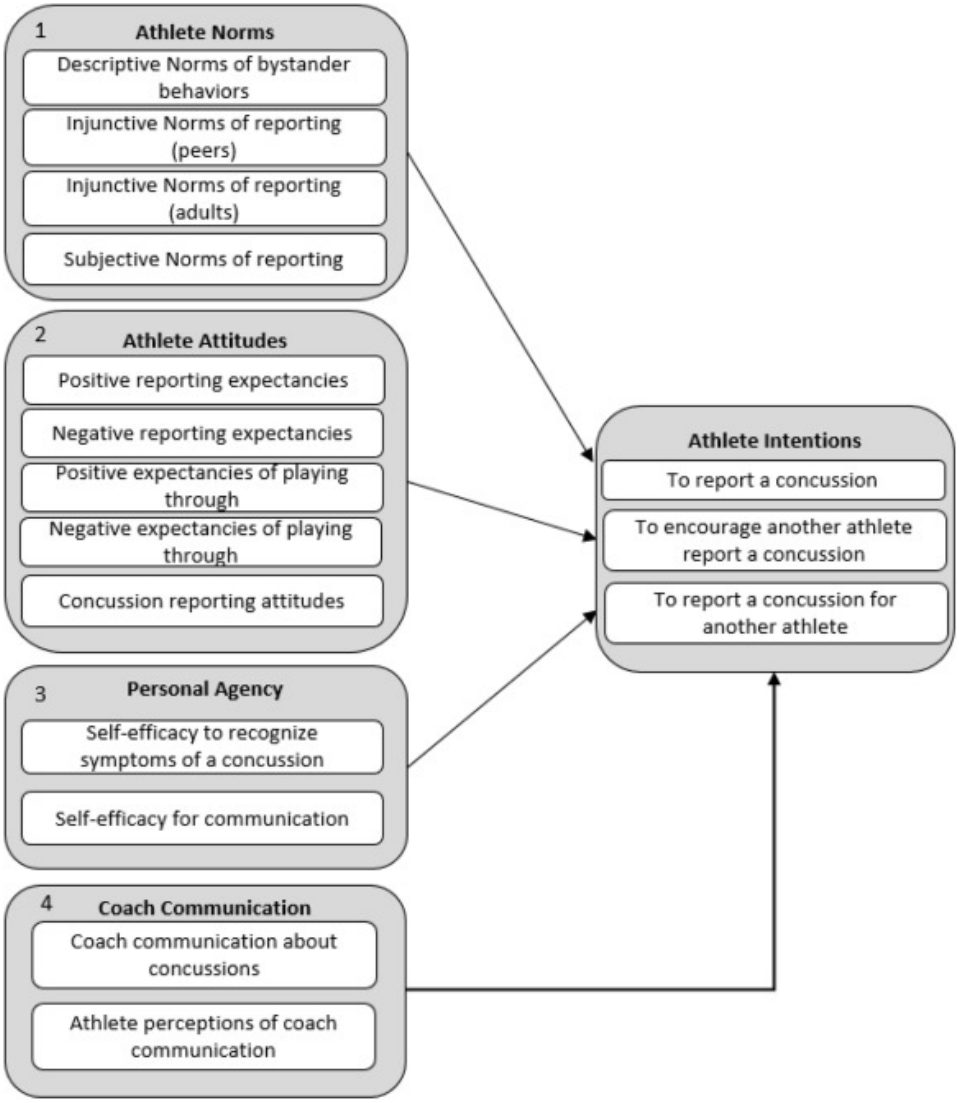

Figure 1. Conceptual model: This figure illustrates the hypothesized relationships between athlete and coach factors and athlete reporting intentions.

Attitudes

We also expected that athletes with favorable attitudes about concussion reporting would express higher intentions to report. Specifically, athletes who believe that concussions are serious injuries and those who believe that reporting a concussion is a good decision would be more likely to report concussion symptoms. Our *second hypothesis* was that more favorable attitudes about concussion reporting as well as less favorable attitudes about playing through injury would be positively associated with increased intentions to report a concussion (Figure 1, Box 2).

Personal agency

A third component preceding intentions is personal agency. This includes an individual's self-efficacy to engage in a given behavior as well as their perceived control over that behavior. This study focused on self-efficacy to identify symptoms of a concussion and self-efficacy to report concussion symptoms to their coach. Our *third hypothesis* was that self-efficacy to identify symptoms and self-efficacy to report a concussion would be positively associated with reporting intentions (Figure 1, Box 3).

Environmental constraints

In addition to intentions, IBM suggests that environmental constraints also directly shape behavior. Given that coaches shape athletes' environments and play an important role in their life [[13], [14], [15]], coaches may be an important factor that affects concussion reporting. We included coaches' behavior as a potential predictor of concussion reporting intentions. For example, if coaches talk to their athletes about concussion safety, these athletes might have greater intentions to report concussion symptoms. Therefore, our *fourth hypothesis* was that coach communications about concussions would be positively associated with reporting intentions (Figure 1, Box 4).

This study extends previous work in three important ways. First, we test a comprehensive model that includes all three predictors of intentions to report concussion symptoms. Second, given the importance of bystander behaviors in prevention [16,17], we tested whether these same factors predict intentions to engage in two bystander behaviors (1) bystander reporting intentions (i.e., reporting another athlete's concussion symptoms); and (2) bystander encouragement (i.e., encouraging another athlete to report concussion symptoms). Finally, unlike other studies, we include data from coaches in addition to data from athletes.

Methods

Participants and procedures

Data were collected in the fall semester of 2016 and occurred before participants were exposed to any intervention. Institutions were recruited through a national athletic trainers' listserv. Initially, 28 National Collegiate Athletic Association (NCAA) colleges/universities expressed interest; ultimately, 16 of those (57%) institutions agreed to participate (Table 1). Athletics departments provided the names and email addresses of their athletes (N = 6,001) and coaches (N = 472). Researchers emailed all athletes and coaches, inviting them to participate. To promote participation, schools that exceeded a survey completion rate of 80% received a school-level report and were entered into a drawing for $1,000.00. A total of 2,793 (47%) athletes and 267 (57%) coaches provided data for this study. On average, there were 15 athletic teams at each school (range: 7–23), with an average of 11 athlete respondents per team (range: 1–67). Within school, participation rates ranged from 2% to 97% for athletes and between 0% and 97% for coaches; however, most schools had more than 30% of their athletes and coaches participate. Table 1 includes school-specific athlete and coach participation rates. Including the coach

variable led to missing data for athletes (i.e., those who did not have a coach that responded) and reduced the athlete sample by 935 and the coach sample by 18. This resulted in a final analytic sample of 1,858 athletes and 249 coaches. Procedures were approved by an institutional review board, and informed consent was obtained electronically before survey access.

Table 1. Detailed information for participating schools

School	Enrollment	Athletes, n (%)	Coaches, n (%)	NCAA division	Geographical region
1	18,295	73 (17)	16 (34)	I	South Atlantic
2	18,056	84 (19)	5 (11)	I	Pacific
3	6,474	212 (46)	25 (83)	I	Northeast
4	8,096	16 (6)	0 (0)	I	South Atlantic
5	22,284	247 (65)	34 (71)	I	Mid-Atlantic
6	19,653	218 (97)	33 (97)	I	South Atlantic
7	3,151	94 (24)	15 (71)	II	South Atlantic
8	1,177	248 (60)	25 (71)	II	Midwest
9	6,764	125 (47)	25 (83)	II	Midwest
10	27,681	71 (33)	11 (65)	II	Pacific
11	4,300	89 (39)	5 (46)	II	Southwest
12	4,478	5 (2)	1 (4)	II	South
13	1,357	66 (40)	9 (60)	II	South Atlantic
14	2,217	135 (32)	24 (71)	III	Midwest
15	10,826	98 (22)	8 (23)	III	Midwest
16	697	77 (21)	13 (48)	III	South Atlantic

NCAA = National Collegiate Athletic Association.

Measures

Athlete outcome measures

Reporting intentions: Self. Athletes reported how likely they were to tell their coach if they had experienced symptoms of a concussion during: (1) a preseason practice; (2) a regular season practice; (3) a regular season game; and (4) a championship game (1 = extremely unlikely to 5 = extremely likely). Athletes also reported how likely they were to tell an athletic trainer if they had experienced symptoms of a concussion during (1) a preseason practice; (2) a regular season practice; (3) a regular season game; and (4) a championship game (1 = extremely unlikely to 5 = extremely likely). We averaged the four coach and four athletic trainer items ($\alpha = .94$) to capture students' intentions to report their *own* concussion symptoms.

Bystander effects: Reporting intentions. Athletes also reported how likely they were to tell (1) a coach; or (2) an athletic trainer if a teammate was experiencing concussion symptoms (1 = extremely unlikely to 5 = extremely likely). We averaged these two items ($r = .90$) to capture athletes' intentions to report concussion symptoms in others.

Bystander effects: Encouragement. Athletes reported how likely they were to encourage a teammate to report their concussion to (1) a coach; or (2) an athletic trainer (1 = extremely unlikely to 5 = extremely likely). We averaged these two items ($r = .90$) to capture athletes' intentions to encourage concussion reporting in other athletes.

Athlete predictor measures

Athlete norms. With guidance from previous concussion research [18], we used four measures to capture athletes' perceptions about concussion reporting. First, athletes reported the percentage of all NCAA athletes they believed would (1) tell a coach, athletic trainer, or a sports medicine staff member; and (2) "encourage a teammate to tell" if they suspected that their teammate was experiencing symptoms of a concussion. We averaged the responses (0%–100%) for these two items and divided by 100 to create a *bystander descriptive norms* scale (r = .67). Second, athletes reported what percentage of all NCAA athletes they thought would approve of five reporting behaviors (e.g., "Would approve of a teammate telling a coach…if he or she was experiencing concussion symptoms?). We averaged the responses (0%–100%) and divided by 100 to create an *injunctive norms: peers* scale (α = .85). Third, athletes reported how much four different athletics staff members (e.g., head coach and athletic trainer) would approve of them reporting a concussion (1 = strongly disapprove to 5 = strongly approve). We averaged these items to create the *injunctive norms: athletics staff* scale (α = .95). Finally, athletes reported how much each of these same athletics staff members *expected* them to report concussions. We averaged these items to create a *subjective norms scale* (α = .86).

Athlete attitudes. We used five measures to assess athlete concussion attitudes. We adopted four measures from the Rosenbaum and Arnett's Concussion Attitudes Index [19]. First, athletes reported how likely it was that they would experience different consequences (e.g., make my family proud and let my teammates down) if they told a coach or athletics staff about concussion symptoms (1 = extremely unlikely to 5 = extremely likely). We created two measures from the responses: *positive reporting expectancies* (two items; *r* = .36) and *negative reporting expectancies* (three items; α = .61). Athletes also reported how likely it was that playing through concussion symptoms would lead to specific outcomes (e.g., help me achieve my athletic goals; prevent me from maintaining my long-term health; 1 = extremely unlikely to 5 = extremely likely). We created two measures from their responses: *positive expectancies of playing through* (four items; α = .87) and *negative expectancies of playing through* (four items; α = .78). We adapted the final measure from the Theory of Reasoned Action/Theory of Planned Behavior questionnaire developed by Register-Mihalik et al. [8], in which athletes indicated their attitudes about reporting concussion symptoms to a coach or other athletics staff. Each item was rated on a 7-point scale that had two opposite anchors (e.g., "Reporting symptoms of a concussion would be… 1 = difficult to 7 = easy). We deleted two items that had been included in the original scale because we included the wrong number of response options when setting up the survey. We averaged the remaining five items to create a *concussion reporting attitudes* scale (α = .83).

Personal agency. Athletes answered six questions about how confident they were that they could recognize and report concussion symptoms (1 = not at all confident to 5 = completely confident). *Self-efficacy to recognize athlete* was a 1-item measure that captured how confident athletes were that they could recognize signs and symptoms of a concussion in someone else. *Athlete self-efficacy for communication* was the average of five items (α = .81) measuring how confident athletes were that they could communicate with a coach and/or other athletes about concussion-related issues (e.g., "talk with a coach, athletic trainer, or other medical personnel if you think a teammate is showing symptoms of a concussion).

Perceived coach communication. Athletes reported whether their coach talked to their team about different concussion issues (e.g., "the importance of managing concussions properly"). We averaged the six items (0 = no and 1 = yes) to create the *athlete perceptions of coach communication* scale (α = .93).

Coach predictor measures

Coach communication. Coaches reported how often since the beginning of the season they had communicated about different concussion topics with their athletes (e.g., that they will not be penalized for reporting a concussion) on a 5-point scale (1 = never to 5 = very often (four or more times)). We averaged these seven items to create the *coach communication* scale (α = .94) for each coach. For teams that had multiple coaches respond to the survey, we then averaged across all coaches for that team to create a single team-level score.

Data analysis

We used multilevel modeling to account for the nesting of athletes (level 1) within athletic team (level 2), as athletes on the same team have the same coach(es) and therefore are not independent of each other. We originally examined a three-level model but found nonsignificant variance at the school level for each of the three outcomes (all accounted for by teams). Therefore, we chose to keep the models simpler and run them as a two-level model. We also confirmed that the results did not change when a three-level model was used. We ran a separate model for each of the three outcome measures. Owing to potential differences in concussion reporting intentions between male and female athletes, we controlled for athlete gender (indicator group = female). Based on the immediacy of some effects (e.g., losing spot on team), we expected that athletes reporting intentions would differ based on season status; therefore, we controlled for whether the athlete's sport was in season at the time of the survey. Finally, we controlled for the level of contact (limited contact, contact, and collision) in the athlete's sport, as defined by the NCAA [20]. We expected that reporting intentions may differ depending on how likely they are to experience a concussion (e.g., limited contact sport athletes may view concussion as unlikely and thus express greater intentions to report because they have never experienced a concussion). We conducted all analyses using SPSS version 24 (IBM Corp., Armonk, NY), and an alpha level of $p < .05$ was used as the threshold for significance in all analyses.

Results

Participant descriptive information

The analytic sample of athletes had slightly more males (N = 1,025, 55%) than females (N = 833, 45%), and two thirds of the coaches were male (Table 2). Most participants indicated that they were white (athletes: N = 1,357, 73%; coaches: N = 202, 81%) or black/African American (athletes: N = 247, 13%; coaches: N = 30, 12%). Most of the athletes (N = 1,268, 68%) were currently in-season, and there were slightly more athletes in their first (N = 670, 36%) or second (N = 457, 25%) year of athletic eligibility compared with those in their third (N = 365, 20%) or fourth (N = 310, 17%) year.

Table 2. Sample characteristics

Characteristic	Athlete (N = 1,858), n (%)	Coaches (N = 249), n (%)
Gender		
Male	1,025 (55.2)	166 (66.7)
Female	833 (44.8)	83 (33.3)
Contact category		
Collision	909 (48.9)	98 (39.4)
Contact	457 (24.6)	68 (27.3)
Limited contact	492 (26.5)	83 (33.3)
Season		
In	1,268 (68.2)	170 (68.3)
Out	590 (31.8)	79 (31.7)
Year		
First	670 (36.1)	-
Second	457 (24.6)	-
Third	365 (19.6)	-
Fourth	310 (16.7)	-
Fifth+	45 (2.4)	-
Not reported	11 (.6)	-
Race		
White	1,357 (73.0)	202 (81.1)
Black or African American	247 (13.3)	30 (12.0)
Multiracial	77 (4.1)	2 (.8)
Hispanic or Latino	121 (6.5)	8 (3.2)
Asian	25 (1.3)	1 (.4)
Other	24 (1.3)	6 (2.8)
Not reported	7 (.4)	-
Coach rank		
Head coach	-	127 (51.0)
Associate coach	-	9 (3.6)
Assistant coach	-	113 (45.4)

Percentages may not add to 100 because of rounding.

Table 3. Bivariariate correlations for all key risk and protective factors

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Reporting intentions: self																
2. Bystander effects: reporting int.	.57∗															
3. Bystander effects: encouragement	.57∗	.54∗														
4. Bystander descriptive norms	.32∗	.29∗	.32∗													
5. Injunctive norms: peers	.30∗	.26∗	.32∗	.66∗												
6. Injunctive norms: athletics staff	.19∗	.14∗	.23∗	.15∗	.21∗											
7. Subjective norms	.32∗	.23∗	.39∗	.28∗	.34∗	.32∗										
8. Positive reporting expectancies	.29∗	.24∗	.26∗	.10∗	.15∗	.17∗	.21∗									
9. Negative reporting expectancies	−.28∗	−.12∗	−.20∗	−.16∗	−.17∗	−.09∗	−.20∗	−.20∗								
10. Positive expectancies of playing	−.25∗	−.14∗	−.28∗	−.13∗	−.11∗	−.14∗	−.20∗	−.06∗	.30∗							
11. Negative expectancies of playing	.21∗	.13∗	.34∗	.12∗	.14∗	.18∗	.27∗	.20∗	−.09∗	−.14∗						
12. Concussion reporting attitudes	.52∗	.36∗	.49∗	.25∗	.28∗	.25∗	.34∗	.28∗	−.29∗	−.25∗	.25∗					
13. Self−efficacy to recognize concussion	.21∗	.21∗	.22∗	.15∗	.12∗	.12∗	.17∗	.13∗	−.03∗	−.06∗	.11∗	.16∗				
14. Self-efficacy to communicate	.45∗	.50∗	.44∗	.26∗	.25∗	.17∗	.26∗	.24∗	−.16∗	−.16∗	.15∗	.38∗	.45∗			
15. Percepeption of coach communication	.18∗	.23∗	.14∗	.07∗	.10∗	.09∗	.12∗	.12∗	−.06∗	−.04	.02	.14∗	.11∗	.19∗		
16. Coach communication	−.04	−.01	−.05∗	−.02	−.03	.03	−.02	.04	.02	.00	−.03	.00	−.01	−.01	.14∗	
Mean	3.79	4.24	3.50	.52	.64	4.60	4.34	3.43	2.77	2.12	4.06	5.89	3.38	3.52	.58	2.54
SD	.89	.76	1.05	.26	.25	.77	.72	.84	.80	.93	.81	1.02	.98	.79	.42	.96

Significant correlations ($p < .05$) are indicated with an Asterisk.
SD = standard deviation.

Table 3 provides descriptive statistics for each key variable in this study and provides bivariate correlations among these variables.

Regression results

Table 4 provides the results of multilevel regression models. We found that as *bystander descriptive norms* increased, so did all three outcomes. More specifically, for every unit increase in *bystander descriptive norms*, there was a .38 unit increase in reporting intentions: self; a .46 unit increase in bystander effects: reporting intentions; and a .25 unit increase in bystander effects: encouragement. We also found that as *subjective norms* increased, so did two of the three outcomes (i.e., reporting intentions: self and bystander effects: reporting intentions). For every unit increase in *subjective norms*, there is a .07 unit increase for reporting intentions: self and a .11 unit increase in bystander effects: encouragement. Neither *injunctive norms* measure was independently associated with any of the outcomes.

Table 4. Results of multilevel regression models for all factors and the three primary outcomes

Characteristic	**Reporting intentions: self**	**Bystander effects: reporting intentions**	**Bystander effects: encouragement**
	Estimated (SE)	**Estimated (SE)**	**Estimated (SE)**
Intercept	.74 (.19)***	−.13 (.25)	.91 (.16)***
Controls			
Female	−.06 (.04)	−.03 (.05)	.20 (.04)***
In season	−.02 (.04)	−.01 (.06)	.00 (.04)
Collision	-	-	-
Contact	.08 (.05)	.18 (.07)*	.03 (.05)
Limited	.17 (.05)**	.18 (.07)*	.10 (.05)*
Perceived norms			
Bystander descriptive norms	.38 (.08)***	.46 (.10)***	.25 (.07)***
Injunctive norms: peers	.06 (.09)	.12 (.11)	.12 (.07)
Injunctive norms: athletics staff	−.01 (.02)	−.02 (.03)	.01 (.02)
Subjective norms	.07 (.03)**	.02 (.03)	.11 (.02)***
Attitudes			
Positive reporting expectancies	.10 (.02)***	.11 (.03)***	.04 (.02)*
Negative reporting expectancies	−.09 (.02)***	.05 (.03)	.03 (.02)
Positive expectancies of playing	−.08 (.02)***	−.03 (.02)	−.08 (.02)***
Negative expectancies of playing	.04 (.02)*	.00 (.03)	.14 (.02)***
Concussion reporting attitudes	.25 (.02)***	.15 (.02)***	.17 (.02)***
Personal agency			
Self-efficacy to recognize	.00 (.02)	−.02 (.02)	.01 (.02)
Self-efficacy to communicate	.25 (.02)***	.48 (.03)***	.22 (.02)***
Coach communication			
Perceptions of coach communication	.16 (.04)***	.33 (.05)***	.12 (.03)***
Coach communication	.00 (.02)	.03 (.03)	−.02 (.02)

SE = standard error.
*$p < .05$.
**$p < .01$.
***$p < .001$.

Regarding attitudes, we found that as *positive reporting expectancies* increased, so did reporting intentions: self and both bystander effects. This results in a .10 unit increase for reporting

intentions: self; a .11 unit increase in bystander effects: reporting intentions; and a .04 unit increase in bystander effects: encouragement with every unit increase in *positive reporting expectancies*. We also found that as *negative reporting expectancies* increase, concussion reporting intentions: self decreased. For every unit increase in *negative reporting expectancies*, there was a .09 unit decrease for reporting intentions: self. We found that as *positive expectancies for playing through* a concussion increased, intentions to report: self and bystander effects: encouragement decreased. For every unit increase in *positive expectancies for playing through* a concussion, there was a .08 unit decrease in intention to report: self and .08 unit decrease in bystander effects: encouragement. *Negative expectancies for playing through* a concussion was associated with two of the three outcomes (i.e., reporting intentions: self and bystander effects: encouragement) but was not associated with bystander effects: reporting intentions. As *negative expectancies for playing through* a concussion increased, so did intentions to report: self and bystander effects: encouragement. For every unit increase in *negative expectancies for playing through* a concussion, there was a .04 unit increase in intentions to report: self and .14 unit increase in bystander effects: encouragement. Finally, we found that as *concussion reporting attitudes* increased, so did reporting intentions: self and both bystander effects. For every unit increase in *concussion reporting attitudes*, there was a .25 unit increase for reporting intentions: self, a .15 unit increase in bystander effects: reporting intentions, and a .17 unit increase in bystander effects: encouragement.

With respect to personal agency, *self-efficacy to recognize athlete* (i.e., recognize symptoms in another athlete) was not significantly associated with any of the outcomes. By contrast, *self-efficacy to communicate* about a concussion was positively associated with all three outcomes. Specifically, athletes who felt more confident that they could communicate with their coaches and teammates also reported they would be more likely to report a concussion for themselves and others, as well as encourage their teammates to report their concussions. Consequently, for every unit increase in *self-efficacy to communicate* about a concussion, there was a .25 unit increase for reporting intentions: self, a .48 unit increase in bystander effects: reporting intentions, and a .22 unit increase in bystander effects: encouragement.

Finally, *coach communication* about concussions was not associated with any of the outcomes. However, as athletes' *perceptions of coach communication* increased, so did reporting intentions: self and both bystander effects. For every unit increase in an athletes' *perceptions of coach communication*, there was a .16 unit increase for reporting intentions: self, a .33 unit increase in bystander effects: reporting intentions, and a .12 unit increase in bystander effects: encouragement.

Discussion

In our final models, only bystander norms predicted all three outcomes. Athletes who believed others would report their peers' concussion symptoms (e.g., descriptive norms) also had higher intentions to report concussions in themselves and others, as well as encourage their peers to report concussion systems. Consistent with other studies [18], subjective norms predicted intentions to report concussion symptoms. We found subjective norms also predicted encouraging another athlete to report but did not predict intentions to report another athlete's concussion symptoms. To shift normative perceptions, athletes should be presented with accurate

reporting normative data. This can be accomplished through a variety of methods, including social media, face-to-face presentation, and direct communication from coaches. Importantly, normative messaging should be accurate and presented in a salient manner. Neither injunctive norms measures were independently associated with the outcomes, although it is an important factor related to other college student behaviors [21] (e.g., substance abuse). Notably, both injunctive norms measures were positively associated with the outcomes in the bivariate correlations. It is possible that they were not significant predictors in the final model because of their shared correlations with other variables. Indeed, injunctive norms about peers were strongly correlated with bystander descriptive norms, perhaps because perceived approval from peers about reporting might influence their perceptions of how their peers would react.

Consistent with other studies [22,23], we found that athletes who expected negative consequences of reporting and few positive had lower intentions to report. Sport culture is deep seated in a culture of "toughness" and heavily performance based (e.g., "nothing less than 100%") and may be related to playing through pain and potential injury [24]. We found that athletes with higher positive attitudes related to playing through injury had lower intentions to self-report concussion symptoms. This is challenging because if no one else but the athlete knows about their symptom and then receives praise for their play, their attitude regarding playing through becomes favorable. Similarly, as an athlete's negative attitudes related to playing through injury increase, so too do reporting intentions. This held true for encouraging another athlete to report their symptoms but not for intentions to tell a coach about another athlete's symptoms. Perhaps, the idea of telling a coach about another athlete's symptoms contradicts sport culture that is rooted in loyalty, and therefore, negative attitudes about playing through are not important enough to counter sport culture. To shift athlete expectations, future interventions ought to consider scenario-based strategies in which athletes navigate through reporting versus playing through. In addition, education for coaches should include strategies to encourage the use of communication to purposefully minimize the perpetuation of a culture supportive of playing through injury.

To our knowledge, this is the first study to investigate self-efficacy and concussion reporting among collegiate athletes, although Kroshus et al. [25] found that reporting self-efficacy was significantly associated with both concussion reporting intentions and behaviors. We found that confidence in recognizing symptoms of a concussion was not independently associated with any of the outcomes, suggesting education alone is not enough. We did, however, find that those with greater self-efficacy to communicate about a concussion had greater intentions to report their symptoms, and greater intentions to engage in positive bystander behaviors. Those interested in promoting concussion reporting among collegiate athletes should consider educational approaches that bring coaches and athletes together to develop their collective communication skills. This could be done through coach–athlete small group sessions or team-based activities to promote the use of effective communication strategies.

Pressure from coach is an important element regarding continuing to play while symptomatic [26,27]. Kroshus et al. noted that athletes are more likely to intend to continue playing when they received pressure from multiple sources and that 13.68% of their sample experienced pressure from a coach [27]. Another study indicated that perceived coach support was an important factor related to returning to play while symptomatic [28]. We found coach communication

significantly associated with all three outcomes; however, it was athlete *perceptions* of coach communication that mattered most. It may be more important what athletes believe they hear rather than what's communicated. Alternatively, it may be more about the coach–athlete relationship (e.g., athletes with positive coach relationships believe concussion safety communication occurred more often than it did). Others have noted the importance of positive coach–athlete attachment and concussion reporting [29]. Future interventions for athletes and coaches should consider strategies to strengthen the coach–athlete relationship. This could be accomplished through team-based and small group–based activities that allow coaches and athletes opportunity to reflect on their relationship and its role with concussion care-seeking [29].

Limitations

First, our final analytic sample only included athletes whose coaches provided data. This resulted in a decrease in sample size. We conducted analyses to test if the analytic sample differed from those with missing coach data. We found the analytic sample was overrepresented by males and collision sport athletes and had statistically significantly lower intentions on all three outcomes. However, the regression results did not change after including those without coach data and removing the coach communication variable, so we elected to remove those without coach data. Second, we did not measure reporting behaviors; however, intentions have been established as a reliable measure for predicting future athlete concussion reporting behaviors [22]. Third, as with many studies, selection bias may have occurred; however, our sample's gender and race proportions match that of the NCAA's data from the 2016 year [30], and our sample is balanced by NCAA division and contact category (Table 2). Finally, our sample draws from more first- and second-year athletes. Other studies [27,28] underscore class year as an important factor related to concussion reporting, and this may have impacted our findings.

Conclusion

Underreporting of concussion is driven by multiple factors. Much of the research to date has focused on single domains and have not included multilevel factors in their analyses. Our findings suggest factors within the IBM predict concussion reporting intentions and intentions to encourage more so than to report another student–athlete's concussion symptoms. Importantly, we identified multiple factors that significantly affect concussion reporting intentions of athletes and underscore the complexity of concussion reporting behaviors of athletes.

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References

[1] Langlois JA, Rutland-Brown W, Wald MM. The epidemiology and impact of traumatic brain injury: A brief overview. J Head Trauma Rehabil 2006;21:375e8.

[2] Torres DM, Galetta KM, Phillips HW, et al. Sports-related concussion: Anonymous survey of a collegiate cohort. Neurol Clin Pract 2013;3:279e87.

[3] Llewellyn T, Burdette GT, Joyner AB, Buckley TA. Concussion reporting rates at the conclusion of an intercollegiate athletic career. Clin J Sport Med 2014;24:76e9.

[4] Choe MC, Babikian T, DiFiori J, et al. A pediatric perspective on concussion pathophysiology. Curr Opin Pediatr 2012;24:689e95.

[5] Shrey DW, Griesbach GS, Giza CC. The pathophysiology of concussions in youth. Phys Med Rehabil Clin N Am 2011;22:577e602.

[6] Kroshus E, Kubzansky LD, Goldman RE, Austin SB. Norms, athletic identity, and concussion symptom under-reporting among male collegiate ice hockey players: A prospective cohort study. Ann BehavMed 2015;49:95e103.

[7] Kroshus E, Daneshvar DH, Garnett CM, et al. NCAA concussion education in ice hockey: An ineffective mandate. Br J Sports Med 2013;48:135e40.

[8] Register-Mihalik JK, Guskiewicz KM, Valovich TC, et al. Knowledge, attitude, and concussion-reporting behaviors among high school athletes: A preliminary study. J Athletic Train 2013;48:645e53.

[9] McCrory P, Meeuwisse W, Aubry M, et al. Consensus statement on concussion in sport e The 4th international conference on concussion in sport held in Zurich. Clin J Sport Med 2013;23:89e117.

[10] Kerr ZY, Register-Mihalik JK, Marshall SW, et al. Disclosure and non-disclosure of concussion and concussion symptoms in athletes: Review and application of the socio-ecological framework. Brain Inj 2014;28:1009e21.

[11] Fishbein M, Yzer MC. Using theory to design effective health behavior interventions. Commun Theor 2003;13:164e83.

[12] Register-Mihalik J, Baugh C, Kroshus E, et al. A multifactorial approach to sport-related concussion prevention and education: Application of the socioecological framework. J Athletic Train 2017;52:195e205.

[13] Bolter N, Weiss M. Coaching behaviors and adolescent athletes' sportspersonship outcomes: Further validation of the sportsmanship coaching behavior scale (SCBS). Sport Exerc Perform Psychol 2013;2:32e47.

[14] Jowett S, Cockerill IM. Solutions in sport psychology. London: Thomson Learning; 2002.

[15] Price M, Weiss M. Relationships among coach leadership, peer leadership, and adolescent athletes' psyhcosocial and team outcomes: A test of transformational leadership theory. J Appl Sport Psychol 2013;25:265e79.

[16] Katz J, Moore J. Bystander education training for campus sexual assault prevention: An initial metaanalysis. Violence Vict 2013;28:1054e67.

[17] Zinzow HM, Thompson MP, Goree J, et al. Evaluation of a college sexual violence prevention program focused on education, bystander intervention, and alcohol risk reduction. Coll Student Aff J 2018;36:110e25.

[18] Register-Mihalik JK, Linnan LA, Marshall SW, et al. Using theory to understand high school aged athletes' intentions to report sport-related concussion: Implications for concussion education initiatives. Brain Inj 2013;27:878e86.

[19] Rosenbaum AM, Arnett PA. The development of a survey to examine knowledge about and attitudes toward concussion in high-school students. J Clin Exp Neuropsychol 2008;32:44e55.

[20] National Collegiate Athletic Association. NCAA sports medicine handbook: Sport-related concussion. Indianapolis, IN: NCAA; 2014.

[21] Larimer ME, Turner AP, Mallett KA, Geisner IM. Predicting drinking behavior and alcohol-related problems among fraternity and sorority members: Examining the role of descriptive and injunctive norms. Psychol Addict Behav 2004;18:203e12.

[22] Kroshus E, Baugh CM, Daneshvar DH, et al. Concussion reporting intention: A valuable metric for predicting reporting behavior and evaluating concussion education. Clin J Sport Med 2015;25:243e7.

[23] Foster CA, D'Lauro C, Johnson BR. Pilots and athletes: Different concerns, similar concussion non-disclosure. PLoS One 2019;14:e0215030.

[24] Jessiman-Perreault G, Godley J. Playing through the pain: A university-based study of sports injury. Adv Phys Educ 2016;6:178e94.

[25] Kroshus E, Baugh CM, Daneshvar DH, Kasisomayajula V. Understanding concussion reporting using a model based on the theory of planned behavior. J Adolesc Health 2014;54:269e274.e2.

[26] Kroshus E, Garnett BR, Baugh CM, Calzo JP. Social norms theory and concussion education. Health Educ Res 2015;30:1004e13.

[27] Kroshus E, Garbett B, Hawrilenko M, et al. Concussion under-reporting and pressure from coaches, teammates, fans, and parents. Soc Sci Med 2015;134:66e75.

[28] Baugh M, Kroshus E, Daneshvar DH, Stern RA. Perceived coach support and concussion symptom-reporting: Differences between freshmen and non-freshmen college football players. J Law Med Ethics 2014;42:314e22.

[29] Milroy JJ, Hebard S, Kroshus E, Wyrick DL. Sport-related concussion reporting and coach-athlete attachment among collegiate student-athletes. J Clin Sport Psychol 2017;12:268e81.

[30] NCAA demographics search. Indianapolis, IN: National Collegiate Athletic Association. Available at: http://www.ncaa.org/about/resources/research/ncaa-demographics-search. Accessed March 3, 2019.