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# United States Air Force Academy Cadets' Unprompted Knowledge of Concussions and "Bell Ringers" or "Dings": Perceived Differences and Similarities

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***Context:*** After a possible concussion mechanism, cadets are unlikely to have a list of concussion signs and symptoms at their disposal. As such, unprompted concussion knowledge may be an essential factor in personal recognition of injury.

***Objective:*** To explore determinants that contributed to United States Air Force Academy (USAFA) cadets' disclosure of a concussion. This research focused on 1 of 8 overall discovered themes of unprompted concussion knowledge.

***Design:*** Qualitative study.

***Setting:*** Military academy.

***Patients or Other Participants:*** Cadets at the USAFA (males = 23, females = 11, age = 19.91 ± 1.14 years).

***Main Outcome Measure(s):*** We conducted 34 semistructured interviews. The transcribed text was analyzed in a 5-cycle process. From this process, 8 overall themes emerged, including unprompted concussion knowledge. Subthemes were concussion definition, concussion symptoms, "bell-ringer" or "ding" definition, "bell-ringer" or "ding" symptoms, and concussion versus "bell ringer" or "ding."

***Results:*** Many participants were able to describe a concussion fairly accurately. The most commonly listed concussion signs and symptoms were dizziness (n = 22/34, 64.7%); "can't remember"/"memory loss"/"forgetful" (n = 19/34, 55.9%); and headache (n = 16/34, 47.1%). The cadet participants characterized the most common bell-ringer or ding signs and symptoms as dizziness (n = 2/34, 5.9%) and headache (n = 2/34, 5.9%). Cadets also described how a bell ringer or ding differs from a concussion, often commenting that concussions were more severe than bell ringers or dings.

***Conclusions:*** Overall, USAFA cadet participants listed common concussion signs and symptoms. However, they perceived differences between a concussion and a bell ringer or ding. Although decreasing the use of colloquial terms for concussion is recommended, use of these terms when examining a concussion history may be helpful. Concussion-education interventions should continue to focus on describing concussion signs and symptoms using cadets' own words to describe the injury (eg, "forgetful") but differentiating between what may and may not be a concussion and encouraging individuals to consult health care providers regarding possible concussion symptoms.

***Key Words:*** mild traumatic brain injuries, military academy, concussion recognition, concussion signs and symptoms

**Key Points**

- United States Air Force Academy cadets identified common concussion signs and symptoms, including dizziness, "can't remember"/"memory loss"/"forgetful," and headache.
- Health care professionals should avoid using colloquial terms to describe a concussion; however, using these terms to gain insight into the concussion history may be beneficial.
- Educational interventions should describe concussion signs and symptoms but also include targeted messages encouraging individuals to consult health care providers to determine if a concussion has been sustained.

United States Air Force Academy (USAFA) cadets are at particular risk for sustaining a concussion, as reflected by the fact that 512 concussions were recorded among nearly 4100 cadets in slightly more than a 3-year span.[1] In order to seek appropriate medical treatment, an individual must first recognize that a concussion may have occurred.[2–4] Because not all signs and symptoms of a concussion are outwardly noticeable, the person experiencing possible concussion signs and symptoms must first acknowledge that what he or she is experiencing may be a concussion and then decide to seek medical treatment. Thus, recognition relates to concussion knowledge, and most concussion-education interventions have focused on concussion knowledge, including symptom identification.[5–8] Concussion knowledge has primarily been examined using researcher-driven "check all that apply" or Likert-scale surveys instead of open responses.[4,9,10] When people experience a suspected concussion, they likely do not have access to a list of symptoms to determine if what they are initially experiencing is indeed a concussion. Instead of merely recognizing symptoms on a list, individuals must recall them in an environment very

different from that of most concussion-knowledge studies.[11] After any perceived concussion, the person still must decide, in the moment, whether to seek medical treatment.

More concussion knowledge does not necessarily relate to better concussion-reporting intentions or behavior.[3,5,12,13] However, as previously mentioned, one needs a basic knowledge of concussion signs and symptoms to recognize that what he or she is experiencing may be a concussion[5] and begin the reporting process; hence, recognition is still an important step before disclosure. Typical concussion-knowledge tests may cue certain responses, but open response allows free recall, which may more accurately reflect contemporaneous knowledge and informal beliefs less likely to be anticipated by researchers. Our aim was to fill the gap in understanding how the cadets themselves described concussion with free recall using their words as data. The overall purpose of this study was to explore factors that led USAFA cadets to either disclose or conceal a concussion. Eight themes were discovered in the larger study[14]; the current article focuses on the theme and subthemes related to unprompted concussion knowledge. This portion of the study highlights how concussions are recognized and understood using free recall. Understanding these processes will allow us to create educational interventions with these principles in mind.

## METHODS

The methods for this study were part of a larger study and have been described earlier.[14] This study was approved by the USAFA Institutional Review Board before data collection. We recruited first- and third-year cadets in their mandatory behavioral science course and offered extra credit for study involvement. Participants completed baseline concussion assessments and a 5-minute concussion-education presentation approximately 9 to 10 months before data collection (approximately 10 months earlier for first-year cadets and about 9 months prior for third-year cadets). They checked a box on a consent form if they were willing to be interviewed (identity protection was ensured) and were reminded that they could stop the interview at any time without penalty. Two scripts were developed for data collection by 3 concussion and qualitative researchers: 1 for cadets with a concussion history and 1 for cadets without a concussion history (Table 1). Interview scripts were designed with a phenomenological philosophical framework[14] and began with 2 introductory questions before proceeding to specific questions relating to the topic and then closing questions.[15] In the study design phase, we anticipated that individuals with a concussion history and those without a concussion history might answer interview questions differently, specifically recalling a particular concussion event and their experience; however, the 2 scripts were mostly similar. Participants also completed a preinterview demographic form. We conducted pilot interviews before data collection and did not change the interview scripts after those interviews. Two members of the research team (M.L.W.R. and C.J.D.) conducted all interviews. Interviews were approximately 10 to 35 minutes long and were conducted until saturation was achieved for both scripts. We were confident that saturation was achieved after 12 interviews with individuals who had a concussion history and 11 with individuals who did not have a concussion history. However, because we established data trustworthiness using prolonged exposure, we completed an additional 5 interviews with individuals who had a concussion history and an additional 6 interviews with those who did not have a concussion history.

Once each interview ended, the audio files were sent to a professional transcription company (Rev.com). When the transcripts were returned, the lead investigator (M.L.W.R.) listened to each audio file while reading the transcript to ensure accuracy and redacted any identifying information.

We used a 5-cycle process to analyze the transcripts as described by Anderson,[16] Wertz et al,[17] and Weber Rawlins et al.[14] Cycles 1 and 2 consisted of an initial view into the topic, which was usually completed in an introduction and literature review. Data were collected and summarized in cycle 3. To complete cycle 3, the lead researcher first read the entire data corpus. Five transcripts for each interview script were randomly selected and read by a 4-person research team.[14] The team then met to deliberate and create an initial codebook. During this meeting, the team determined that both interview scripts elicited similar responses and thus could be analyzed together. The lead researcher read all transcripts to code the themes and subthemes as developed from the initial codebook. Eight themes emerged from this process: perceived costs following concussion, cultural differences within squadrons, educational initiatives, the need to disclose, peer encouragement/advocacy, rumors, self-management, and unprompted knowledge. To permit a sufficient analysis of each theme, we focused this article on unprompted concussion knowledge. Cycles 4 and 5 involved relating the findings to other research literature and creating final interpretations. We also counted the frequency of the mentioned signs and symptoms.

As described earlier, data credibility was established through prolonged exposure.[18] We also called on 2 external reviewers to establish dependability and confirmability.[14,18] Finally, we calculated the demographic data using frequencies, means, and SDs.

## RESULTS

Overall, we interviewed a total of 34 participants (males = 23, females = 11, age = 19.91 ± 1.14 years).[14] Full participant demographics are provided in Weber Rawlins et al.[14] This article focuses on the theme of unprompted knowledge with the following 5 subthemes: definition, concussion symptoms, "bell-ringer" or "ding" definition, bell-ringer or ding symptoms, and concussion versus bell-ringer or ding.

### Concussion Definition

The USAFA cadets had many definitions of concussion. One cadet noted, "Some hard impact on the head or neck that causes some sort of disorientation." Another participant stated,

> So as I've always perceived it, any time that you've received either a blow to the head, or it could even be a full-body kind of thing, it's just the fact that the brain moves in your skull and it bruises itself to a degree, and it slows down your cognitive reflexes, impairs judgment to a degree. Even though some of the side effects might

**Table 1. Interview Script[a14] Continued in Next Column**

| Interview Question |
|---|
| 1. To begin, please tell me about your time at the Air Force Academy. |
| a. What year student are you? |
| b. If participant is a student athlete: |
| i. Which sport do you participate in? |
| ii. How long have you been playing that particular sport? |
| 2. If you had to stop being a member of the Air Force Academy today, how would you react? |
| a. How would your daily life change? Goals? |
| 3. Describe what the term "concussion" means to you. |
| a. Does a concussion differ from a "bell-ringer" or "ding?" If so, how? |
| 4. *For individuals with a concussion history:* On the demographic questionnaire, you indicated you had personally experienced a [concussion] and/or [bell-ringer/ding]. The following questions will be about your experience. What went through your head immediately following your [concussion] and/or [bell-ringer]? |
| a. What led you to believe it was a [concussion] and/or [ding]? |
| b. Did you report the injury? To whom? How long after impact? |
| c. Why did you or why did you not report the injury? |
| d. Do you feel as though you were treated differently after injury? |
| i. Family, friends? |
| e. (If participant reported experiencing a concussion and bell-ringer) How did your concussion differ from the "bell-ringer" or ding? |
| 5. (If the participant indicated more than 1 concussion/bell-ringer was sustained, the following questions were asked) Can you describe each of your concussion experiences? |
| a. What went through your head immediately following your [concussion] and/or [bell-ringer]? |
| b. For each concussion, what led you to believe your injury was a concussion? |
| c. Did you report each injury? To whom? How long after impact? |
| d. For each concussion, why did you or why did you not report the injury? |
| e. Do you feel as though you were treated differently after injury? |
| i. Family, friends? |
| f. (If participant reported experiencing multiple concussions and "bell-ringers") How did your concussion differ from the "bell-ringer" or ding? |
| 6. *For individuals without a concussion history:* On the demographic questionnaire, you indicated you had never personally experienced a [concussion] and/or [bell-ringer/ding]. Can you describe someone you know who has had a concussion? |
| a. What led you to believe it was a [concussion] and/or [ding]? |
| b. How were they acting? |
| c. Did they report their injury? |
| d. How were they treated postinjury from you and others? |
| i. Family, friends? |
| 7. What are your thoughts regarding concussion reporting? |
| a. Why would individuals report a concussion? |
| i. Long-term health consequences (eg, dementia, CTE, etc)? |
| ii. Short-term health consequences (eg, delayed reaction time, impaired balance, etc)? |
| b. Why would someone at the Air Force Academy not report their concussion? |
| i. Desire to continue playing? |
| ii. Not knowing it was a concussion? |
| 8. If you suspected you might have a concussion next week, describe how you would approach the situation. |
| a. What thoughts do you think would go through your mind? |
| b. What symptoms would lead you to believe you had a concussion? |
| c. To whom would you report your injury? |
| d. Would your answer change after you become a pilot? |
| 9. I am going to start this sentence and would like you to finish it, "When I experience possible concussion symptoms, I . . ." |
| a. What led you to that choice? |
| b. What factors would influence your reporting or not-reporting injury? |

**Table 1. Continued From Previous Column**

| Interview Question |
|---|
| 10. Is there anything else you would like to add about concussion reporting? |
| 11. Are there any questions or topics I have not asked that you would like to discuss? |

[a] The instrument is reproduced in its original format.

not be noticed, there still could be some type of damage there.

Another participant defined a concussion as

> . . . a form of mental disorder where you forget and can't really remember things. It doesn't last for long after your memory comes back, but I'm not really sure if it comes back intact as it was originally. But pretty much, like 95%.

### Concussion Symptoms

Frequencies of concussion signs and symptoms listed by participants are shown in Table 2. The most commonly cited concussion sign and symptom was dizziness (n = 22/34, 64.7%), followed by "can't remember"/"memory loss"/"forgetful" (n = 19/34, 55.9%), and headache (n = 16/34, 47.1%).

### Bell-Ringer or Ding Definition

Participants defined a bell ringer or ding as,

> I think it does differ, because with a bell ringer or a ding, I guess from my ... From the way it sounds to me, it's kind of like you get knocked in the head, and kind of hurt for a minute, but then you recover and you're fine the next day, I guess?

Another cadet said,

> I think it does just for the severity of it. You're disorientated and all that, but a concussion goes a little farther than just being disorientated. I figure that as more of just a shock that occurs.

### Bell-Ringer or Ding Symptoms

Frequencies of bell-ringer or ding signs and symptoms listed by participants are given in Table 3. The most common bell-ringer or ding signs and symptoms were dizziness (n = 2/34, 5.9%) and headache (n = 2/34, 5.9%).

### Concussion Versus Bell-Ringer or Ding

The cadets described what they believed was the difference between concussions and bell ringers or dings. One cadet said,

> I think it kind of goes back to, I mean, if you're hit in the head or if you're taking a shot to the upper body and your whole . . . kind of get, like, that whiplash effect, definitely I think you can have the same effects, even people who get hit and they'll black out for a second and they figure

**Table 2. Concussion Signs and Symptoms Listed by Participants (n = 34) Continued in Next Column**

| Sign or Symptom | Frequency of Listing, No. (%) | Concussion Symptom Category[a] |
|---|---|---|
| Dizziness/dizzy | 22 (64.7) | Symptoms |
| Can't remember/memory loss/ forgetful | 19 (55.9) | Symptoms |
| Headache | 16 (47.1) | Symptoms |
| Sensitivity to light | 16 (47.1) | Symptoms |
| Nausea | 16 (47.1) | Symptoms |
| Sleep disturbances/tired/fatigue | 11(32.4) | Sleep/wake disturbances |
| Lack of focus/difficulty focusing | 9 (26.5) | Symptoms |
| Loss of consciousness/passing out/knocked out/black out | 9 (26.5) | Physical signs |
| Sensitivity to noise/needs quiet/ sounds hurt | 9 (26.5) | Symptoms |
| Blurry/blurred vision | 7 (20.6) | Physical signs |
| Vomiting/puking/throwing up | 7 (20.6) | Physical signs |
| Feeling abnormal/off/out of sorts/ out of it | 6 (17.6) | Behavioral changes |
| Cognitive impairments | 5 (14.7) | Cognitive impairment |
| Amnesia/didn't remember events right after incident/not remembering things from that event | 5 (14.7) | Physical signs |
| Disorientation | 4 (11.8) | Symptoms |
| Emotional | 4 (11.8) | Behavioral changes |
| Concentration/can't concentrate | 4 (11.8) | Symptoms |
| Balance | 3 (8.8) | Balance impairment |
| Confusion | 3 (8.8) | Symptoms |
| Increase with mental activity | 3 (8.8) | Other |
| Slowed reaction time | 3 (8.8) | Cognitive impairment |
| Amnesia | 2 (5.9) | Physical signs |
| Fear | 2 (5.9) | Behavioral changes |
| Mood | 2 (5.9) | Behavioral changes |
| Head pain | 2 (5.9) | Symptoms |
| Pupils don't dilate | 2 (5.9) | Physical signs |
| Slurred speech | 2 (5.9) | Physical signs |
| Irritability/angry | 2 (5.9) | Behavioral changes |
| Difficulty thinking/critical thinking | 2 (5.9) | Physical signs |
| Hearing "beeps" | 1 (2.9) | Other |
| Vertigo | 1 (2.9) | Physical signs |
| Biological features | 1 (2.9) | Other |
| Can't complete basic skills | 1 (2.9) | Physical signs |
| Can't write properly | 1 (2.9) | Physical signs |
| Combination of symptoms | 1 (2.9) | Other |
| Dazed | 1 (2.9) | Symptoms |
| Delusional | 1 (2.9) | Behavioral changes |
| Trouble thinking | 1 (2.9) | Symptoms |
| Unable to think critically | 1 (2.9) | Symptoms |
| Drainage from the ears | 1 (2.9) | Other |
| Dumb | 1 (2.9) | Behavioral changes |
| Dysfunction | 1 (2.9) | Cognitive impairment |
| Depression | 1 (2.9) | Behavioral changes |
| Psychological dysfunction | 1 (2.9) | Behavioral changes |
| Rage | 1 (2.9) | Behavioral changes |
| Glazy | 1 (2.9) | Symptoms |
| Impaired abilities | 1 (2.9) | Other |
| Impaired reflexes | 1 (2.9) | Physical signs |
| Impaired sensory function | 1 (2.9) | Physical signs |
| Sight loss | 1 (2.9) | Physical signs |
| Spotty vision | 1 (2.9) | Physical signs |
| Tunnel vision | 1 (2.9) | Physical signs |
| Impact on learning | 1 (2.9) | Other |
| Lightheadedness | 1 (2.9) | Symptoms |
| Loopy | 1 (2.9) | Behavioral changes |
| Mental fogginess | 1 (2.9) | Symptoms |

**Table 2. Continued From Previous Column**

| Sign or Symptom | Frequency of Listing, No. (%) | Concussion Symptom Category[a] |
|---|---|---|
| Mental performance and capacity | 1 (2.9) | Cognitive impairment |
| Motor skills | 1 (2.9) | Cognitive impairment |
| Not walk properly | 1 (2.9) | Physical signs |
| Out of body experience | 1 (2.9) | Symptoms |
| Affect your performance in basically anything | 1 (2.9) | Other |
| Personality changes | 1 (2.9) | Behavioral changes |
| Poor hand-eye | 1 (2.9) | Cognitive impairment |
| Random behavior | 1 (2.9) | Behavioral changes |
| Restless | 1 (2.9) | Symptoms |
| Shortness of breath | 1 (2.9) | Symptoms |
| Sluggish | 1 (2.9) | Sleep/wake disturbances |

[a] Concussion signs and symptoms categories are symptoms, physical signs, balance impairment, behavioral changes, cognitive impairment, and sleep/wake disturbances.[22]

out where they are once they're looking up at the sky. Sometimes that happens. And there's not symptoms I've seen, or in my case, have never shown up afterwards. But I'm sure that they definitely … there's a correlation depending on the type of injury or the type of collision.

**Table 3. "Bell-Ringer" or "Ding" Signs and Symptoms Listed by Participants (n = 34)**

| Frequency of Listing, No. (%) | Sign or Symptom | Concussion Symptom Category[a] |
|---|---|---|
| 2 (5.9) | | |
| | Dizzy | Symptoms |
| | Headache | Symptoms |
| 1 (2.9) | | |
| | Balance | Balance impairment |
| | Dazed | Symptoms |
| | Disoriented | Symptoms |
| | Losing focus | Symptoms |
| | Head hurts | Symptoms |
| | Hear the "zzzz" kind of thing | Other |
| | Knocked out | Physical signs |
| | Lapse in event | Physical signs |
| | Losing your breath | Symptoms |
| | Moving a lot slower | Cognitive impairments |
| | Nasal congestion/nasal cavity cleared | Other |
| | Nausea | Symptoms |
| | Rattled | Other |
| | Can't remember | Symptoms |
| | Ringing sensation in ears | Other |
| | Seeing stars | Symptoms |
| | Severity of the symptoms | Other |
| | Shake head off and get back out there | Other |
| | Shock of what occurred | Other |
| | Tired | Sleep/wake disturbances |
| | Weren't on their game | Other |
| | Wind knocked out of you | Other |

[a] Concussion signs and symptoms categories are symptoms, physical signs, balance impairment, behavioral changes, cognitive impairment, and sleep/wake disturbances.[22]

Another participant described how the duration of symptoms played a role:

> I feel like that would be more 5 to 10 minutes of just after it happened, whereas a concussion you feel it an hour or all day.

Another cadet discussed a longer duration of symptoms:

> I would say just the longevity of the symptoms. I think if it's only like for a day, then it's not a concussion.

One individual commented on the duration of symptoms in more depth:

> I think concussion is more on the severe end. If you think of just getting hit in the head, and maybe you have a few seconds of dizziness and then you shake it off, I don't think that qualifies as a concussion. It's only when those symptoms persist for, say more than a few hours, or a day, that it really can be qualified as a concussion.

Finally, a cadet explained that often what we suspect is a bell ringer may also be a concussion: "... I'd say what I feel like most people would refer to as a bell ringer is actually a concussion."

## DISCUSSION

Overall, the participants' free recall communications reflected a high level of concussion knowledge. They were able to define concussions and bell ringers or dings, listed many common concussion signs and symptoms, and described their perceptions of the difference between concussions and bell ringers or dings. In order to recognize and disclose a concussion, one must understand what a concussion is and that the symptoms being experienced are abnormal. If concussion-education programs can build foundational knowledge regarding what a concussion is, how concussions relate to bell ringers or dings, what the typical signs and symptoms of concussion are, and the importance of reporting any abnormal symptoms, concussion-disclosure rates may increase.

Concussions are defined in many ways.[19–22] The Fifth International Conference on Concussion in Sport defined a concussion as "a traumatic brain injury induced by biomechanical forces."[22(p2)] No matter which definition of concussion is adopted, a common theme is that concussions are injuries that affect brain function caused by biomechanical processes and may or may not involve loss of consciousness. These definitions are useful for clinicians in guiding diagnosis. Participants in this study also had a wide range of concussion definitions. However, numerous cadets' definitions included a mechanism of injury (eg, impact to the head or body) and resulted in some type of abnormal symptoms. A specific definition of a concussion does not necessarily need to be memorized and would likely even be unrealistic, yet it is important for cadets to recognize if what they are experiencing after a possible mechanism of injury could be a concussion. Our research highlighted the concussion definitions used by participants when unprompted; it is important to understand what individuals perceive a concussion is in order for them to recognize the injury and seek medical care.

The most common concussion signs and symptoms are headache and dizziness.[23] These were most frequently noted as signs and symptoms by our participants when describing both concussions and bell ringers or dings. Loss of consciousness was cited as a symptom of a concussion by 26.5% of cadets. In actuality, loss of consciousness only occurred in 9% of reported concussions.[24] Therefore, misconceptions regarding loss of consciousness persist, and concussion education should include this information. Other less common symptoms not usually associated with concussions were described as "hearing beeps" or "drainage from the ears." Recently, Register-Mihalik et al[25] found similar results in that cadets most frequently identified headache and pressure in the head as concussion symptoms but less often identified emotional symptoms. Similarly, nearly 12% and 6% of the participants in our sample remarked on "emotional" or "mood" symptoms, respectively, as opposed to 47% who identified headache. It is encouraging that cadets in this study and that of Register-Mihalik et al[25] recognized similar concussion signs and symptoms when unprompted and when given a list to choose from, indicating that cadets may answer similarly in a real-world situation when asked about symptoms. Concussion-education interventions should target typical concussion signs and symptoms, including emotional symptoms, and should address "red flags" such as "drainage from the ears" or other signs that would indicate a medical emergency.

Although *bell ringer* lacks a formal definition, Register-Mihalik et al[4] found that athletes often used this term to depict a "brief, transient alteration in neurologic function."[4(p 647)] Our USAFA cadets also described a bell ringer or ding as brief (eg, "... for a minute ..."), and an alteration in neurologic function (eg, "You're disoriented ..."). Register-Mihalik et al[4] stated that even though not all bell ringers or dings are concussions, they at minimum warrant medical attention to determine if a concussion occurred before consideration can be given to returning the athlete to sport. We are the first to examine how cadets themselves define a *bell ringer* and *ding*. This information can be used to better relate to patients using targeted educational interventions incorporating their own phrasing and words, especially if this terminology is intended to minimize perceptions of seriousness.

When describing a concussion, health care professionals are encouraged not to use colloquial terms such as a bell ringer or ding, "clearing the cobwebs," "seeing stars," etc. However, authors have continued to observe misconceptions regarding concussions and bell ringers or dings in student-athletes.[26] Cadets frequently discussed the duration of symptoms in differentiating a concussion and bell ringer or ding, which was noteworthy. Currently, no concussion definition includes a minimum duration of symptoms.[19–22] Given these continuing misconceptions regarding the differences between concussions and bell ringers or dings, clinicians may consider using these terms when asking student-athletes or cadets if they have a concussion history or determining if what they are currently experiencing is a concussion.

Many authors[3,12,13] have commented that an increase in concussion knowledge does not always equal an increase in

concussion disclosure. Nonetheless, to recognize a concussion, one must have the foundational knowledge of the signs and symptoms.[2–5] This can be delivered during a concussion-education intervention and should include a wide range of symptoms, especially because numerous concussion signs and symptoms were used to describe a concussion versus a bell ringer or ding. For example, discussing symptoms using cadet terminology such as "feeling loopy" may also be beneficial. Our study highlighted specific educational targets that may be included in concussion-education interventions. This information is the first of its kind using wording and targeted notes from the patient perspective and providing clear evidence for educational concepts and novel educational strategic opportunities. It can be used to supply clinicians with the information needed to approach education and concussion history in a manner that helps cadets identify symptoms if they experience them, not just via a symptom checklist.

Qualitative research does not aim to be generalizable, and our results apply only to those USAFA cadet participants we interviewed. Additionally, we analyzed the data similarly between those with and those without a concussion or bell-ringer or ding history. Future investigators should examine educational interventions that include more colloquial terms to describe a concussion in a broad population. Authors should also explore the mechanisms that may influence a cadet's definition of a concussion or bell ringer or ding, such as peer relationships, previous history, and sport influences.

## CONCLUSIONS

Cadets in our sample were able to describe and identify many concussion-related symptoms without cues from the researchers, yet many participants viewed *bell ringer* and *ding* in ways that appeared to minimize the seriousness of the injury. Clinicians may use this information to accurately describe concussions, discouraging colloquial terms such as a bell ringer or ding, and discussing the common concussion signs and symptoms and terms found in this study. By highlighting concussion information from the cadet perspective, including common terminology used by cadets, we may better design educational interventions and increase concussion disclosure.


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**Conflict of Interest**

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**Disclosure**

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