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Exploring Sandbagging Behaviors, Effort, and Perceived Utility of the ImPACT Baseline Assessment in College Athletes

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Baseline computerized neurocognitive testing (CNT) is a commonly used tool for the assessment and management of sport-related concussion (SRC). Research on the frequency of sandbagging behaviors and suboptimal effort on baseline CNT is limited, and contributing factors to these behaviors are unknown. This study described the prevalence of sandbagging behaviors on baseline CNT in college athletes and also identified predictors of maximal effort. A descriptive, quantitative survey was used to gather information from 178 college athletes (M = 19.05, SD = 1.16 years; range 18–23 years; 53% female) immediately after completing a baseline CNT. The survey included questions regarding demographics, effort provided, sandbagging behaviors, and perceived utility of the CNT baseline assessment. Six percent of athletes reported a history of sandbagging behavior, and nearly a third of athletes reported they did not provide maximal effort on their CNT baseline test. A logistic regression examining sex, concussion history, previous text exposure, and perceived utility of the baseline test was significant, $\chi^2(4, 166) = 15.85$, $p < .001$. Athletes who perceived very high utility of the baseline CNT assessment were 4.94 times (95% confidence interval [1.91–12.69]) more likely to provide maximal effort on their CNT baseline (relative risk = 2.95× more likely; 95% CI [1.41–6.15]). These data suggest that the prevalence of sandbagging behavior is not as common as previously reported, and educating athletes about the utility of the baseline CNT may improve effort.

Keywords: concussion, baseline testing, effort, computerized neurocognitive testing, sandbagging

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Computerized neurocognitive testing (CNT) is considered to be a cornerstone of the multifaceted approach for the management of sport-related concussion (SRC; McCrory et al., 2013). Neurocognitive assessment measures several domains of neurocognitive function (e.g., working memory, concentration, processing speed, and reaction time) that may be negatively affected by SRC (Covassin, Elbin, Stiller-Ostrowski, & Kontos, 2009; McCrory et al., 2013). It is common practice to administer CNT within a prospective methodology that includes a preinjury (i.e., baseline) measure and serial postinjury assessments (Covassin et al., 2009), enabling the clinician to compare an athlete's postinjury scores with their preinjury baseline scores to better identify neurocognitive impairment and control for unique factors that may influence test performance (Schatz & Robertshaw, 2014). Within this paradigm, ensuring the accuracy of the baseline assessment is critical for the postconcussion management of SRC, as

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these data can be used to support targeted management strategies and treatment programs (Collins, Kontos, Reynolds, Murawski, & Fu, 2014; Covassin et al., 2009; Van Kampen, Lovell, Pardini, Collins, & Fu, 2006). However, "sandbagging" (i.e., athletes intentionally performing poorly on baseline testing) behaviors on the CNT baseline are recognized as limiting the validity and utility of neurocognitive assessments (Bailey, Echemendia, & Arnett, 2006).

Despite claims of high prevalence in the media (Marvez, 2012; Reilly, 2011), sandbagging behavior on baseline CNT has been shown to be difficult to achieve. Researchers (Schatz & Glatts, 2013) investigated the ability to successfully sandbag on the Immediate Post-Concussion Assessment and Cognitive Test (ImPACT) in a nonathlete sample of college students. They reported that built-in invalidity indicators on ImPACT identified 70% of naïve and 65% of coached sandbaggers, and utilizing certain subscales of the ImPACT battery (i.e., forced choice validity measure in the Design Memory task) identified 90% and 95% of naïve and coached sandbaggers, respectively. Others (Erdal, 2012) reported that 11% of college athletes were able to intentionally score "poorly" on baseline CNT without being detected by ImPACT invalidity indicators. Together, these studies provide data suggesting sandbagging is more difficult to achieve, without detection, than reported in the media. Moreover, suboptimal effort has been identified as a contributing variable to sandbagging behaviors on the CNT baseline.

Effort given on psychological testing has been described as falling on a continuum (Heilbronner et al., 2009), making dichotomous end-points (such as "sufficient" vs. "insufficient") impractical (Higgins, Denney, & Maerlender, 2017). In this regard, although "sandbagging" behaviors may reflect intentionally underperforming, such behavior is not reflective of actual effort. In contrast, "less than maximal effort" could be related to lack of interest or motivation, an actual lack of ability (i.e., falling beyond 2 standard deviations from the mean), or other factors which have yet to be identified. However, the deleterious effects of suboptimal effort on neurocognitive performance are recognized in consensus statements as well as empirical studies (Broglio, Ferrara, Macciocchi, Baumgartner, & Elliott, 2007; Bush et al., 2005; Green, Rohling, Lees-Haley, & Allen, 2001; Heilbronner et al., 2009). The American Academy of Clinical Neuropsychology and the National Academy of Neuropsychology discuss the measurement and investigation of suboptimal effort (Broglio et al., 2007; Bush et al., 2005; Green et al., 2001; Heilbronner et al., 2009), and the confounding effect that suboptimal effort has on baseline CNT performance is also a concern within the field of sports neuropsychology (Bailey et al., 2006; Rabinowitz, Merritt, & Arnett, 2015; Solomon & Haase, 2008). Despite these concerns, the incidence of suboptimal or poor effort is not widely documented. Hunt, Ferrara, Miller, and Macciocchi (2007) reported poor effort in 10% of high school athletes on baseline testing (using the Rey 15-item and Dot-Counting tests), and poor effort was associated with lower scores on information processing, memory, attention/concentration, learning and gross motor speed tasks. Similarly, others (Bailey et al., 2006) reported that athletes exhibiting suboptimal effort during baseline testing (as measured by performance below two standard deviations from the mean on the test battery) showed significantly improved scores on cognitive tests (i.e., Stroop Color-Word test, Symbol-Digit Modalities Test, Controlled Oral Word Association, and Trail Making Test) at 1-week postinjury compared with athletes that provided high effort at baseline. Recently, using a computer-based measure, researchers (Higgins et al., 2017) predicted suboptimal effort (i.e., sandbagging behavior) using neurocognitive scores in a sample of high school athletes. Specifically, the invalidity indicators built into the ImPACT test (denoted as "Baseline ++" based on a score of Impulse Control <30, Word Memory Learning Percentage $<69\%$, Design Memory Learning Percentage $<50\%$, X's and O's Total Incorrect >30, or Three Letters Total Letters Correct <8) identified 99.7% of high school athletes providing "best effort" and "sandbag" behaviors. Despite the apparent relationship between optimal effort and best performance on the baseline CNT, little is known regarding the factors that predict and influence effort.

Several factors could influence an athlete's effort on baseline CNT including history of concussion (Collins et al., 1999; Iverson, Gaetz, Lovell, & Collins, 2004), sex (Schatz, Moser, Solomon, Ott, & Karpf, 2012), previous test exposure, and perceived utility of the test (Vansteenkiste et al., 2004). Previously concussed athletes exposed to

CNT may appreciate the importance and utility of the baseline assessment for ensuring their safe return to play (RTP) and provide optimal effort during testing. Alternatively, athletes with a concussion history could also perceive that CNT kept them from returning to play sooner following their prior concussion, thus potentially increasing the likelihood of providing suboptimal effort (i.e., sandbagging behavior). Although the practice effects associated with repeat neurocognitive assessments are well-documented (Alves, Rimel, & Nelson, 1987; Collie, Maruff, McStephen, & Darby, 2003; Macciocchi, 1990), it is not yet clear if repetitive exposure to an assessment battery is also linked to suboptimal effort. Researchers have reported that intrinsic rewards (i.e., increasing knowledge) result in lower perceived utility of tasks than extrinsic rewards (i.e., benefitting one's self; Vansteenkiste et al., 2004). As such, athletes failing to recognize or understand tangible benefits from baseline CNT may appraise them as being less desirable or useful. In addition, negative expectations regarding testing have been linked to decreased effort on cognitive task performance (Carver, Blaney, & Scheier, 1979), and serial exposure to nonverbal stimuli presented across serial assessments has been linked to negative appraisals of the test (Brickman, Redfield, Harrison, & Crandell, 1972). The relationship between these factors and effort on baseline CNT has yet to be examined.

Overall, the research examining the frequency of sandbagging behaviors on baseline CNT is scant, and predictors for these behaviors are understudied. Identifying predictors for effort on the CNT baseline may help inform the need for prebaseline testing educational interventions that are designed to improve effort on baseline testing. The purpose of this study was twofold: (a) to describe the prevalence of self-reported sandbagging behaviors on baseline neurocognitive testing in college athletes and (b) to identify factors that predict maximal effort on baseline neurocognitive assessments.

Method

Research Design

A descriptive, quantitative survey.

Participants

Participants were male and female college-aged varsity and club-sport athletes (ages 18–23) who completed a survey after baseline administration of the ImPACT. Athletes were tested in groups of 10–15, prior to participation in practice, with athletes seated every other seat. All sessions were proctored or supervised by a senior athletic trainer or psychology professor trained in the administration of the measures. Although completion of baseline assessments was mandatory for participation in varsity and club sports, completion of the survey was anonymous and voluntary. A link to the online survey was provided to all athletes completing baseline assessments, and 178 of 189 (94%) athletes completed the survey.

Measures

A 33-item online survey was created and checked for face validity on clarity and accuracy of items by three researchers in the area of sport-related concussion. The demographics section of the survey included items assessing age, gender, sport, concussion history, and prior exposure to taking ImPACT both baseline and postconcussion test versions. Athletes then rated their overall effort, speed, accuracy, and honesty in reference to their performance on the ImPACT baseline completed immediately before to taking the survey. Athletes were then asked a series of questions regarding their perceptions on how difficult they thought it was to sandbag their baseline test and hide symptoms and cognitive effects of SRC. Items assessed the perceived utility of the ImPACT baseline and postconcussion test versions in assisting sports medicine professionals with making RTP decisions. Responses to survey items were gathered via dropdown boxes, multiple choice, or a 10-point Likert scale (0—*not at all*, 10—*Very Much*). The survey is listed in the supplemental material.

An exploratory factor analysis (EFA) was conducted on the survey questions selected for analysis in the current, using principal components analyses. Varimax rotation with Kaiser normalization and Eigenvalues (>1) were used to assist with interpretation of the factors and structure. The EFA yielded a three-factor solution, with eight items, explaining 72% of the

total variance. The postrotation factor structure is presented in Table 1.

Procedures

Institutional review board approval for experimental procedures was obtained prior to commencement of the study. All athletes completing a preseason baseline ImPACT assessment on a computer were provided a link to the online survey immediately after completion of the baseline assessment. Athletes read a consent document on the computer informing them that their participation was voluntary and that their survey responses would be anonymous. Athletes were informed that choosing not to participate would not result in any consequences and that their responses both individually and as a group would not be shared with their sports medicine staff or coaches. In addition, athletes were informed that their responses could not be linked to their ImPACT test results.

Data Analysis

Descriptive statistics (e.g., means, standard deviations, percentages) were used to describe the survey responses for the effort and honesty, sandbagging perceptions and behaviors, and utility of the ImPACT test in helping RTP decisions. A logistic regression was conducted to identify the relative contribution of maximal effort (maximal effort, less than maximal effort) on the ImPACT baseline test among four predictors that included concussion history (yes/no), sex (male, female), first time taking impact (yes, no), and perceived utility of the ImPACT baseline for helping with the RTP process (maximal utility, less than maximal utility). These analyses were conducted using SPSS 21.0 (IBM Corp., 2012), and statistical significance was set at $p \leq .05$.

Results

Participant Demographics

A total of 178 participants ($M = 19.05$, $SD = 1.16$ years; range 18–23 years) completed the survey. The sample was 53% female (95 females, 83 males) and composed of several sports including rugby (33%, 59/178), lacrosse (27%, 48/178), soccer (12%, 21/178), field hockey (9%, 16/178), ice hockey (8%, 14/178), softball (7%, 13/178), cheer (3%, 5/178), and basketball (1%, 2/178). Sixty-one percent (106/173) of the sample reported zero previous concussions, 22% (38/173) reported one concussion, and 17% (29/173) had a history of two or more concussions (range = 0–8). Approximately 25% (43/174) of the sample had never completed an ImPACT baseline (i.e., they were a first-time test taker), whereas 30% (52/174), 22% (38/174), and 24% (41/174) completed an ImPACT baseline one time, two times, and three or more times prior to this baseline testing session, respectively. The majority of the sample (76%, 133/175) had never completed a postconcussion administration of ImPACT. A description of the means and standard deviations for the 10-point Likert scale survey items is presented in Table 2.

Table 1
Survey Question Factor Loadings (N = 178)

Item	Effort and honesty	Utility of ImPACT	Sandbagging behaviors
Overall effort	**.856**	.136	−.078
Speed of responses	**.848**	.221	−.010
Accuracy of responses	**.725**	.085	−.002
Utility of baseline testing in RTP	.089	**.955**	−.065
Utility of postconcussion testing in RTP	.096	**.953**	−.056
Ease of hiding symptoms	.091	−.053	**.907**
Ease of hiding cognitive problems	−.050	−.061	**.907**
Ease of tanking baseline	−.387	.158	−.123

Note. Bold values denote the items associated with each factor. ImPACT = Immediate Post-Concussion Assessment and Cognitive Test; RTP = return to play.

Table 2
Means and Standard Deviations for Survey Items on Self-Reported Effort and Honesty, Sandbagging Perceptions and Behaviors, and Perceived Utility of the Baseline and Postconcussion Test (n = 178)

Survey item	Mean	*SD*
Effort and honesty[a]		
Overall effort given on the test	9.48	.98
The speed of your responses	9.22	1.10
The accuracy of your responses	8.74	1.15
How honest were you in reporting your current symptoms	9.60	1.09
Sandbagging perceptions and behaviors[b]		
Ease of tanking baseline	6.17	2.67
Ease of hiding symptoms	5.05	2.84
Ease of hiding cognitive problems	4.31	2.56
Utility of the ImPACT test[c]		
The baseline test results will help the athletic trainer and/or team doctor from returning me to play too early following a concussion	8.28	1.84
The postconcussion test results will help the athletic trainer and/or team doctor from returning me to play too early following a concussion	8.14	1.89

Note. Responses on a 1–10 scale, with 10 representing. ImPACT = Immediate Post-Concussion Assessment and Cognitive Test.
[a] best/most accurate/most honest. [b] very easy. [c] very helpful.

Sandbagging Behaviors and Effort

Only 6% (8/130) of the athletes who had completed a previous ImPACT baseline assessment reported trying to intentionally perform poorly or sandbag their baseline. However, 29% (41/178) of athletes reported that they did not give maximal effort on the most recent ImPACT baseline test completed prior to taking the survey.

Predictors of Maximal Effort on the ImPACT Baseline Test

A logistic regression was performed to assess the impact of a number of factors on the likelihood that athletes would report they gave less than maximal effort on their baseline test. The model contained four independent variables (history of concussion, sex, first-time test taker, perceived utility of the baseline test in helping make RTP decisions). The full model containing all predictors was statistically significant, $\chi^2(4, 166) = 15.85$, $p < .001$, indicating that the model was able to distinguish between respondents who reported maximal effort on baseline testing and those who did not report giving maximal effort. The model as a whole explained between 9.1% (Cox & Snell R Square) and 13.1% (Nagelkerke R Square) of the variance in maximal effort on the baseline test and correctly classified 71.7% of cases. As shown in Table 3, only one of the four independent variables made a unique, statistically significant contribution to the model (perceived utility of the baseline test in helping make RTP decisions). Athletes who indicated that the baseline tests were very helpful for making RTP decisions were 4.93 times more likely to give maximal effort on the baseline than athletes who did not rate the utility of the baseline very helpful in making RTP decisions. Given that the means are quite high, reflecting skew in the data, a more conservative measure of relative risk reflects athletes indicating that the baseline test were very helpful for making RTP decisions were 2.95 times more likely to give maximal effort on the baseline than athletes who did not rate

Table 3
Logistic Regression Results for Predicting Maximal Effort on the ImPACT Baseline (n = 166)

Predictor variable	*B*	*SE*	Wald	*df*	*p*	Adjusted *OR*	95% CI for odds ratio Lower	Upper
Concussion history	−.20	.37	.30	1	.58	.82	.40	1.68
Sex	−.36	.36	.97	1	.32	.70	.34	1.43
First time taking ImPACT baseline	.03	.44	.01	1	.94	1.03	.44	2.44
Perceived utility of the baseline for making RTP decisions	1.60	.48	10.97	1	.001	4.94	1.91	12.69
Constant	.76	.32	5.83	1	.02	2.14		

Note. ImPACT = Immediate Post-Concussion Assessment and Cognitive Test; RTP = return to play.

the utility of the baseline very helpful in making RTP decisions.

Discussion

The primary purpose of this study was to describe the prevalence of sandbagging behaviors on baseline CNT in college athletes, with only 6% of athletes reporting a history of intentionally attempting to sandbag a baseline neurocognitive assessment. A secondary purpose of this study was to examine predictors of maximal effort on the neurocognitive baseline assessment. The only significant predictor for maximal effort was perceived utility of the baseline assessment. Athletes reporting a very high (i.e., rated a 10 on a Likert scale) perception for the utility of the baseline assessment were 3–5 times more likely to provide maximal effort on the baseline assessment than athletes not rating the utility of the baseline very high. Overall, these findings provide important information on how to better ensure optimal effort on the baseline computerized neurocognitive assessment for concussion.

Although the media has suggested that some professional athletes "sandbag" their concussion test to be "cleared" following an SRC (Marvez, 2012; Reilly, 2011), only 6% of athletes in this study reported a history of sandbagging behavior on a computerized baseline neurocognitive assessment. This percentage is similar to previous reports of sandbagging behavior, as other researchers reported this behavior to occur in 11% of athletes (Erdal, 2012). Although few collegiate athletes reported sandbagging behaviors, nearly 30% of athletes reported giving less than maximal effort on their ImPACT baseline test. Hunt et al. (2007) documented poor effort in 10% of high school athletes completing baseline testing using pencil-and-paper-based measures. The discrepancy between these findings may be due to methodological differences in quantifying effort between the current study and Hunt et al. (2007). The current study defined maximal effort as a "10" on a 10-point Likert scale, whereas Hunt et al. (2007) measured effort with the Rey 15-Item and Dot Counting Tests, classifying their sample as either adequate or poor effort groups. As such, these methodological differences in the operational definition, method of measurement, and classification of effort may explain, or contribute to, this contrast in findings between the current study and Hunt et al. (2007).

In the current study, perceiving a high utility for the CNT baseline assessment for assisting sports medicine professionals with making RTP decisions was the only significant predictor of maximal effort and adds to previous research on this topic (Vansteenkiste et al., 2004). It is important to note that perceived utility of CNT assessments may have been moderated by other potential predictors of behavior, not measured in the present study. For example, the "culture" of the team, athletic program, coach, or team physician may have contributed to athletes' positive or negative attitudes. In this context, the subjective utility of the test measures or concussion management procedures may also have been contributing factors. An athlete with faith in the athletic trainers and team physician may attribute positive perceptions toward the measures and procedures, in accordance with correspondent inference theory (Jones & Davis, 1965). Moreover, an athlete may recognize socially desirable (concussion management) decisions, made to assist and directly benefit them, in a positive manner, and attribute these feelings to the measures and procedures. However, an athlete with less confidence in the personnel may believe they (or their coach) are better able to determine their neurocognitive status and suitability for returning to competition after a concussion. In this case, resolving cognitive dissonance (e.g., "I am fine, but the trainer said I didn't pass the concussion test"; [Festinger, 1962]) may be achieved by devaluing the utility of the tests or procedures (e.g., "that test is not helpful"). In addition, athletes who are more intrinsically motivated may have less positive attributions, whereas athletes who are more extrinsically motivated may have more positive attributions (Ryan & Deci, 2000).

Factors such as history of concussion, sex, or first-time test taker were not predictive of athletes' providing maximal effort on the CNT baseline. The lack of support for concussion history as a predictor of maximal effort is in concordance with other researchers who also documented no differences for athletes with and without a history of concussion on effort scores for the CNT baseline (Hunt et al., 2007). In the current study, sex did not emerge as a predictor of maximal effort. It is widely accepted that

student-athletes are highly motivated to succeed in their athletic domain, owing to their ability and desire to succeed (Cecchini, Fernández-Rio, & Méndez-Giménez, 2015). Given that female athletes have exhibited significantly higher achievement motivation and have been shown to be more intrinsically motivated to accomplish tasks (Fortier, Vallerand, Brière, & Provencher, 1995; Gillet & Rosnet, 2008), one might expect higher levels of performance on baseline testing. Females have generally been found to perform better than males on tasks of verbal memory, verbal fluency, visual attention, and processing speed, whereas males perform better in visual-spatial tasks, spatial-motor tasks, mental rotation, and quantitative problem solving (Barr, 2003; Covassin et al., 2006; Watson & Kimura, 1991), negating any "overall higher performance" based on sex. As such, it is unclear, how factors such as sex or motivation to succeed in athletes might be related to intentionally underperforming, or providing less-than-optimal effort, on baseline testing.

There are several limitations in the current study. Owing to Health Insurance Portability and Accountability Act, the baseline test results for the CNT assessment were not available to match up to survey responses to examine relationships between variables of interest. As with all survey research, athletes may have not been as forthcoming with their responses and the exposure to a baseline CNT may have influenced responses on the survey both positively and negatively. In addition, although athletes were distributed across several contact and noncontact sports, there were no football players in the sample, limiting the generalizability. Finally, the sample size was low, and these results may have limited external validity, as they were derived from a sample of college athletes from one university in the northeastern United States.

Overall, this is the first study to document attitudes toward baseline CNT within the context of concussion assessment and management. Only 6% of university athletes reported a history of intentionally attempting to sandbag a baseline neurocognitive assessment, and perceived utility of the baseline assessment emerged as a significant predictor of maximal effort on baseline CNT. Given the widespread attention on concussion, both in the United States and worldwide, it is likely that concussion education and management programs will continue to be implemented within educational institutions and organized sports leagues. As such, improved athletes' understanding of the utility of baseline CNT, within the context of management of postconcussion RTP decision making, may ultimately eliminate sandbagging behaviors and improve athletes' effort provided.

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