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## Personality and Risk Taking in Sports: A Focus on Unintentional and Intentional Head Impacts in Amateur Soccer Players

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### Abstract

**Objective**—In soccer, unintentional and intentional (heading) head impacts are associated with concussive symptoms and cognitive dysfunction. We examined whether personality traits were associated with these behaviors in soccer players.

**Design**—Cross-sectional study.

**Setting and Participants**—Participants completed study visits at the Albert Einstein College of Medicine. A total of 307 adult amateur soccer players, recruited from the New York City and surrounding area, completed 737 HeadCount-2w questionnaires.

**Predictor Variables**—Personality traits (Intellect/Imagination, Conscientiousness, Extraversion, Agreeableness, and Neuroticism) were assessed with the Mini-International Personality Item Pool questionnaire at the baseline study visit.

**Main Outcome Measures**—Participants completed an on-line questionnaire (HeadCount-2w) to ascertain frequency of intentional head impacts and occurrence of unintentional head impacts

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every 3–6 months. Generalized estimating equations repeated measures regressions determined if personality predicted unintentional and intentional impacts.

**Results**—Personality traits were not associated with unintentional head impact(s) or frequency of intentional head impacts.

**Conclusions**—These findings have important clinical implications, suggesting that personality is *not* driving the association between high levels of unintentional and intentional head impacts and worse neuropsychological functioning and concussive symptoms.

### Keywords

personality; risk; soccer; heading; concussion; extraversion; sports

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## INTRODUCTION

Risk-taking behavior, which can be measured by assessing stable personality traits shown to predict personal harm (e.g., gambling, substance abuse, unsafe driving), may also be relevant to participation in and risk-taking behavior in sports like soccer<sup>1–3</sup>. In general, personality traits are predictive of participation in sports. People who engage in athletic activity tend to be more extraverted, less conscientious, and less neurotic than those who do not participate in athletic activity<sup>3–5</sup>, and these differences persist over time<sup>4</sup>. Personality traits also predict risk-taking behaviors among athletes, especially in extreme or high-risk sports where injury or death is inherent (e.g., skydiving, mountain biking). Among risky-sport participants, low conscientiousness and high extraversion have consistently predicted the greatest risk-taking behaviors<sup>6,7</sup>, while the findings for neuroticism are inconsistent<sup>6,8</sup>. Most studies have focused on extreme sports in which risk of injury is readily apparent. In soccer, risk of injury is less extreme and not as apparent in the short-term, yet important to study nonetheless. We examined whether these same traits were relevant to less extreme forms of risk-taking behavior in soccer.

Soccer, the most popular sport worldwide, may account for a significant share of sports-related head injury from both unintentional (i.e., direct head contact with other player's body or head, the ground, and stationary objects (e.g., goal post) and ball hitting the back of the head) and intentional (i.e., heading the ball) events<sup>9–11</sup>. Intentional head impacts (heading) are largely regarded as a complex skill that requires precise timing, coordination, and strength<sup>12</sup>. However, even with proper technique, the intentional head impact itself can elicit brain injury and functional sequelae over time<sup>13</sup>. In light of the growing awareness of medical<sup>9</sup> and neuropsychological sequelae<sup>14–16</sup> of unintentional and intentional head impacts in soccer play, it is important to study the personality factors that may increase a player's tendency to experience injury. If personality traits are predictive of risk-taking behaviors among soccer players, this could inform the development of more targeted public health interventions to reduce the rate of head injuries. Whereas, if personality traits are not predictive of risk-taking behaviors, this suggests that other interventions should be investigated. Thus, the goal of the current study was to examine if relationships exist between personality and unintentional head impacts and intentional head impacts (heading) in a well-characterized sample of amateur adult soccer players. Based on the personality

traits associated with participation in sports and risk-taking behaviors among athletes, we hypothesized that high levels of extraversion and low levels of conscientiousness would be related to unintentional and intentional head impacts. Given mixed evidence for the association between neuroticism and risk-taking behaviors among athletes, the hypothesis for this personality trait was more exploratory in nature.

## METHODS

### Participants

The Einstein Soccer Study is an ongoing, multi-faceted longitudinal study of heading during soccer play and its consequences in adult amateur soccer players. Details on the study population and data collection protocol are described in detail elsewhere<sup>9</sup>. In brief, amateur adult soccer players recruited by various outreach methods in New York City and surrounding areas were directed to an enrollment website for preliminary consent and screening. Inclusion criteria included: age 18–55; at least 5 years of active amateur soccer play; current active amateur soccer play; 6 months of amateur soccer play per year; and English language fluency. Exclusion criteria included: schizophrenia, bipolar disorder; known neurological disorder; prior moderate or severe TBI; pregnancy; and medical contraindication to MRI (relevant to a separate arm of the study). The study protocol was approved by The Albert Einstein College of Medicine Institutional Review Board. Written informed consent was obtained from qualifying individuals prior to enrollment at their initial in-person study visit. Participants visited the laboratory up to 5 times every 3 to 6 months over the course of a maximum study period of 2 years. The enrollment period for the data included in this study was 2013 to 2016. At these visits, participants were asked to complete a battery of neuropsychological tasks and psychological questionnaires. Immediately following each visit, participants were asked to complete a web-based two-week recall questionnaire (Head Count-2w) on soccer activity and unintentional and intentional head impacts.

### Unintentional and Intentional Head Impacts: HeadCount-2w

Details on the development of HeadCount-2w, the two-week recall questionnaire, are described elsewhere along with the format and structure of the questionnaire<sup>9,17</sup>. In brief, HeadCount-2w was designed as a web-based questionnaire organized into four categories of play including outdoor practice, outdoor games, indoor practice, and indoor games and two categories of head impacts including intentional and unintentional. Days played was computed by adding number of indoor and outdoor games and practices the participants reported within the two-week HeadCount-2w recall period. For indoor and outdoor competition and practice, questions ascertained: 1) Number of competitive soccer games and number of practice sessions; 2) Positions played during games; and 3) Average number of headings during games or practice. For all soccer activities in the past two weeks, participants were asked how often they experienced unintentional head impacts from specific causes (e.g., ball hitting the back of the head, head to goal post, head to head, head to ground, head to body part (elbow, knee etc.), and head stepped on or kicked). Participants were asked to report these unintentional head impacts over the time period of the questionnaire.

## Personality Questionnaire: Mini International Personality Item Pool (Mini-IPIP)

The Mini-IPIP<sup>18,19</sup>, administered at the first study visit only, is a 20-item short form questionnaire based on the 50-item IPIP five-factor model<sup>20,21</sup> that measures the “Big Five” personality factors of Intellect/Imagination (also referred to as “Openness to experience”), Conscientiousness, Extraversion, Agreeableness, and Neuroticism. When presented with a statement (e.g., “I am the life of the party”), participants are instructed to choose a response that most accurately describes themselves on a 5-point Likert-type scale ranging from 1=*very inaccurate* to 5=*very accurate*. There are four items for each of the five personality domains. Eleven of the items are reverse scored. A total score ranging from 4 – 20 is derived for each of the five personality domains. This measure has demonstrated high test-retest reliability, metric invariance, and criterion validity<sup>18,19</sup>. The primary variable of interest for this study was the total score for each of the five personality domains.

## Statistical Analysis

IBM SPSS Statistics for Windows Version 24.0 (IBM Corp.; Armonk, NY) was used to determine if selected personality traits were directly associated with unintentional and intentional head impacts. Two-week recall of unintentional head impacts was defined as a dichotomous variable (0 versus 1+ unintentional head impacts). Given the non-linear distribution of intentional head impacts, heading exposure was represented as ten ordinal groups of equal size (deciles); this transformed intentional head impacts into zero exposure (median=0), and the nine subsequent groups were assigned the median value of the range of the group.

Separate generalized estimating equations (GEE) repeated measures regressions were used to determine the relation of unintentional head impacts and intentional head impacts (dependent variables) with each of the five personality traits (independent variables). For unintentional impacts a binary logistic regression was used. For the intentional impacts, a linear regression was used. The GEE models were fit with the following additional covariates: gender, age, number of days played in two weeks, concussion count, number of drinks of alcohol in a week, years of soccer play at a similar frequency, cigarette use (yes/no), the Wide Range Achievement Test (WRAT-4) Reading subtest estimated premorbid intelligence score<sup>22</sup>, and main position played. The final GEE models reported in Table 2 included only the covariates which remained significant at the  $p < 0.1$  level.

## RESULTS

### Sample characteristics

Three-hundred and seven participants reported soccer activity (Table 1). Of these, 125 participants completed one HeadCount-2w questionnaire, 70 participants completed two HeadCount-2w questionnaires, and 112 participants completed three or more for a total of 737 HeadCount-2w questionnaires. Of the 737 questionnaires, 245 reported both intentional and unintentional head impacts, 432 reported intentional but no unintentional head impacts, 11 reported unintentional but no intentional head impacts, and 49 reported neither intentional nor unintentional head impacts.

### Unintentional head impacts and personality

Among all eligible HeadCount-2w questionnaires, 34.7% reported one or more unintentional head impacts, with 15.9% reporting two or more unintentional head impacts in the past two weeks. “Head hit elbow or knee” and “ball hit the back of the head” were the two most common unintentional head impact exposures. The mean unintentional head impact score was 0.66 with a median of zero.

The multivariable GEE binary logistic regression models for predicting unintentional head impacts adjusted for number of days played and main position. Number of days played was computed as described above. Main Position was a self-reported question. Separate GEE regression models were fit with each of the five personality domains as a predictor and unintentional head impact (0 versus 1+ unintentional head impacts) as the outcome. Personality traits were not significantly associated with unintentional head impacts (Table 2). The association between higher levels of extraversion and the occurrence of unintentional head impact(s) was nearly significant ( $p=0.06$ ) with an Odds Ratio per 5 unit increase in extraversion score equal to  $\exp(0.06 \times 5) = 1.35$  (95% CI: 1.05, 1.82).

### Intentional head impacts (heading) and personality

Among all eligible HeadCount-2w questionnaires, 91.9% reported intentional head impacts (heading) in the past two weeks. The mean number of headers was 45.04 with a median of 15 headers per two weeks.

The linear GEE models for predicting intentional head impacts adjusted for number of alcoholic drinks per week, main position of the player, the number of days played within a two-week period, and the number of concussions reported. For the agreeableness personality domain, gender was included as an additional covariate. Alcoholic drinks per week was calculated based on the self-reported question, “How many alcoholic drinks do you drink per week?” with possible responses including 0, 1–2, 3–7 and 8–12 drinks per week. Concussion count was computed by asking the participants how many instances did they seek or were advised to seek medical attention after a head impact.

Separate GEE regression models were fit with each of the five personality domains as a predictor and the intentional head impact category (0–10) as the outcome. None of these models yielded significant findings (Table 2). However, a nearly significant relationship between intellect/imagination and frequency of intentional head impacts was found ( $p=0.08$ ).

## DISCUSSION

Overall, personality traits of amateur adult soccer players were *not* associated with risk of incurring unintentional head impact(s), such as impact of the head against a goal post, the ground, or another player’s body or head, the head being stepped on or kicked, and impact of ball unintentionally hitting the player’s head. Personality also did not predict frequency of intentional heading of the ball. The findings from this study were contrary to our hypothesis that some of the “Big Five” personality traits, namely extraversion, conscientiousness, and neuroticism, would be related to risk-taking behaviors among soccer players. We propose an

explanation for the lack of an association between personality traits and unintentional and intentional head impacts in this study and explore the implications of such null-findings for interventions to ensure safe-soccer play.

Based on the small existing literature examining personality traits that predict level of engagement in sports and risk-taking behaviors among such athletes<sup>4,6,7</sup>, we predicted that the personality traits of high extraversion and low conscientiousness would be related to risk-taking behaviors among soccer athletes. We also predicted that the trait of neuroticism would be related to risk-taking behaviors, but did not specify directionality. However, as noted above, no statistically-significant association was found between personality traits and risk-taking behaviors in soccer players (i.e., unintentional and intentional head impacts). There is growing awareness that heading of the ball and unintentional head impacts incurred during soccer play place athletes at risk for injury, including poorer neuropsychological functioning<sup>11,15,16,23</sup>, concussive symptoms<sup>9</sup>, abnormal white matter microstructure<sup>11,24</sup>, structural brain changes<sup>25,26</sup>, and electrophysiological changes<sup>27</sup>. As mentioned above, the risk of injury from soccer, although important in its implications, is not as extreme or readily apparent to soccer athletes as the risk level of sports examined in prior studies in which potential for injury or death is clear to participants. The absence of an association of personality with exposure to risk in our study may be because intentional head impacts in soccer are not perceived by participants as sufficiently high-risk activities. In this vein, a recent study reported heading as an uncommon cause of concussion<sup>28</sup>, but failed to acknowledge the potential for adverse effects of cumulative heading on brain function over time<sup>29,30</sup>. This recent study<sup>28</sup> highlights the importance of public health interventions to increase awareness of the potential risks of soccer-related intentional head impacts over the long-term.

In the only other study to date to examine the association between personality and intentional head impacts (heading) in soccer players, higher extraversion was related to an increased likelihood of heading the ball among 60 elite male players<sup>31</sup>. The present study did not replicate these findings, possibly due to differences between the samples. Importantly, the present study included (1) a much larger sample (737 questionnaires from 307 players), (2) a higher percentage of female soccer athletes relative to their representation in the general population of soccer players worldwide (22% females, compared to 10% females in the population of registered and unregistered soccer players according to the 2006 FIFA Big Count Survey<sup>32</sup>), (3) study of both unintentional and intentional head impacts, and (4) inclusion of amateur league, not elite or professional soccer players. Amateur and elite soccer players may differ in heading technique, which could contribute to risk of injury from such cumulative heading exposures. The current findings may better represent the worldwide population of soccer players, with amateur players far outnumbering professional players<sup>32</sup>.

The reasons for the lack of an association between personality traits and unintentional head impacts may differ from the reasons stated above for intentional head impacts (heading). The way in which personality traits could alter risk for the two types of head impacts likely differs. For example, unintentional head impacts are somewhat random and athletes may have less control over these types of exposures, while intentional head impacts, as stated in their name, are more intentional and calculated.



In the largest sample of amateur soccer players studied to date, personality traits were not associated with frequency of unintentional head impacts (heading) of the ball during soccer play. This finding adds to the growing study of heading and neuropsychological functioning by expanding our understanding of underlying mechanisms. One potential implication is that personality traits are not likely to drive the association between high levels of heading and worse neuropsychological functioning<sup>11,16,33</sup>, placing the focus on the repetitive exposure to head impacts rather than pre-existing traits.

There are several limitations to our study that should be noted. Our measure of heading and unintentional head impacts was obtained from a self-report questionnaire that has demonstrated reliability and validity across settings<sup>9,11,17,34</sup>, but caution should still be taken when interpreting our results as recall bias cannot be excluded. For unintentional head impacts, the choices we included for mechanism of injury were based on a series of focus groups held with the population from which we subsequently enrolled participants and included common types of unintentional head impacts experienced among this population (i.e., ball hitting the back of the head, head to goal post, head to head, head to ground, head to body part (elbow, knee etc.), and head stepped on or kicked). This range of possibilities may not be exhaustive in light of prior work<sup>35</sup>. Other possible mechanisms of injury include head to shoulder, head to lower leg, head to trunk, as well as specifying the location of contact on the head and should be included in future studies. Additionally, our sample comprises amateur adult soccer players. Although study enrollment criteria ensured a relatively high level of commitment to the game (at least 5 years of active amateur soccer play, current active amateur soccer play, and at least 6 months of amateur soccer play per year), the findings should be considered as reflective of this unique sample and may not necessarily apply to elite, youth, or amateur athletes with lower levels of routine soccer play. Additionally, as players self-selected to participate in the study, a self-selection bias cannot be ruled-out; caution should be taken when generalizing our study to soccer play among community samples, who may experience different patterns of exposure. However, the mean activity level of our study participants has been deemed comparable to that of amateur players worldwide<sup>36</sup>. Despite these limitations, these findings from our large, well-characterized sample may help inform the development of interventions aimed to increase awareness of the risks of both unintentional and intentional in the ever-increasingly popular, yet high-risk, sport of soccer.

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**Table 1**

Demographic Characteristics and Exposure Variables Presented as Mean (SD)

Variables	Category	Percent (n=737)	Heading/2-wks		Unintentional/2-wks (%)	Extraversion	Agreeableness	Conscientiousness	Neuroticism	Imagination
			Mean	Median						
<b>Total</b>		100	35.3	14	36	13.4	15.7	15.1	9.2	15.1
<b>Gender</b>	Male	78	50.2	17	33.9	13.3	15.3	15	9.2	15.4
	Female	22	26.7	7.5	37.7	13.6	16.7	15.4	9.4	14.4
<b>Age</b>	18–20	23.8	63.6	24.5	40.9	13.3	14.9	14.6	9.6	15.2
	21–23	25.1	58.1	24	37.8	13.9	15.9	14.8	9.4	15.8
	22–30	28.6	26.8	10	28.9	13.6	15.7	15.2	9.1	15.4
	31+	22.4	34	13	32.1	12.6	15.7	15.7	8.9	14.2
<b>Years Playing Soccer at similar frequency</b>	0–5.9	20.2	37.6	11	36.9	13.4	15.9	15	9.3	15.1
	6–9.9	17.9	50.9	22	32.6	12.9	15.8	14.8	9	15.5
	10–15.9	32.7	58.6	21	41.5	13.2	14.9	15.2	9.9	14.9
	16+	29.2	31.4	12	27	13.7	15.9	15.3	8.6	15.2
<b>Number of Days Played</b>	0–1	10.2	5.1	2	21.3	13.8	15.9	15.1	9.3	15
	2–3	27.4	12.6	7	25.7	13.2	15.7	15.1	9.1	15.2
	4–7	35.7	32.7	15	33.5	13.3	15.7	15.1	9.2	15.3
	8+	26.7	110	76	50.8	13.4	15.1	15.1	9.5	15
<b>Position played most often</b>	Forward	19.8	56.1	22	45.2	12.5	15.1	15.8	9.7	14.7
	Midfield	37.3	39.9	15	32.7	13.2	15.5	14.9	9.2	15.4
	Defense	36	48.6	15	29.1	13.8	16	15	9.1	15.3
	Goal	6.9	22.9	6	45.8	14.2	15.1	14.6	8.9	14.6
<b>Concussions (all causes): Lifetime</b>	None	79.6	50.7	16	34.2	13.5	15.5	15.1	9.5	15
	1	12.2	19.6	9	33.3	12.6	15.8	15.1	8.8	16
	>2	8.1	28.3	13.5	41.7	13.6	16.2	15.5	7.3	15.3
<b>Drinks of Alcohol Per Week</b>	Never	30	80.3	36	40.7	11.9	14.5	15	9.8	15

Variables	Category	Percent (n=737)	Heading/2-wks		Unintentional/2-wks (%)	Extraversion	Agreeableness	Conscientiousness	Neuroticism	Imagination
			Mean							
			Mean	Median						
	1-2	36	33.7	15	32.5	15.1	16.3	15.7	9	15.6
	3-7	26.2	24.4	10	32.6	13.6	15.7	14.4	9	14.7
	8+	7.9	31.3	11.5	29.3	15.1	16.4	15.3	8.9	15.4
<b>Cigarette Use</b>	0	71.6	49	16	35	13.4	15.5	15.2	9.4	15.1
	1	28.4	35.1	13	34	13.3	15.6	14.8	8.7	15.3
	0-96	23.3	71.6	31	37.2	12.6	14.5	18.8	10.5	14.6
	97-104	25.4	42	17	35.3	14.2	15.5	15.2	9	15.1
<b>WRAT-4 Reading</b>	105-113	26.2	41.7	15	31.6	13	15.9	15.3	8.6	15.1
	114+	25.1	26.9	9	35.1	13.6	16.3	15.1	9	15.8

**Table 2**

Generalized Estimating Equation model mean differences in unintentional head impacts and intentional head impacts by personality traits

Personality Traits	Unintentional Impacts		Heading Impacts	
	$\beta$ (95% CI)	p-value	$\beta$ (95% CI)	p-value
<b>Intellect/ Imagination</b>	0.01 (-0.06,0.08)	0.78	1.31 (-0.17, 2.78)	0.08
<b>Conscientiousness</b>	-0.03 (-0.09,0.03)	0.32	0.13 (-0.99, 1.25)	0.83
<b>Extraversion</b>	0.06 (0.01,0.12)	0.06	0.57 (-0.66, 1.80)	0.37
<b>Agreeableness</b>	0.06 (-0.02,0.14)	0.15	0.62 (-0.87, 2.12)	0.41
<b>Neuroticism</b>	0.03 (-0.04, 0.10)	0.41	0.46 (-0.93, 1.84)	0.52

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