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SHORT COMMUNICATION

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Devoted fans release more cortisol when watching live soccer matches

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Abstract

Why do some sports fans experience intense emotions when watching live matches? Identity fusion is a strong form of group alignment in which personal and group identities are activated synergistically to produce a visceral sense of 'oneness' with one's team. Here we examine the role of fusion (using a three-item state measure with high internal validity) in elevating salivary cortisol levels while watching football (n = 41). Our evidence was gathered at field laboratories during the 2014 sFIFA World Cup in Natal, Brazil, with live screenings of two Brazilian victories (Colombia, 2–1; Chile, 1–1 with penalties), and the historic semi-final loss to Germany (1–7). We replicated previous studies showing that salivary cortisol concentrations fluctuate during live football events and are related to group membershipbut we also extended them by showing that identity fusion is even more strongly related to cortisol concentrations than identification. We found an interaction between match outcome and cortisol, such that watching a loss, i.e. *dysphoria*, was associated with particularly high cortisol concentrations. While women were more fused to the team than men, there were no other gender effects. Taken together, these findings suggest that identity fusion modulates physiological reactivity, resulting in distinct psycho-physiological profiles during stressful events.

KEYWORDS
cortisol, football, identity fusion, physiological profiles, soccer, stress response system

1 | INTRODUCTION

Attending live sports matches at stadia or public viewing events can produce intense shared emotions, commonly expressed by ritualized chanting and singing, synchronous stamping and clapping, and even intergroup violence (Brown, 2007; Giulianotti, 1995; King, 2002, 2003; Pearson, 2012; Stone, 2007; Stroeken, 2002; Weed, 2007). Football (or soccer) is the most watched sport in the world, with nearly half the globe—3.2 billion viewers—tuning in for the 2014 FIFA World Cup (FIFA, 2015). But why do so many people tune in to football, and what are the effects of watching a live sporting event? Recent research into international football has identified a number of physiological responses associated with spectatorship, including heightened cortisol and testosterone levels on match days (van der Meij et al., 2012); increased rate of myocardial infarction (heart attacks) following major games (Carroll, Ebrahim, Tilling, Macleod, & Smith, 2002; Wilbert-Lampen et al., 2008); heightened emotions among spectators (Jones, Coffee, Sheffield, Yangüez, & Barker, 2012; Sullivan, 2014); and, in some cases, aggressive or violent altercations among fans (Stott, Adang, Livingstone, & Schreiber, 2007; Stott, Hutchison, & Drury, 2001; Stott & Pearson, 2007).

To what extent do group identities and bonding contribute to these reactions? Using field laboratories for maximum ecological

The full dataset will be available on the Open Science Framework when the article is published.

validity and the collection of salivary cortisol samples under carefully controlled conditions, we offer replication evidence for van der Meij et al.'s (2012) finding that group identity predicts increased cortisol concentrations regarding sports events but gender does not. We also measure a particularly strong form of group bonding, 'identity fusion' (Buhrmester & Swann, 2015; Swann, Gómez, Seyle, Morales, & Huici, 2009), and test for its relationship to cortisol concentrations both during live matches and up to a week after the game.

1.1 | The stress response system

The main role of the stress response system is to coordinate behavioural and physiological responses when an individual faces physical and/or psychosocial challenges (Del Giudice, Ellis, & Shirtcliff, 2011; Sapolsky, Romero, & Munck, 2000). Non-invasive biomarkers of the stress response system have been widely used in stress research, of which salivary cortisol is the most representative glucocorticoid and has been a major biomarker of physical and/or psychosocial challenges (Ulrich-Lai & Herman, 2009). Past studies have shown that psychosocial stress or situations that threaten the social self promotes an increase in cortisol secretion (Dickerson & Kemeny, 2004), suggesting that cortisol helps the individual to cope with psychosocially demanding scenarios.

Increases in salivary cortisol have also been implicated in the physical and social demands of numerous sports (Hayes, Grace, Baker, & Sculthorpe, 2015). For instance, peak cortisol levels have been found in badminton players who have just lost a game (González Jiménez et al., 2012). These effects also apply to players who are not involved in anaerobic exercise, such as pairs of Caribbean domino players competing against a neighbouring town (Wagner, Flinn, & England, 2002). Spectators, who experience vicarious competition, also experience an increase in cortisol levels, as shown by the higher cortisol secretions found among Spanish soccer fans during the final football match of the 2010 FIFA World Cup, compared with those found on a control day (van der Meij et al., 2012). The social component of soccer seems integral to cortisol production, as the increases observed in Spanish participants were highest among participants who reported the highest levels of fandom.

1.2 | The stress response system and identity fusion

Little is known about the impact of group bonding on salivary cortisol release and still less is known about how strong forms of alignment, such as identity fusion, affect physiological stress when the welfare of the group is at stake. Mazur (2005) hypothesized that stress-induced alliances form due to a stressor promoting a physiological response, which encourages an alliance with immediate others (e.g., other allies or fans); this in turn reduces the physiological response, thus weakening the initial alliance or coalition. The closest research to test such a hypothesis was conducted by Swann, Gómez, Huici, Morales, and Hixon (2010). It showed that heightened arousal (i.e., increased heart rate via physical exercise) translates into progroup activity for people reporting high fusion scores but not for people simply reporting high identification scores. This is because, once fused, an individual's group identity is completely merged with their personal identity and therefore increasing agency (via arousal) also increases progroup behaviours.

Indeed, it is well established that 'fused' individuals demonstrate extraordinarily high levels of group commitment (Swann, Jetten, Gómez, Whitehouse, & Bastian, 2012). Although identification refers to social identities that are context dependent and can effectively be switched 'off' or 'on' (Tajfel & Turner, 1979; Whitehouse & Lanman, 2014), fusion reflects a group identity that is always 'on' (Buhrmester & Swann, 2015). Fusion to one's football club is associated with lifelong loyalty to the club (Newson, Buhrmester, & Whitehouse, 2016), violence towards rival fans (Newson et al., 2018), willingness to fight and die for one's fellow fans (Bortolini, Newson, Natividade, Vázquez, & Gómez, 2018; Newson et al., 2018), and even a willingness to sacrifice one's life for fellow fans who are in danger (Whitehouse et al., 2017). If heart attacks are among the health risks for World Cup spectators and fusion is a strong predictor of negative stress, then perhaps identity fusion could contribute to better understandings of stress and other factors that predict myocardial infarctions and coronary heart disease (Steptoe & Kivimäki, 2012).

As yet, fusion's relationship with psychophysiological measures has not yet been extensively studied (Swann, Gómez, Huici, et al., 2010), an issue that we address in this paper. Using field laboratories where we broadcasted live 2014 FIFA World Cup matches in Brazil, we examined whether experiences of a major global sporting event can have physiologically arousing (i.e., stressful), yet socially cohesive effects.

2 | PRESENT STUDY

Field sites provide higher levels of ecological validity than laboratory studies (Wilson & Whitehouse, 2016), give access to hard to reach populations, and generate data that are rich in variation, which helps to move overarching theories forwards (Newson, Buhrmester, Xygalatas, & Whitehouse, n.d.). This is especially important when quantifying social situations, which are challenging to authentically replicate in the lab. However, most research on human psychology has been carried out in nonecologically valid contexts, using WEIRD samples, that is, samples that are *Western*, *Educated*, *Industrialized*, *Rich*, and *Democratic*, and usually undergraduate psychology students seeking course credits (Henrich, Heine, & Norenzayan, 2010a). These WEIRD participants appear to be outliers in numerous cognitive and behavioural domains, from visual perception, spatial reasoning, and inferential induction, to moral reasoning, decision making, and the heritability of intelligence quotient. As such, WEIRD participants are 'the worst population from which to generalize' (Henrich et al., 2010a, p. 79). Over 90% of articles in leading 2018 psychology journals still reported studies of European and English-speaking nations, and less than 1% focused on Latin-American or African nations (Newson et al., n.d.).

Some fusion research has taken considerable steps to move away from the confines of recruiting students online and in the laboratory (e.g., the empirical studies associated with the dysphoric pathway to fusion mentioned above), but more can be done. To move beyond WEIRD realms, we ran a longitudinal study using Brazilian spectators during the 2014 World Cup. Held in Brazil, this was a sporting catastrophe for the hosts (Sullivan, 2014) who, despite a promising start, suffered the worst home defeat in World Cup history, considered by many as a 'historical disaster' (Bowman, 2014). Although this paper's sample size is small, our findings must be considered in the context of exploratory, naturalistic research, with rigorous controls on physiological measures.

First, we predicted that salivary cortisol concentrations would increase during live World Cup games and that stress would be particularly acute under dysphoric match outcomes, i.e. loss (H1). Next, we predicted that cortisol concentrations would correlate with both fusion and identification (H2). Finally, we predicted that the relationship between cortisol and fusion would be stronger than its relationship with identification (H3).

3 | MATERIALS AND METHOD

3.1 | Participants and procedure

We organized free, high-quality, live screenings of three matches near a commercial district of the city of Natal, north-east Brazil. We screened two wins (Brazil vs. Chile, 1–1 with penalties/Colombia, 2–1: n = 32) and one loss (Brazil vs. Germany, 1–7: n = 10). Although the winning games were euphoric events and enabled the team to progress through group stages against national rivals, the loss game was acutely dysphoric; their worst national defeat since 1920. All those attending the screenings supported Brazil. Ethics were obtained from the School of Anthropology, University of Oxford. Any participants who selected a nationality other than the nationality under study or were under the age of 18 were not accepted for this study.

An advert of the screening and study was posted in local universities, hostels, and shopping districts, with the chance to win a lottery prize worth R$400 (approximately £100) as well as free food and drink for taking part following the game (bottled water was provided during the game). This was supported by a snowball technique (viz., through social media and WhatsApp groups that are highly popular in Brazil). Potential participants were made aware of our eligibility criteria in advance.

We sought to control baseline cortisol concentrations, more extensively than we have seen in other field studies (van der Meij et al., 2012), with exclusion criteria preventing participants from being admitted to the study for habitual smoking (Kirschbaum & Hellhammer, 1994); caffeine intake up to 2 hr before the experiment (Kudielka, Hellhammer, & Wüst, 2009); alcohol consumption up to 24 hr before the experiment (Badrick, Kirschbaum, & Kumari, 2007); and, for women, the use of oral contraceptives or being in the follicular phase of their cycle according to the last date of their period (Kirschbaum, Kudielka, Gaab, Schommer, & Hellhammer, 1999). We estimated menstrual cycle phases based on the backward method (Gangestad et al., 2016), which counts days from the next menstrual onset backward to the day of assessment. For this purpose, we asked women to report the date of their last three menses onset.

A prescreening survey determined whether participants who came to the field laboratory were permitted to take part in the cortisol measures, or only the psychometric measures (n = 70). N = 29 were excluded for the effects their cigarette/caffeine/alcohol consumption or whose hormones might have affected the cortisol analyses. Only participants who completed both cortisol and survey measures are included here (n = 41, females = 19, males = 22; M_{age} = 27.66, SD = 6.51, range = 19–48).

Physiological studies often use sample sizes with n < 50, compared with the n > 100 or even 1,000 of social psychology. For example, van der Meij et al.'s, 2012 study of the cortisol and testosterone levels of 50 World Cup fans; Porges, Smith, and Decety's (2015) study on vagal regulation and testosterone using a sample of 43 students; or Yoo et al.'s (2016) study on salivary cortisol and social anxiety among 42 children.

3.2 | Measures

Psychometric data were collected before kick-off (up to 20 min in advance). Participants were invited to complete the psychometric measures again up to a week later, but these are excluded due to attrition (61.9%, see Supporting Information). All participants were invited to complete salivary cortisol measures, for which they were required to provide a saliva sample by chewing on a Salivette® for 1 min during each of the three time points. Psychophysiological measures were taken at three time points: 20 min prematch; during the half-time interval; and 20 min post-match. Thus, Sample 2 was taken 50–90 m following Sample 1, and Sample 3 taken 50–90 m following Sample 2. Saliva sampling took a total of 4 min on each occasion, that is, 1 min to collect the salivette, 2 min to chew it, and 1 min to return to the researcher and record their details.

To control for circadian effects, saliva samples were collected after midday (Pruessner et al., 1997). All samples were stored at −20°C until the assaying day. Before the assay, samples were thawed and centrifuged at 3,000 rpm for 10 min to produce a clear supernatant of low viscosity. Free salivary cortisol concentrations were determined in duplicate aliquots using a commercial enzyme-linked immunosorbent assay kit with a high sensitivity of 0.012 ng/ml (DRG Instruments, Marburg, Germany). The intra- and inter-assay coefficients of variation were 3.6% and 8%, respectively.

As we were working at live events, we used a reduced version of the verbal fusion scale (Gómez et al., 2011) comprising three state-type items, assessed on a 7-item Likert scale (*I am "one" with the Brazilian national team and my fellow fans; I make the Brazilian national team and my fellow fans strong; The Brazilian national team and my fellow fans make me strong*). Fusion items were selected that represented the cornerstones of the fusion construct: The porous boundary between self and group identities and reciprocal strength (Swann et al., 2012). The reduced scale demonstrated good internal validity (Cronbach's α = .89). We also used a single-item measure of identification that has been previously validated (Postmes, Haslam, & Jans, 2013); *I identify with the Brazilian national team and my fellow fans*. Both fusion and identification were assessed in state form, by adding 'Right now' at the start of each item. Measures were translated into Brazilian Portuguese by three English/Brazilian Portuguese bilingual speakers. They were then back translated and checked for validity by a native English speaker.

3.3 | Analysis

All analyses reported below were conducted using the IBM SPSS statistical Software package (V22). Prior to analyses, all variables were examined for missing and extreme values. Skew and kurtosis were observed for cortisol (i.e., leptokurtic, highly positively skewed data, see the Supporting Information), but deemed manageable by ordinary least squares regressions. To estimate the magnitude of cortisol response, the area under the curve with respect to ground (AUCg) was calculated. This metric reflects the total cortisol concentration (nmol/L) released in a time interval, using the first measure as the reference (i.e., as zero; Pruessner, Kirschbaum, Meinlschmid, & Hellhammer, 2003). We ran the models using the raw values of cortisol to calculate the AUCg, because recent discussion shows log-transformation overestimates biological phenomena, for example, conception probability (Roney, 2019). Therefore, we deem raw values a better proxy for hormonal mechanisms, though log-transformation results are reported in full in the Supporting Information. Only results pertaining to one of the hypotheses had their significance changed in the transformation analyses, which is reported below.

For consistency with endocrinological literature, we checked for AUCg outliers that were 3 *SD*s above the mean (n = 2; Pollet & van der Meij, 2017). See Figure 1 for data distribution. Excluding these outliers resulted in slightly larger p values, likely as an effect of reducing the already small sample size, but the significance of the results was not changed (see the Supporting Information). Analyses for all data points are thus included below. Outliers were not found for psychometric measures.

4 | RESULTS

Descriptives and correlations are reported in Table 1. Across win (n = 31) and loss games (n = 10), participants were quite similar in terms of gender, pre-game cortisol, and pre-game fusion ($p > .162$). However, participants were significantly older in the loss game (M = 31.50, SD = 9.59) compared with the win games (M = 26.42, SD = 4.72), t = −2.25, p = .030. We found that females in this sample (M = 4.85, SD = 1.47) were significantly more fused than males (M = 3.64, SD = 1.74), $t(38)$ = −2.36, p = .024, although males and females did not differ for identification (p = .243). We thus reran all analyses including gender as a covariate, but this did not affect any of the results (Supporting Information).

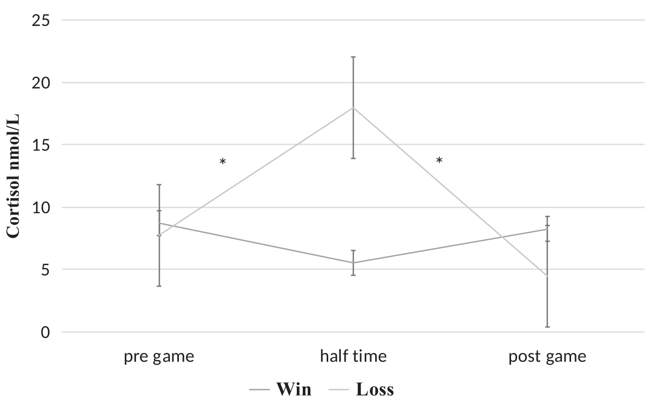

FIGURE 1 Higher fusion levels are associated with higher salivary cortisol concentrations (AUCg)

4.1 | Cortisol concentrations fluctuate during live sporting events

A repeated measures analysis of variance including T1, T2, and T3 cortisol as within-subject factors and game outcome as a between-subject factor showed an overall change in salivary cortisol before, during and after the match, $F(2, 38) = 3.87$, $p = .030$, partial $\eta^2 = 0.17$. There was also a significant cortisol × result interaction, $F(2, 38) = 10.13$, $p < .001$, partial $\eta^2 = 0.35$. Mauchly's test of sphericity was not violated (p = .272). Post hoc tests revealed that at half-time (T2), the loss game was associated with significantly more cortisol release (M = 17.98, SD = 15.17) than the win games (M = 5.55, SD = 4.83), $t(40)$ = −4.10, $p < .001$, but there were not significant

TABLE 1 Principle (*M*, *SD*, or %) and demographic variables and their correlations (Spearman's rho)

	T1 fusion	Cortisol AUCg	Age	Gender	T1 ident.
T1 fusion	**4.18** (**1.71**)				
Cortisol AUCg	.40**	**16.34** (**13.50**)			
Age	−.03	.07	**27.66** (**6.51**)		
Gender	.35*	.17	−.06	**53.7%** (*M*)	
T1 ident.	.62***	.35*	−.02	.14	**5.05** (**1.61**)

**p* < .05.; ***p* < .005.; ****p* < .001.

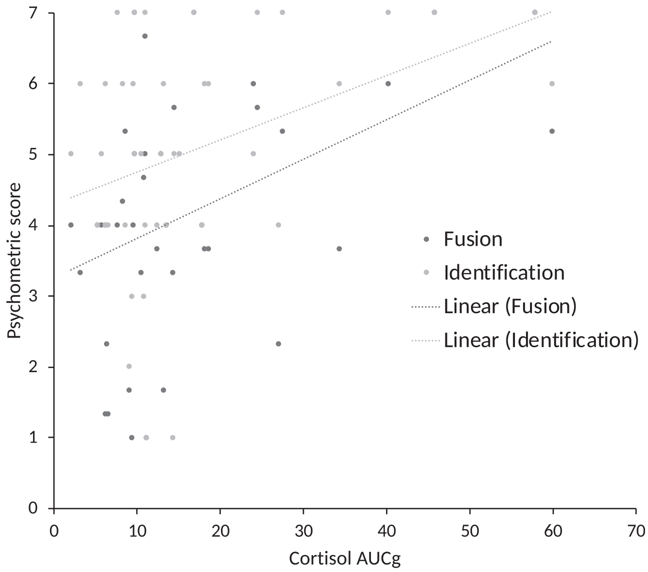

FIGURE 2 Salivary cortisol concentrations peak during half-time, compared with an hour before or immediately after a match in loss game (mean *SE*). *$p < .05$

differences between win/loss outcomes on other occasions. This is likely because the loss game involved the opposition leading 5–0 by half-time (Figure 2). We log-transformed the data (Supporting Information) and found no significant change in cortisol over time ($p = .112$). However, the interaction reported above, and subsequent results reported below, did not change significance in the transformation analyses.

4.2 | Increased cortisol concentrations correlate with fusion

Spectators who reported higher levels of fusion and identification to their team and fellow fans also experienced the greatest increases in cortisol concentration over the course of the game (see Table 1 for correlations, $r > .37$, $p < .014$). A step-wise linear regression with fusion and identification entered as independent variables, and cortisol AUCg entered as the dependent variable indicated that fusion ($\beta = .45$, $p = .004$) was the best predictor of cortisol AUCg, $R^2 = .20$, $F(1, 38) = 9.59$, $p = .004$. In this model, identification was excluded ($\beta = .16$, $p = .390$). However, when entered alone, identification also related to cortisol AUCg but not as well as fusion, $R^2 = .15$, $F(1, 38) = 6.74$, $p = .013$. See Figure 1 for a scatterplot of fusion and identification plotted against cortisol AUCg.

5 | DISCUSSION

Across win and loss outcomes, analyses provided some evidence that participants who experienced the greatest stress response system activation over the course of a World Cup match also tended to be the most fused. We expected dysphoric outcomes to induce more cortisol release, particularly given the scale of stress experienced by Brazilians in their final 2014 World Cup game at home (5–0 defeat by half-time), and this was tentatively supported by the results albeit sample sizes were particularly small when split by game outcome. Previous research has only looked at euphoric events; hence, earlier reports of salivary cortisol concentrations were increasing on match days compared with non-match control days but not increasing during the (win) match itself (van der Meij et al., 2012).

A distinct pattern in cortisol secretion for highly fused individuals emerged. This relationship has never before been demonstrated, and fusion was more strongly related to cortisol AUCg than identification. Though grounded in well-supported theory (Swann, Gómez, Huici, et al., 2010; Swann et al., 2009; Whitehouse, 1996, 2004), this was an exploratory study, and these initial results must be treated cautiously. Fusion appears to modulate physiological reactivity, resulting in distinct psychophysiological profiles. This research, using a naturalistic setting, empirically tested how stress (i.e., salivary cortisol concentrations) relates to important self-group identity relations, paving the way for future research.

This study focused on spectators, but a question remains as to whether highly fused active participants (i.e. players) in competitive sport experience heightened cortisol concentrations during matches in a similar way, or perhaps to an even greater extent. The stress levels exhibited by the sample, which correlated with a measure of extreme group bonding, support theories of stress-induced alliances that would have been relevant in the ancestral past, that is, during intergroup conflict (Choi & Bowles, 2007; Mazur, 2005; McDonald, Navarrete, & Van Vugt, 2012). As identity fusion was a significant predictor of stress in a context that is already associated with a higher risk for heart attacks, we suggest that it should be considered as a factor when determining risk groups for the purposes of health research and policy, for instance, hardcore (highly fused) fans may be offered cardiac exams by their clubs as part of community programmes and provided with education around heart health and managing high stress events.

We did not find significant sex differences in this sample, aside from Brazilian women being significantly more fused to their World Cup team and fellow fans than men. This supports van der Meij et al.'s findings concerning salivary cortisol concentrations of fans watching their teams play during World Cup football events. This is perhaps surprising given evolutionary research that places males at the forefront of sports spectatorship (Deaner, Balish, & Lombardo, 2015; Lombardo, 2012). As World Cup sport is explicitly tied up with national and cultural identities, further work is needed to explore whether club-level competitive sport induces more stress (and potentially alliance) among men than women and whether this is responsible for the disproportionate number of men who engage with regional football compared with women, at least across Europe.

A major limitation concerns our small sample size. Post hoc power analyses were conducted, revealing that for medium effect sizes of $F^2 = .25$ and $r = .45$ for correlations, sample sizes of 44, 39, and 64 were needed for the repeated measures analysis of variance (H1), correlations (H2), and linear regressions (H3), respectively (Faul, Erdfelder, Buchner, & Lang, 2009). Nonetheless, consistent with psychophysiological research, our sample consisted of *n* = 41, with just 10 in the loss game due to many participants sobbing or walking out before half-time. Participants in the loss game were also older, perhaps due to younger participants spontaneously deciding to leave the research early due to the game's outcome. Presumably the cortisol scores of those deciding to quit the research were even higher. Furthermore, the dysphoric game occurred later in the World Cup tournament, with the euphoric games occurring at the start. As Brazil won all of its opening games, there was not an opportunity to compare dysphoric and euphoric games from the same subsection of the tournament, though it would be a more controlled comparison for future research.

The study with perhaps the most parallels is van der Meij et al.'s (2012) field study on cortisol and testosterone secretion among football fans. We commend the authors' ambitions and strong results and aimed to extend their research by using a challenging field environment coupled with even more rigorous controls (e.g., smoking/drinking/eating rules were stricter for cortisol analyses). Even laboratory studies including hormonal and other physiological measures tend to have samples of around 50 participants, such as Diekhof, Wittmer, & Reimers's (2014) study with football fans on testosterone and parochial altruism (*n* = 50) or van der Meij's other fan study into basal cortisol (*n* = 74; van der Meij et al., 2015). This demonstrates how challenging it is to recruit and retain participants for such measures in the field. Both time and financial costs influence sample sizes in such studies. In addition, our small subsample sizes are balanced by the fact that there are fewer uncontrolled social and background variables in physiological measures. Indeed, health research using physiological measures have often comprised only eight subjects (Reinard, 2006). Nonetheless, the issue of sample sizes should be addressed in future studies—potentially by visiting participants' homes or running controlled laboratory studies as per van der Meij et al.

In the present study, sample sizes were too small to assess the effect of loss versus win outcomes on the cortisol–fusion relationship. Nonetheless, it appears that watching one's team lose produces a significant increase in salivary cortisol concentrations, whereas watching a victory does not. It may be, as per van der Meij et al.'s paper, that cortisol concentrations also rose on victorious match days in relation to control non-match days, but we did not detect an increase during the game itself. Given the time constraints of collecting data in the field, the survey was kept very brief. The original survey was administered to >400 participants during live games in stadia and at FanFest sites, as well as at our field laboratories in homes and community centres. The short nature of the survey thus reflects this need to attract and retain participants in a challenging environment. Of particular value for future inclusion would be a measure of state anxiety, which could be used as a control for results. Furthermore, identification should be measured beyond the single-item measure we used here.

Previous research has not found significant associations between negative affect and fusion, but relationships between positive affect and fusion have been demonstrated (Kavanagh, Jong, McKay, & Whitehouse, 2017). An issue with such self-reported measures then is that although an event may be painful, embarrassing, or traumatic, participants may still rate it as 'positive' because of the potent social ties it facilitates. Further work is needed to tie together objective physiological measures, self-reported affect measures, and qualitative participant testimonies. Testing how frequently participants spectate or participate in a given event may also be important—does regular exposure to highly emotive crowd rituals such as football matches produce cumulative stress or does it reduce stress via familiarity or increased bonding to the extended group?

This study highlights the challenges of collecting longitudinal data in the field and is a methodological step towards less WEIRD, and more WILD (Worldwidel, In Situ, Local, and Diverse) (Henrich, Heine, & Norenzayan, 2010b; Newson et al., n.d.). The criteria for physiological measures were strict, so only participants who did not smoke, and agreed not to eat nor drink prior to or consume any alcohol during the experiment were included. To combat threats to external validity of forgoing alcohol during a World Cup game, we included local beers in the post-match buffet, which participants were aware of—so it was a matter of delaying rather than forgoing alcohol consumption. It is also important to note that the relationship between alcohol and football consumption is not quite as high in Brazil as it often is in Northern Europe, with respect to differences in 'binging' culture more generally. A particular obstacle in this research was persuading participants to chew on an unpleasant salivette for a minute, three times, after experiencing the worst World Cup defeat in living memory. At a cost to our relatively high levels of ecological validity (i.e., natural groups attending a live event in a natural setting) are issues of internal validity. Specifically, there is a possibility that the data are non-independent, i.e., the game was watched as a group, with the highs and lows of the game shared among fans. As such, ingroup variability may be biased downward, increasing the likelihood of a Type 1 error. This points to the merits of mixing methods and analyses to triangulate results, whereby carefully controlled laboratory studies can confirm or disprove our ecologically valid results (Newson et al., n.d.).

6 | CONCLUSIONS

Although sample sizes could be improved in future studies, these exploratory results are encouraging. Taken together, analyses suggest that highly fused people have a distinct physiological profile, such that there seems to be an interaction between the stress response system and fusion during stressful group events. The behavioural consequences of fusion have the potential to be some of the most extreme and dangerous social behaviours we know, with fused group members risking life and limb in the name of their group (Buhrmester, Fraser, Lanman, Whitehouse, & Swann, 2015; Newson et al., 2018; Sheikh, Gómez, & Atran, 2016; Swann, Gómez, Dovidio, Hart, & Jetten, 2010; Whitehouse et al., 2017; Whitehouse, McQuinn, Buhrmester, & Swann, 2014). When viewed in this way, a more thorough understanding of extreme forms of group alignment, such as fusion, and how this bonding relates to stress and stressful environments could inform practices around crowd control and group relations more broadly.

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CONFLICT OF INTEREST

There are no conflicts of interest.

AUTHOR CONTRIBUTIONS

M. N., H. W., J. J., and E. Y. designed the experiment. M. N., V. S., and W. H. conducted the experiment. M. N., V. S., W. H., and M. B. ran the analyses. M. N., V.S., H. W., J. J., and M. B wrote the paper.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of this article.

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