Title: Nonverbal Post-Shot Celebrations and their Relationship with Performance in Elite Handball

Authors: Karin Moesch[1], Göran Kenttä[2], Martin Bäckström[1], C. Mikael Mattsson[2]

Affiliations: [1] Department of Psychology, Lund University, Sweden; 2 The Swedish School of Sport and Health Sciences, Stockholm, Sweden

Correspondence: karin.moesch@rf.se

Abstract

Nonverbal behaviour has an important function in team sports, but research is limited. Adopting a psychological momentum (PM) framework, this study explores the relationship between a team's history of events, nonverbal post-shot celebrations in the form of gestures and touch shown by the shooter after scoring, and subsequent team performance during handball matches. A naturalistic design with systematic observation was chosen for the present study. Based on an existing coding scheme, 616 post-shot periods from 18 high-stake matches of the highest league in Sweden were analysed. Results showed that the better a team's prior performance, the more gestures were displayed after scoring in the following period. A high degree of touch when playing well, and a low degree of touch when playing poorly were related to positive subsequent team performance, while, showing much touch when playing poorly, or showing little touch when playing well were related to negative subsequent team performance. The amount of displayed gesture and touch alone was not significantly related to subsequent team performance. To conclude, nonverbal post-shot celebrations were related to subsequent team performance, but only when the ongoing history of events was taken into account, and only for touch. Based on these results, the history of events emerges as an important variable when the dynamics of ongoing team sport matches are investigated. Further, touch, compared to gesture, seems to be of more importance for subsequent team performance. As expected when investigating complex phenomena in ongoing matches, the findings resulted in small effect sizes.

Keywords: Touch, gesture, psychological momentum, emotional expression, team sport

Nonverbal Post-Shot Celebrations and their Relationship with Performance in Elite Handball

During prolonged competitive events, such as team sport matches, players often respond with a repertoire of behaviour to successful and unsuccessful trials. Such behaviours can be verbal (e.g., giving feedback to a teammate, shouting) and/or nonverbal. The latter can be observed as various cues from different channels, as for example facial expression, gesture, touch, or posture (Riggio & Riggio, 2012), expressing the emotional state of the individual. In the presence of others, such nonverbal behaviours function as nonverbal communication messages (Richmond, McCroskey, & Hickson, 2012). Burgoon, Buller, and Woodall (1996) postulate that people tend to rely more heavily on nonverbal (as opposed to verbal) communication in times of stress (Burgoon et al., 1996), and sport competitions entail a high amount of stress for the athletes (e.g., Mellalieu, Neil, Hanton, & Fletcher, 2009). Given these facts, nonverbal behaviour is both a relevant and interesting area of research that has only in recent times got increased attention in sport psychology research (see e.g., Moll, Jordet & Pepping, 2010; Furley, Moll, & Memmert, 2015; Greenlees, Bradley, Holder, & Thelwell, 2005) . The present study focuses on nonverbal behaviours responding from successful attempts during handball matches that are subsequently labelled nonverbal post-shot celebrations.

The display of emotions through nonverbal behaviour has several functions. The athlete is assumed to be affected by his or her own emotional expression through internal feedback loops (e.g., Price, Peterson, & Harmon-Jones, 2012). In the sport context, this argumentation suggests that a player celebrating a successful action (e.g., through gestures implying pride) will cultivate or intensify this emotional state. Lately, an increasing focus has been laid on the fact that emotions and their expression are not just individual phenomena, but rather fulfil an important social function (see e.g., Parkinson, 1996, Van Kleef, 2009). Based on that social view of emotions, it is assumed that players form perceptions of their opponents (the "out-

group", see Sherif, 1966) based on nonverbal behaviour, which influence their judgment about the opponent's ability, and finally their own emotional response (Warr & Knapper, 1968). A qualitative study by Ronglan (2007) showed that handball players perceived that positive nonverbal behaviour intensified the opponent's feeling of defeat. Several studies support the importance of different nonverbal cues on the formation of impression in a sport context (Furley & Dicks, 2012; Furley, Dicks, & Memmert, 2012; Greenlees et al., 2005; Greenlees, Buscombe, Thelwell, Holder, & Rimmer, 2005). Moreover, teammates (the "in-group", see Sherif, 1966) are influenced by a player's emotional expression through a mechanism called emotional contagion (see Hatfield, Cacioppo, & Rapson, 1994). In such, expressing positive or negative emotions through nonverbal behaviour can induce similar emotional states in teammates. Some support exists for emotional contagion during sport competitions (Moll et al., 2010; Totterdell, 2000). The difference between the last two described mechanisms depends upon group membership. van der Schalk et al. (2011) found that emotional convergence is likely to occur for individuals who share a group membership. Fischer and Manstead (2008) argued that, due to the higher amount of interaction between group members, contagion effects should be greater within groups than to members of other groups. Considering between-group effects, a study by Epstude and Mussweiler (2009) revealed that more negative mood was reported when participants were exposed to out-group positive displays and more positive mood when they had been exposed to out-group negative displays. In line with that, a recent study within the sport context by Furley et al. (2015) revealed that the nonverbal expression of pride caused opponents to anticipate more negative, and teammates more positive emotions, cognitions, and performance expectations.

Regarding the relationship between emotions and performance, an overview by McCarthy (2011) concluded that "positive emotions might be the catalyst of excellence in sport" (p. 63). In line with that statement, Rathschlag and Memmert (2013) found in their

experiments that participants produced significantly better physical performances in a happy condition. Based on that, it is assumed that fostering positive emotions by nonverbal behaviour benefits performance.

The process of emotional contagion has been proposed as a possible mechanism underlying the development of positive and negative psychological momentum (PM) in teams (Moesch & Apitzsch, 2012), and nonverbal behaviours in general have been connected with PM (Adler & Adler, 1978; Jones & Harwood, 2008; Young, 2011). Based on a dynamical system approach, Gernigon, Briki, and Eykens (2010) defined PM as "a positive or negative dynamics of cognitive, affective, motivational, physiological, and behavioural responses (and their couplings) to the perception of movement toward or away from either an appetitive or aversive outcome" (p. 397). Furthermore, they suggested that such a perception "might emerge from the feedback and feedforward that are provided by the specific ongoing history of events" (p. 397). In line with previous conceptualizations of PM (e.g., Vallerand, Colavecchio, & Pelletier, 1988), these authors thus suggested that both individual and situational factors made up a complex interaction to create perceptions of PM. Affective responses have emerged as an important factor in PM from both qualitative and quantitative research (e.g., Briki, Den Hartigh, Bakker, & Gernigon, 2012; Briki, Den Hartigh, Hauw, & Gernigon, 2012; Cornelius, Silva, Conroy, & Petersen, 1997; Jones & Harwood, 2008; Moesch & Apitzsch, 2012). The expression of such affective responses through nonverbal behaviours has also been in focus in PM research: Moesch and Apitzsch (2012) revealed that handball coaches considered showing positive reactions within a team as a useful strategy to enhance positive PM, while negative body language is considered a trigger of negative PM. A similar study within PM in soccer showed that negative body language of the opponent functions as a trigger for positive PM of the own team, and, correspondingly, negative body language of the own team was considered to be a result of being in a negative PM (Jones &

Harwood, 2008). Furthermore, the results revealed that teammates' reactions could be utilized to influence perceptions of PM. A similar result from Young (2011) showed that athletes perceived positive PM when they saw positive nonverbal behaviours such as clapping and cheering for each other, which in turn influenced their own cognitions, affects, and behaviours. Already Adler and Adler (1978) pinpointed body language and the display of emotion after successes as crucial factors for maintaining PM.

The ongoing history of events, which includes the performance an athlete or a team has shown in the ongoing competition, is a situational variable that has been emphasized in both early (e.g., Adler, 1981; Vallerand et al., 1988) and recent (e.g., Briki, Den Hartigh, Markman, Micallef, & Gernigon, 2013; Gernigon et al., 2010) conceptualizations of PM. The importance of this variable has been confirmed in research (Briki et al., 2013; Den Hartigh, Gernigon, Van Yperen, Marin, & Van Geert, 2014). It is therefore supposed that the history of events as it unfolds during a match has an important impact on the psychological experience of the athlete(s) and should therefore be taken into account in research.

As emerges from the exposition above, nonverbal behaviour and PM are closely related. However, an important question is to what extent these concepts are related to performance. Regarding PM, athletes have a strong *belief* that PM affects their performance (Cornelius et al., 1997). But despite this conviction, there exists so far contradicting evidence about the impact of PM on performance: For example, Perreault, Vallerand, Montgomery, and Provencher (1998) showed that when participants perception of PM were highest, they pedalled faster; meanwhile other studies (Cornelius et al., 1997; Silva, Cornelius, & Finch, 1992; Stanimirovic & Hanrahan, 2004) did not reveal a link between perceptions of PM and performance. When investigating the impact of different PM scenarios (e.g., winning resp. losing successive trials in a row or coming from behind resp. losing the lead), the results are likely inconclusive: There is evidence that negative PM scenarios lead to better performance

(Briki et al., 2013; Perreault et al., 1998; Stanimirovic & Hanrahan, 2004), with only one study finding a relationship in the expected direction (i.e., a decrease in the negative scenario and an increase in the positive scenario, see Den Hartigh et al., 2014). Lastly, different studies revealed no relationship (Kerick, Iso-Ahola, & Hatfield, 2000; Shaw, Dzewaltowski, & McElroy, 1992) respectively prediction (Silva et al., 1992) between PM scenarios and subsequent performance.

Only sparse knowledge exists about the influence of nonverbal behaviour on performance during sport competitions. The findings of Kraus, Huang, and Keltner (2010) revealed that touch (such as high fives and team hugs) was associated with higher performance at individual and group level, even when accounting for player status, preseason expectation, and early season performance. However, the outcome variable was assessed at the end and touch behaviour was assessed at the beginning of the season; therefore, no inferences can be made whether this positive relationship also exists within a match. The results of Moll et al. (2010) revealed that specific post-shot behaviours associated with pride, such as hand movement with both arms, expanding the chest, and celebrating with both fists increased the chances of being in the winning team, while behaviours associated with shame, such as looking down, were related with losing the penalty shootout. It has, however, to be questioned if the context of a penalty shootout, which is static, organized, and highly structured in its processes, can be compared with dynamic and complex situations as they unfold during regular playing time.

One reason for the sparse research within nonverbal behaviour in sports is the fact that coding schemes that offer a valid and reliable way of assessing nonverbal behaviour in athletes during sport events do not exist (Moesch, Kenttä, & Mattsson, 2015). Therefore, Moesch et al. (2015) recently proposed the “Handball Post-Shot Behavior Coding Scheme” (H-PSB-CS) that can be used to reliably gather post-shot behaviours in the form of gesture

and touch in handball players. Their results further showed that other forms of emotional expressions, such as facial expressions, body posture, and movement velocity could not be captured reliably in handball players in motion. The present study uses this coding scheme and focuses on celebration behaviours in the form of gestures and touch by the player performing the shot (i.e., the shooter).

Gestures have been connected with the expression of pride and shame (Tracy & Robins, 2007), which are social status emotions (App, McIntosh, Reed, & Hertenstein, 2011). Pride is activated when humans positively evaluate the extent to which emotion-eliciting events (i.e., competitions) correspond to their personal goals (i.e., winning; see Tracy & Robins, 2004). Pride expressions have an important social function by informing others of one's individual achievement (Tracy & Robins, 2007b) and are crucial in status seeking and dominance (Shariff & Tracy, 2009; Tracy & Robins, 2004). Pride and its expression through gestures is a very individual and egocentric way of celebrating one's success.

Touch has been connected with the expression of positive emotions (Hertenstein, Holmes, McCullough, & Keltner, 2009; Hertenstein, Verkamp, Kerestes, & Holmes, 2006). Of importance from a team perspective is the assumption that touch can function as positive reinforcement, foster intimacy, encourage compliance, communicate liking, and is vital to trust, cooperation, and group functioning (Hertenstein et al., 2006; Kraus et al., 2010). As touch inherently includes others, it implies a greater social value compared to gestures.

Adopting a PM framework, the present study aims to explore the relationship between the team's history of events, nonverbal post-shot celebrations in the form of gestures and touch by the shooter, and subsequent team performance during ongoing handball events. More specifically, it will be investigated if prior performance predicts the display of nonverbal post-shot celebrations, if nonverbal post-shot celebrations predict subsequent performance and if prior, resp. current performance and the display of nonverbal post-shot

celebrations together predict subsequent performance. Due to the lack of research in this topic, no specific hypotheses are formulated.

Method

Design

A naturalistic design with systematic observation was chosen for the present study. Such a design enables the gathering of rich data of the phenomenon in question within a real-world setting with high ecological validity (Hertenstein et al., 2006; Stangor, 2007). The target behaviour was videotaped from the public area, thus adopting a nonparticipant observer perspective, which is unobtrusive and minimizes reactivity in the observed person (Cooper, Heron, & Heward, 2007; Miltenberger & Weil, 2013; Stangor, 2007).

Data

Matches. Data gathering took place at matches from the highest women's handball league in Sweden during the 2011-2012 season. It is generally acknowledged that emotions, and, with that, subsequent behavioural expressions, are more frequent when high value goals are at stake (Lazarus, 1999). Due to the fact that there are substantial performance differences between top and bottom teams in the national league, it seemed necessary to select specific matches from the regular league in order to minimize the risk to include matches with large goal differences early in the game. Based on Lazarus' (1999) statement, we hypothesise that players of a team that is leading big, respectively players of a team that is trailing big, will not experience a strong emotional reaction following a goal, and the behavioural expressions thus will be small. Based on this notion, matches were selected on the following criteria: League matches were defined to be high-stake when they are either played between teams from the same city/region ("derbies") or played between teams that were not more than four places apart from each other in the current ranking. Moreover, playoff matches were also considered high-stake matches due to their importance for qualification to the next round. From all

matches fulfilling one of the above criteria, matches were selected only when played in an arena with good light conditions for filming and within reasonable distance for the three cameramen involved. Eighteen matches (eight from the official league, ten from the final rounds) were filmed exclusively for the purpose of this study.

Coding situation. The coding situation started when a player executes a shot to the goal and ends when she has returned to her defence position. For the analyses of the present study, 616 coding situations with positive outcome, i.e., that resulted in a goal, were used. The 18 filmed matches resulted in 1,416 filmed coding situations, ranging from 45 to 98 per match (M = 78.47, SD = 13.58). Thereof, 177 coding situations had to be deleted due to problems while filming (n = 80, e.g., a teammate blocked the view to the player in focus) or because the coding situation was interrupted because of game-related issues (n = 97, e.g., a player got injured, or a team took a timeout directly after an attack). From these 1,239 coding situations, 162 had to be excluded because the shooting player was substituted on the way back to defence, and, therefore, no complete coding situation was available. From the remaining 1,077 coding situations, 461 were unsuccessful shots to the goal, and were therefore not used for analyses in the present study.

Materials

Coding scheme. The "Handball Post-Shot Behavior Coding Scheme" (H-PSB-CS) proposed by Moesch et al. (2015) consists of six post-shot behaviours involving gestures (one fist down, two fists down, one fist up, two fists up, thumbs up, clapping hands) and five post-shot behaviours involving touch (low five, high five, high ten, touch shoulders, double touch). Inter-observer agreement tests with a research assistant who was blind to the research question, as well as intra-observer agreement tests after a six-week break resulted in a mean agreement for gesture of 84% respectively 86%, and for touch of 91% respectively 95%. A

complete description of the development of the coding scheme, as well as psychometric properties can be found in Moesch et al. (2015).

Additional data. Aggregated data files were created by merging all situations within each five-minute period for each team in every match (i.e., the 60 minutes playing time were divided into 12 consecutive five-minute periods), resulting in a mean value for each teams' nonverbal post-shot celebrations for gestures and touch. Additional variables regarding the performance of the teams were added by counting the *relative* performance during every period from each teams' perspective. This variable refers to the score difference of the two teams during every five-minute period, and thus focuses on the team's performance within each five-minute period in relation to the opponent team's performance. For example, if team A leads 13-11 after the fourth period, and team B scores three times during the fifth period while team A only scores twice, team B outperforms team A in the relative performance in the fifth period with a score of 3-2. That means that team B won that period with one goal, while still trailing by 15-14 in the overall match score. This performance variable was calculated for the prior period (i.e., prior team performance, representing the history of events), the main period (i.e., current team performance, representing the history of events), and the following period (i.e., subsequent team performance, representing the resulting performance of the team). In contrast to the real match score, relative performance does not correlate over time ($-.03 \leq r \leq .05$, see table 1). To clarify, Figure 1 displays the time sequence of the variables involved in this study.

---------- Insert figure 1 here ----------

All additional data was extracted from match protocols that were available from *Clientware* (Jilsén System AB, Sweden), a program that is free to download and offers statistics from all matches in the elite women's league in Sweden.

Procedure

Coding consisted of registering all behaviours shown by the shooter (i.e., the player who performed the goal rendering shot) during the coding situation. It could include none of the behaviours, up to several behaviours per category, and it was also possible to code the same behaviour several times during the same coding situation (e.g., when a player after scoring raises a fist, runs back, and raises it again when approaching the defence position). No behaviours from other players were coded and analysed. All data coding was done with *Sideline XPS Video Analyzer* (version 12.5, Sideline Sports, Iceland), a software that helped organize the coding decisions over time and permitted to play and re-play a specific coding situation as many times as necessary.

Data analyses

Thorough descriptive analyses of all variables were conducted to check the assumptions for the main analyses. Multiple regression analyses using the Enter method were performed to estimate the contribution of the predictor variables on the criterion variables. The significance threshold was set at 0.05.

Results

After having scored, handball players showed on average 1.52 (*SD* = 1.01) gestures. There is a range from 0 to 5 gestures that are shown during the coding situation, and most often (40.4%), one gesture is shown. Touch is shown on average 1.26 (*SD* = 0.98) times per coding situation, with a range from 0 to 5. Also touch is most often shown once during the coding situation (38.8%). In table 1 and 2, correlations between nonverbal post-shot celebrations and performance variables, respectively between the interaction variables and subsequent performance are displayed.

The initial investigation addressed if prior performance predicted the display of gesture respectively touch. For gesture, a significant model emerged (F (1,335) = 6.70, $p < .05$) and the model explained 1.7% of the variance (see all results displayed in Table 3). Prior

performance was a significant predictor (β = 0.14), which means that the better the prior performance of the team, the more gestures were shown by the shooter after scoring in the following period. Contrary, for touch the model was not significant (F (1,335) = 0.01, p > .05) and prior performance was a non-significant predictor (β = -0.01).

To investigate the influence of nonverbal post-shot celebrations in the form of touch and gesture on subsequent performance, gesture, respectively touch were defined as predictor variables and subsequent performance as criterion variable. Both the analyses for gesture (F(1,306) = .11, p > .05) and touch (F(1,306) = .06, p > .05) turned out to be non-significant.

Interaction variables are of interest when one wants to test whether the impact of one independent variable varies over the range of another (Tabachnick & Fidell, 2007). Based on previously described research, it can be assumed that the display of nonverbal post-shot celebrations (i.e., gesture or touch) changed according to a team's history of events. Therefore, interaction variables were built with either touch or gesture and prior or current performance. As recommended to avoid multicollinearity in analyses using interaction variables (see.e.g., Tabachnick & Fidell, 2007), all predictor variables were centred using the grand mean. It was then analysed if the prior, respectively current, performance, one of the variables on nonverbal post-shot celebrations and the respective interaction of the two variables predict subsequent performance, resulting in four different models that were calculated.

The results revealed significant coefficients for the interaction variables touch and prior performance (β = 0.14, p < .05) and touch and current performance (β = 0.14, p < .05). The regression models in both cases were slightly above the significant threshold (model with prior performance: F(3,304) = 2.21, p > .05; model with current performance: F(3,304) = 2.19, p > .05), and the amount of explained variance in both models was small. The results for the two models including gesture ended non-significant (model with prior performance:

$F(3,304) = .43$, $p > .05$; model with current performance: $F(3,304) = .57$, $p > .05$) and the interaction variables were in both cases above the significant threshold. Figure 2 (prior performance) and 3 (current performance) show the findings graphically, displaying subsequent performance in relation to the prior (current) performance for low and high touch (i.e., ± one standard deviation). Low prior (or current) performance and showing a low degree of touch is related with positive subsequent performance, while high prior (or current) performance is related to good performance when players show a high degree of touch. Performing well, but only displaying a low amount of touch is related with poor subsequent performance. Finally, poor prior (or current) performance with players showing a high degree of touch predicts poor subsequent performance.

---------- Insert figures 2 and 3 here ----------

Discussion

The results of the present investigation revealed that prior performance significantly predicted the degree of gestures in the following period: The better team performance in the preceding period, the more gestures were shown by the shooter after scoring in the following period. For touch, the analyses were non-significant. A possible interpretation of this result is that good prior team performance enhances athletes' feeling of pride, which is displayed through many gestures following goals (see also Tracy & Robins, 2007).

Next, it was explored if the display of gesture or touch directly predicted subsequent team performance. The results of these analyses were non-significant, thus revealing that the display of nonverbal post-shot celebrations after scoring cannot be considered as a sufficient intervention to enhance subsequent performance. This result is in contrast to qualitative research: Handball players (Ronglan, 2007) respectively coaches (Moesch & Apitzsch, 2012) considered celebration behaviour to have a positive impact on performance. This belief, however, cannot be supported with the data of the present study. Likewise, the result is not in

line with the finding of Kraus et al. (2010) stating that touch behaviour is positively related with team performance at the end of the season.

Finally, it was investigated if nonverbal post-shot celebrations predicted subsequent team performance when the history of events, measured through either prior or current performance, was taken into account. The results revealed that a high amount of post-scoring touch displayed by the shooter in periods with good team performance, and a low amount of post-scoring touch in periods with poor team performance were both related with positive subsequent team performance. In contrast, a high amount of displayed touch during bad periods, and a low amount of displayed touch during good periods were related with negative subsequent team performance. The findings showed that nonverbal post-shot celebrations by the shooter in the form of touch indeed had a small impact on subsequent team performance when the ongoing history of events was taken into account. Adler and Adler (1978) stated in their work on PM that the display of emotions is a means of maintaining PM. The result of the present study lends support to that assumption, as nonverbal post-shot celebrations in the form of touch after successful periods seem to be a good strategy for continued good team performance (i.e., maintaining PM). Based on this result, handball coaches' perception that the display of positive reactions within the team is a good strategy to develop positive PM (Moesch & Apitzsch, 2012) might need to be questioned; this strategy only seems to work when the team has performed well, and only when nonverbal celebrations with touch (and not gesture) were executed.

A possible explanation for why much touch following goals in periods with bad performance is related to negative subsequent team performance stems from the theory of emotional dissonance (Middleton, 1989). Emotional dissonance is defined as the conflict between emotions required to be displayed in a specific setting (i.e., joy after having scored) and genuinely felt emotions (i.e., hopelessness due to a bad period). Such situations are more

labour intensive, meaning that there is a need for greater control, skill, and attentive action, which creates more emotional load. Likewise, emotion regulation research postulates that the suppression of negative emotions requires effort and consumes cognitive resources that could otherwise be used for optimal performance (Richards & Gross, 2000). A recent study by Wagstaff (2014) indeed found that athletes who were told to suppress their emotions performed worse in an endurance task and perceived more physical exertion than those who were not asked to suppress their emotions.

The findings reported above emerged for the analyses with prior performance and with current performance as variables for the ongoing history of events. The results of these two analyses confirm each other, which can be considered as a replication of the result. Together with the finding that prior performance influences the display of gestures, the finding strengthens the assumption that the history of events is an important variable when the dynamics of ongoing competitions are investigated. The fact that interaction variables between situational and individual factors predict subsequent performance, but not individual variables alone, highlights how complex sport competitions are. Both the history of events and complexity are core features in the PM conceptualization of Gernigon et al. (2010).

A question that arises is why the results regarding the relationship with subsequent performance only were significant for touch, but not for gesture. One possible explanation, mentioned above, is that touch enhances relatedness and team spirit, as it is a celebration behaviour that includes teammates, meanwhile gestures is pre-dominantly an egocentric way of celebrating one's own achievements, without involving teammates. Potentially, the social form of celebrating with touch leads to more emotional contagion in teammates than does the celebration with gestures, or, it does simply help teammates to feel more united. An interesting hypothesis for future research would be to relate the degree of touch after scoring to the concept of cohesion. Cohesion is related to performance (see a meta-analysis of Carron,

Colman, Wheeler, & Stevens, 2002), and it has been proposed that positive and negative changes in cohesion accompany the development of positive and negative PM (Adler, 1981; Eisler & Spink, 1998). Another interesting research question would be to investigate if there is a different impact on post-shot celebration with touch when one player alone counter attacks and scores, or if the goal is the result of a team performance.

For the applied work, some suggestions are made, that need, however, to be backed up with replications of our study. It can tentatively be suggested that teams that perform poorly should be encouraged to keep their attention on task-relevant stimuli and not spending time on celebration activities including touch. As such, the team could work on elaborating cue words to trigger specific game plans, and athletes could be taught to focus on specific technical or tactical behaviours in times when the game is not developing to their advantage. Conversely, teams that perform well might profit from celebrating scores with touching behaviours, as long as the game allows it. Using videos, players could be made more attentive to this specific form of celebration behaviour, and should be encouraged to use it to exploit the positive tendency.

Conclusions should be made cautiously from the present study, as the effect sizes are small. This might be due to several reasons: First, the present analyses only involve nonverbal post-shot celebrations of the shooter. It can be assumed that considering teammates', bench players', and/or coaches' celebration behaviour would result in bigger effect sizes. Second, the coding scheme used for the present study only measures two channels of nonverbal behaviour (gesture and touch), and does further not take into account the intensity, or duration of the displayed nonverbal behaviour (see Moesch et al., 2015). Elaborating reliable methods to gather facial expressions and body posture in team athletes in motion and to measure the intensity and duration of the displayed behaviour, and incorporating such measures into analyses as done in this study would be an interesting approach for future research, and could

assumedly increase the effect sizes. Third, team sport events are very complex in nature, and many different confounders could possibly influence the results. A study by Moesch, Kenttä, Bäckström, and Mattsson (2015) indeed showed that the current match score, the time point in the game, and the importance of the match were related to the amount of displayed nonverbal behaviours. Besides these match-related factors, individual differences (e.g., the status of the player, or the degree to which players infect others or get infected by emotions of others) and team-specific characteristics (e.g., a team's reputation, or a team's rituals to celebrate) could possibly influence the results. However, it was not within the scope of the present study to investigate specific team or individual differences, but rather to start with exploring general trends over a large amount of situations. Future research would benefit from incorporating such additional variables. A possibility to increase the effect sizes in future research would be to incorporate an outcome variable that lies closer to the behaviour under observation: For example, it could be the case that athletes are influenced by the display of nonverbal post-shot celebrations in their emotional, cognitive, or behavioural response. However, these responses might not be strong enough to have an effect on subsequent performance, especially in a sport where the opponent is directly faced. Therefore, studies investigating nonverbal post-shot celebrations on proximal outcome variables, such as defence behaviour, or effort and workload (e.g., measured with GPS) would be an interesting avenue for future research. In general, it has to be kept in mind that predicting performance in the sport domain is a difficult endeavour (e.g., Nevill, Atkinson, & Hughes, 2008), and factors outside the proper play are not expected to result in big effect sizes.

The design of the present study does not answer the question if intra- or interpersonal effects of the displayed emotions were causing the outcome. For future research, it would be interesting to investigate more in-depth the mechanism that led to the results found, if it is merely the intrapersonal effect of the emotional expression, or an interpersonal effect - being

it on the teammates or the opponents - that impacts subsequent performance. To start with, building on the study of Furley et al. (2015), future research could benefit from using the emotion as social information framework (EASI, see van Kleef, 2009) as a theoretical background and solely focusing on the interpersonal effects of emotional expressions, but placing it in a real life context as done in the present study.

Despite the above-mentioned limitations, the chosen design offers high ecological validity with advantages that excels experimental designs that are detached from in situ happenings during elite sport matches. For research examining sport performance, Atkinson and Nevill (2001) called for studies involving real-live sport competitions to optimize external validity, even though such designs can lead to a decrease in internal validity due to a lack of control over all extraneous variables. In addition, even if the correlations were rather weak for a single five-minute period, the small effects for each period could accumulate over a match and may significantly contribute to the final outcome. Most of all, it has to be acknowledged that even small effects can be decisive for the outcome in elite sports, where the marginal between winning and losing is often minimal. An important question is if the results obtained in this study with female elite handball players playing high-stake matches can be generalized to other team sports, to male athletes, and/or to matches with less importance or on a lower level. It is acknowledged that females and males differ in touch behaviour in team sports (Kneidinger, Maple, & Tross, 2001), in nonverbal behaviours in general, and facial and gestural expressiveness in specific (Hall & Gunnery, 2013; Richmond et al., 2012). Team sports played on much bigger courts (e.g., baseball), or with different rules (e.g., a break after a goal) offer different possibilities to celebrate successful performance. And finally, it has to be investigated if players show different levels of emotional reactions following goals when playing less important matches, or play on a lower, more recreational level. It would be warranted to conduct specific studies with other populations before

generalizing these findings. It can, however, be assumed that the results are generalizable for elite female sports with similar characteristics (e.g., basketball).

To conclude, the present study is the first of its kind to investigate the association between a team's history of events, the shooter's nonverbal post-shot celebrations, and subsequent team performance *during* high stake elite handball matches. Interesting insights emerged about how to investigate such a complex phenomenon in a real-live setting. The findings, however, all result in low effect sizes. Replication studies are needed to confirm these findings and verify if they are stable over time.

References

Adler, P. (1981). *Momentum. A theory of social action.* Beverly Hills, CA: SAGE.

Adler, P., & Adler, P. A. (1978). The role of momentum in sport. *Journal of Contemporary Ethnography, 7*, 153-176. doi: 10.1177/089124167800700202

App, B., McIntosh, D. N., Reed, C. L., & Hertenstein, M. J. (2011). Nonverbal channel use in communication of emotion: How may depend on why. *Emotion, 11*, 603-617. doi: 10.1037/a0023164

Atkinson, G., & Nevill, A. M. (2001). Selected issues in the design and analysis of sport performance research. *Journal of Sports Sciences, 19*, 811-827. doi: 10.1080/026404101317015447

Briki, W., Den Hartigh, R. J. R., Bakker, F. C., & Gernigon, C. (2012). The dynamics of psychological momentum: A quantitative study in natural sport situations. *International Journal of Performance Analysis in Sport, 12*, 573-592.

Briki, W., Den Hartigh, R. J. R., Hauw, D., & Gernigon, C. (2012). A qualitative exploration of the psychological contents and dynamics of momentum in sport. *International Journal of Sport Psychology, 43*, 365-384.

Briki, W., Den Hartigh, R. J. R., Markman, K. D., Micallef, J.-P., & Gernigon, C. (2013). How psychological momentum changes in athletes during a sport competition. *Psychology of Sport and Exercise, 14*, 389-396. doi: 10.1016/j.psychsport.2012.11.009

Burgoon, J. K., Buller, D. B., & Woodall, W. G. (1996). *Nonverbal communication: The unspoken dialog*. New York: McGraw-Hill.

Carron, A. V., Colman, M. M., Wheeler, J., & Stevens, D. (2002). Cohesion and performance in sport: A meta-analysis. *Journal of Sport & Excercise Psychology, 24*, 168-188.

Cooper, J. O., Heron, T. E., & Heward, W. L. (2007). *Applied behavior analysis* (2nd ed.). Upper Saddle River, N.J. : Pearson

Cornelius, A., Silva, J. M., Conroy, D. E., & Petersen, G. (1997). The projected performance model: Relating cognitive and performance antecedents of psychological momentum. *Perceptual and Motor Skills, 84*, 475-485.

Den Hartigh, R. J. R., Gernigon, C., Van Yperen, N. W., Marin, L., & Van Geert, P. L. C. (2014). How psychological and behavioral team states change during positive and negative momentum. *PLoS ONE, 9*, e97887. doi: 10.1371/journal.pone.0097887

Eisler, L., & Spink, K. S. (1998). Effects of scoring configuration and task cohesion on the perception of psychological momentum. *Journal of Sport & Exercise Psychology, 20*, 311-320.

Epstude, K., & Mussweiler, T. (2009). What you feel is how you compare: How comparisons influence the social induction of affect. *Emotion*, *9*, 1–14. doi:10.1037/a0014148

Fischer, A. H., & Manstead, A. S. R. (2008). Social functions of emotions. In M. Lewis, J. M. Haviland- Jones, & L. Feldman Barrett (Eds.), *Handbook of emotions* (3rd ed., pp. 456–468). New York, NY: Guilford.

Furley, P., & Dicks, M. (2012). 'Hold your head high'. The influence of emotional versus neutral nonverbal expressions of dominance and submissiveness in baseball. *International Journal of Sport Psychology, 43*, 294-311.

Furley, P., Dicks, M., & Memmert, D. (2012). Nonverbal behavior in soccer: The influence of dominant and submissive body language on the impression formation and expectancy of success of soccer players. *Journal of Sport & Excercise Psychology, 34*, 61-82.

Furley, P., Moll, T., & Memmert, D. (2015). Put your hands up in the air. *Frontiers in Psychology, 6:*1361.

Gernigon, C., Briki, W., & Eykens, K. (2010). The dynamics of psychological momentum in sport: the role of ongoing history of performance patterns. *Journal of Sport & Exercise Psychology, 32*, 377-400.

Greenlees, I., Bradley, A., Holder, T., & Thelwell, R. (2005). The impact of opponents' non-verbal behaviour on the first impressions and outcome expectations of table-tennis players. *Psychology of Sport and Exercise, 6,* 103-115. doi: 10.1016/j.psychsport.2003.10.002

Greenlees, I., Buscombe, R., Thelwell, R., Holder, T., & Rimmer, M. (2005). Impact of opponents' clothing and body language on impression formation and outcome expectations. *Journal of Sport & Excercise Psychology, 27,* 39-52.

Hall, J. A., & Gunnery, S. D. (2013). Gender differences in nonverbal communication. In A. Hall Judith & L. Knapp Mark (Eds.), *Nonverbal Communication* (pp. 639-670). Berlin: Mouton de Gruyter.

Hatfield, E., Cacioppo, J. T., & Rapson, R. L. (1994). *Emotional contagion*. Paris: Cambridge University Press.

Hertenstein, M. J., Holmes, R., McCullough, M., & Keltner, D. (2009). The communication of emotion via touch. *Emotion, 9,* 566-573. doi: 10.1037/a0016108

Hertenstein, M. J., Verkamp, J. M., Kerestes, A. M., & Holmes, R. M. (2006). The communicative functions of touch in humans, nonhuman primates, and rats: A review and synthesis of the empirical research. *Genetic, Social, and General Psychology Monographs, 132,* 5-94. doi: 10.3200/mono.132.1.5-94

Jones, M., & Harwood, C. (2008). Psychological momentum within competitive soccer: Players' perspectives. *Journal of Applied Sport Psychology, 20,* 57-72. doi: 10.1080/10413200701784841

Kerick, S. E., Iso-Ahola, S. E., & Hatfield, B. D. (2000). Psychological momentum in target shooting: Cortical, cognitive-affective, and behavioral responses. *Journal of Sport & Exercise Psychology, 22,* 1-20.

Kneidinger, L. M., Maple, T. L., & Tross, S. A. (2001). Touching behavior in sport: Functional components, analysis of sex differences, and etholocigal considerations. *Journal of Sport Behavior, 25*, 45-62. doi: 10.1023/A:1006785107778

Kraus, M. W., Huang, C., & Keltner, D. (2010). Tactile communication, cooperation, and performance: An ethnological study of the NBA. *Emotion, 10*, 745-749. doi: 10.1037/a0019382

Lazarus, R. S. (1999). *Stress and emotion: a new synthesis*. New York: Springer Publishing.

McCarthy, P. (2011). Positive emotion in sport performance: current status and future directions. *International Review of Sport and Exercise Psychology, 4*, 50-69.

Mellalieu, S. D., Neil, R., Hanton, S., & Fletcher, D. (2009). Competition stress in sport performers: Stressors experienced in the competition environment. *Journal of Sports Sciences, 27*, 729-744. doi: 10.1080/02640410902889834

Middleton, D. R. (1989). Emotional style: The cultural ordering of emotions. *Ethos, 17*, 187-201. doi: 10.1525/eth.1989.17.2.02a00030

Miltenberger, R. G., & Weil, T. M. (2013). Observation and measurement in behavior analysis. In G. J. Madden, W. V. Dube, T. D. Hackenberg, G. P. Hanley & K. A. Lattal (Eds.), *APA handbook of behavior analysis, Vol. 1: Methods and principles* (pp. 121-150). Washington, DC, US: American Psychological Association.

Moesch, K., & Apitzsch, E. (2012). How do coaches experience psychological momentum? A qualitative study of female elite handball teams. *The Sport Psychologist, 26*, 435-453.

Moesch, K., Kenttä, G., Bäckström, M., & Mattsson, C. M. (2015). Exploring nonverbal behaviors in elite handball: How and when do players celebrate? *Journal of Applied Sport Psychology, 27*, 94-109. doi: 10.1080/10413200.2014.953231

Moesch, K., Kenttä, G., & Mattsson, C. M. (2015). Exploring nonverbal behavior in elite handball players: Development of the Handball Post-Shot Behavior Coding Scheme (H-PSB-CS). *Journal of Sport Behavior, 38*, 52-78.

Moll, T., Jordet, G., & Pepping, J.-G. (2010). Emotional contagion in soccer penalty shootouts: Celebration of individual success is associated with ultimate team success. *Journal of Sport Sciences, 28*, 983-992. doi: 10.1080/02640414.2010.484068

Nevill, A., Atkinson, G., & Hughes, M. (2008). Twenty-five years of sport performance research in the Journal of Sport Sciences. *Journal of Sport Sciences, 26*, 413-426. doi: 10.1080/02640410701714589

Parkinson, B. (1996). Emotions are social. *British Journal of Psychology.* 87, 663–683. doi: 10.1111/j.2044-8295.1996.tb02615.x

Perreault, S., Vallerand, R. J., Montgomery, D., & Provencher, P. (1998). Coming from behind: On the effect of psychological momentum on sport performance. *Journal of Sport & Excercise Psychology, 20*, 421-436.

Price, T. F., Peterson, C. K., & Harmon-Jones, E. (2012). The emotive neuroscience of embodiment. *Motivation and Emotion, 36*, 27-37. doi: 10.1007/s11031-011-9258-1

Richards, J. M., & Gross, J. J. (2000). Emotion regulation and memory: The cognitive costs of keeping one's cool. *Journal of Personality and Social Psychology, 79*, 410-424.

Rathschlag, M., & Memmert, D. (2013). The influence of self-generated emotions on physical performance: An investigation of happiness, anger, anxiety, and sadness. *Journal of Sport & Exercise Psychology, 35*, 197-210.

Richmond, V. P., McCroskey, J. C., & Hickson, M. L. (2012). *Nonverbal behavior in interpersonal relations* (7th ed.). Boston: Allyn & Bacon.

Riggio, R. E., & Riggio, H. R. (2012). Face and body in motion: Nonverbal communication. In T. F. Cash (Ed.), *Encyclopedia of body image and human appearance* (Vol. 1, pp. 425-430). San Diego: Elsevier Academic Press.

Ronglan, L. T. (2007). Building and communicating collective efficacy: A season-long in-depth study of an elite sport team. *The Sport Psychologist, 21*, 78-93.

Shariff, A. F., & Tracy, J. L. (2009). Knowing who's boss: Implicit perceptions of status from the nonverbal expression of pride. *Emotion, 9*, 631-639. doi: 10.1037/a0017089

Shaw, J. M., Dzewaltowski, D. A., & McElroy, M. (1992). Self-efficacy and causal attributions as mediators of perceptions of psychological momentum. *Journal of Sport & Exercise Psychology, 14*, 134-147.

Sherif, M. (1966). *Group conflict and co-operation: Their social psychology*. London: Routledge & Kegan Paul.

Silva, J. M., Cornelius, A. E., & Finch, L. M. (1992). Psychological momentum and skill performance: A laboratory study. *Journal of Sport & Exercise Psychology, 14*, 119-133.

Stangor, C. (2007). *Research Methods for behavioral Sciences* (3rd ed.). Boston: Houghton Mifflin.

Stanimirovic, R., & Hanrahan, S. J. (2004). Efficacy, affect, and teams: Is momentum a misnormer? *International Journal of Sport and Exercise Psychology, 2*, 43-62. doi: 10.1080/1612197X.2004.9671732

Tabachnick, B. G., & Fidell, L. S. (2007). *Using Multivariate Statistics* (5th ed.). Boston: Pearson.

Totterdell, P. (2000). Catching moods and hitting runs: Mood linkage and subjective performance in professional sport teams. *Journal of Applied Psychology, 85*, 848-859. doi: 10.1037/0021-9010.85.6.848

Tracy, J. L., & Robins, R. W. (2004). Show Your Pride: Evidence for a Discrete Emotion Expression. *Psychological Science, 15*, 194-197. doi: 10.1111/j.0956-7976.2004.01503008.x

Tracy, J. L., & Robins, R. W. (2007). The prototypical pride expression: Development of a nonverbal behavior coding system. *Emotion, 7*, 789-801. doi: 10.1037/1528-3542.7.4.789

Tracy, J. L., & Robins, R. W. (2007b). Emerging insights into the nature and function of pride. *Current Directions in Psychological Science, 16*, 147-150. doi: 10.1111/j.1467-8721.2007.00493.x

Wagstaff, C. R. D. (2014). Emotion Regulation and Sport Performance. *Journal of Sport & Excercise Psychology, 36*, 401-412.

Vallerand, R. J., Colavecchio, P. G., & Pelletier, L. G. (1988). Psychological momentum and performance inferences: A preliminary test of the antecedents-consequences psychological momentum model. *Journal of Sport & Exercise Psychology, 10*, 92-108.

Van der Schalk, J., Fischer, A., Doosje, B., Wigboldus, D., Hawk, S., Rotteveel, M., & Hess, U. (2011). Convergent and divergent responses to emotional displays of ingroup and outgroup. *Emotion, 11*, 286–298. doi:10.1037/a0022582

Van Kleef, G. A. (2009). How emotions regulate social life: the emotions as social information (EASI) model. *Current Directions in Psychoogical Science,* 18, 184 188. doi:10.1111/j.1467-8721.2009.01633.x

Warr, P. B., & Knapper, C. (1968). *The perception of people and events*. London: John Wiley & Sons.

Young, G. (2011). *"It Can Start From Anything": An Existential Phenomenological Investigation of Athletes' Experiences of Psychological Momentum.* (Doctoral

dissertation, University of Tennessee). Retrieved from http://trace.tennessee.edu/cgi/viewcontent.cgi?article=2126&context=utk_graddiss

Table 1

Correlation matrix between nonverbal post-shot celebration variables and performance variables

	1	2	3	4
1. Gesture				
2. Touch	.21** (337)			
3. Prior performance	.14* (337)	-.01 (337)		
4. Current performance	.15** (337)	.13* (337)	.05 (337)	
5. Subsequent performance	.02 (308)	.01 (308)	-.03 (308)	.05 (308)

Notes: * $p < .05$; ** $p < .01$; in parenthesis the amount of observed situations (N)

Table 2

Correlation between centered interaction variables and subsequent performance (N=308)

	Subsequent performance
Prior performance*gesture	.06
Prior performance*touch	.14*
Current performance*gesture	.05
Current performance*touch	.14*

Notes: * $p < .05$;

Table 3

The unstandardized and standardized regression coefficients resulting from the regression analyses

Predictor variable(s)	Criterion variable	B	SE B	β	Adjusted R Square
PP	G	.08	.03	.14	0.02
PP	T	.00	.03	.00	0.00
G	SP	.04	.11	.02	0.00
T	SP	.03	.11	.01	0.00
T[1]	SP	0.04	0.11	0.02	0.01
PP[1]		-0.02	0.06	-0.02	
Int. [1]		0.19	0.07	0.14*	
G[1]	SP	0.02	0.11	0.01	-0.01
PP[1]		-0.04	0.06	-0.30	
Int. [1]		0.06	0.07	0.05	
T[1]	SP	0.03	0.12	0.02	0.01
CP[1]		0.04	0.06	0.04	
Int.[1]		0.19	0.08	0.14*	
G[1]	SP	0.01	0.11	0.01	-0.00
CP[1]		0.06	0.06	0.05	
Int.[1]		0.06	0.07	0.05	

Notes: G = gesture; T = touch; SP = subsequent performance; PP = prior performance; CP = current performance; Int. = interaction between the two predictor variables; * $p < .05$; [1] centred variables were used in these analyses

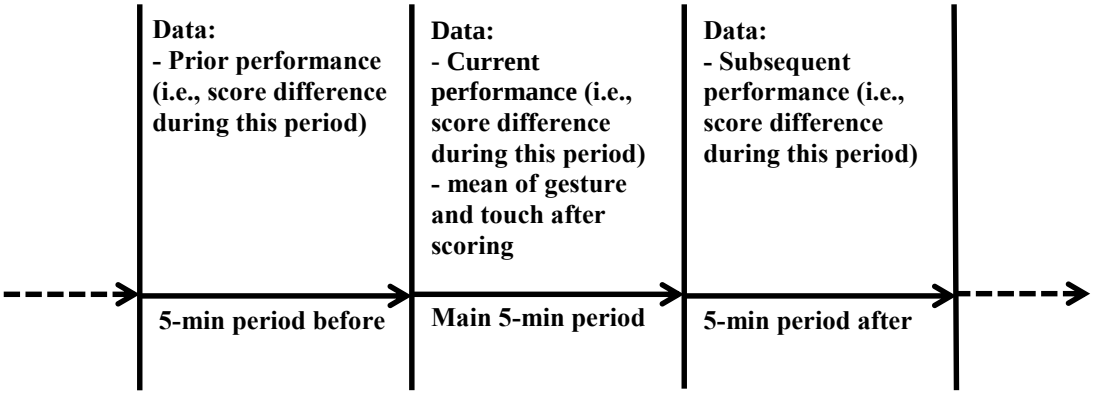

Figure 1. Overview of the data collected with respect to the different time sequences within matches.

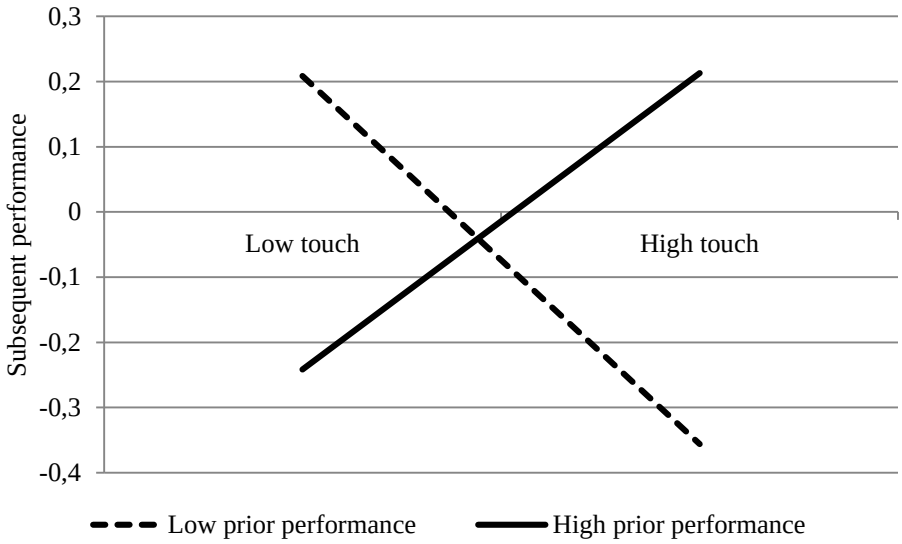

Figure 2. Interaction between prior performance and touch and its relationship with subsequent team performance based on centred variables.

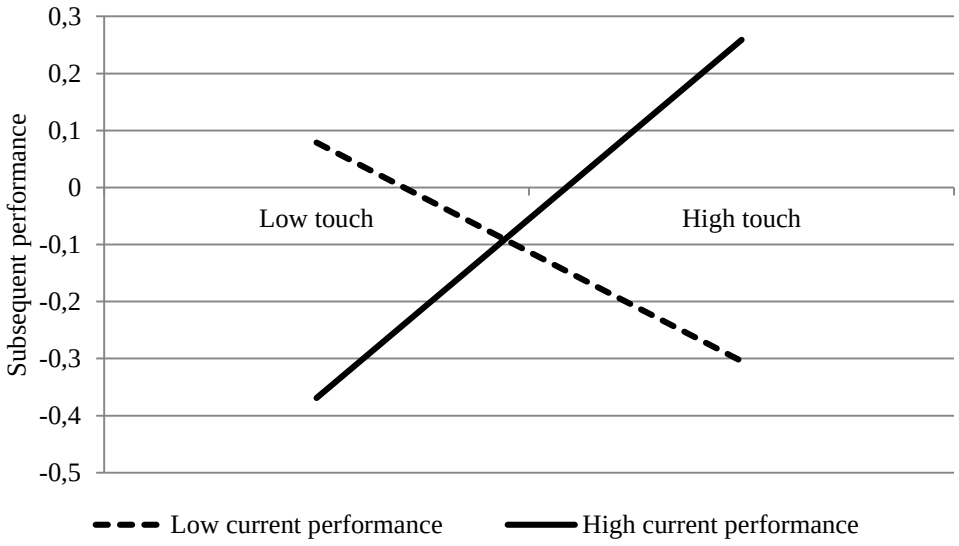

Figure 3. Interaction between current performance and touch and its relationship with subsequent team performance based on centred variables.