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Psychological momentum in handball

Karin Moesch

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DOCTORAL DISSERTATION
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Abstract

This doctoral dissertation deals with a phenomenon that is often referred to in sports, but still poorly understood from a scientific angle: psychological momentum (PM). No consensus has been agreed on how to label this phenomenon, and other terms such as momentum or behavioural momentum (BM) are often used interchangeably. In everyday language, PM can be explained by periods in a match where everything goes perfectly well (i.e., positive PM), or periods in a match where nothing works out as it should (i.e., negative PM). In short, it is about the flow of the game.

Study I investigated the existence of momentum in female elite handball matches. The findings revealed that only 11.6% (autocorrelations), respectively 16.3% ($\chi 2$ tests), of the matches showed signs of momentum. In 7% of the matches, signs of anti-momentum were found. However, in nearly three of four matches, at least one five-minute period of momentum was detected. These results suggest that momentum exists in short periods, but normally does not last for a complete match. In Study II, semi-structure interviews with nine coaches of female elite handball teams were done to explore their perception of triggers, strategies, and characteristics of PM. The results showed that characteristics of both positive and negative PM could be categorised into factors regarding behaviour, cognition, confidence, emotions, and the team. Triggers for positive PM were grouped into the categories confidence, players' individual factors, team factors, and team-opponent factors, whereas triggers for negative PM related to the categories coach factors, confidence, external factors, players' individual factors, and team factors. The coaches mentioned a plethora of strategies that can be applied to enhance the chances to end up in a positive PM. Study III investigated the relationship between a team's history of events, nonverbal behaviours in the form of gesture and touch shown by the shooter after scoring, and subsequent team performance. The results revealed among others that 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.

Several conclusions can be drawn: Momentum in handball is short-lived, complex in nature, and probably best portrayed in a circular way where the different variables influence each other reciprocally. The display of touch after scoring seems to be a means of maintaining positive PM.

Key words: Performance fluctuations, team sports, nonverbal behaviour, performance, emotional contagion

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Psychological momentum in handball

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Abstract

This doctoral dissertation deals with a phenomenon that is often referred to in sports, but still poorly understood from a scientific angle: psychological momentum (PM). No consensus has been agreed on how to label this phenomenon, and other terms such as momentum or behavioural momentum (BM) are often used interchangeably. In everyday language, PM can be explained by periods in a match where everything goes perfectly well (i.e., positive PM), or periods in a match where nothing works out as it should (i.e., negative PM). In short, it is about the flow of the game.

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Several conclusions can be drawn: Momentum in handball is short-lived, complex in nature, and probably best portrayed in a circular way where the different variables influence each other reciprocally. The display of touch after scoring seems to be a means of maintaining positive PM.

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Writing a PhD looks at first sight – and feels at times – as a rather lonely endeavour. However, such a seemingly individual performance would never be possible without the help and support of others, and my PhD is no exception of that. Therefore, I want to express my gratefulness to those persons who have been supportive during my PhD years.

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List of studies

The present doctoral dissertation is based on the three following studies, which will hereafter be referred to by their Roman numerals:

I. Moesch, K., Bäckström, M., Granér, S., & Apitzsch, E. (2014). Hard fact or illusion? An investigation on momentum in female elite handball from a team perspective. *International Journal of Sport and Exercise Psychology, 12*, 106-120. doi: 10.1080/1612197X.2013.804287

II. 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.

III. Moesch, K., Kenttä, G., Bäckström, M., & Mattsson, C. M. (2015). *Nonverbal post-shot celebrations and their relationship with performance in elite handball.* Manuscript submitted for publication.

Introduction

After the first half of the final of the female Swedish National Championships in handball 2012, the score was 9-8, with both teams having had the lead under the first 30 minutes. After the halftime break, however, one team started to collapse, scoring only six goals during the 30-minute long second half. The opponent, on the other hand, scored 27 goals in the same time period. The spectators got a strong impression that the former team was losing and the latter team was gaining momentum after having played the first half quite evenly.

When facing France – a dreaded opponent – at the European Championships 2014, the Swedish handball national team was trailing with six goals in the middle of the first halftime. It seemed as if the team did not really come into the match, and everything pointed to another loss against that opponent. However, the team slowly started to pick up goal after goal, leading to an even score in the first half of the second halftime. The team seemed to get "wind in the sails", and finally won the match with three goals.

There are plenty of examples as the ones described above in the world of sports, where athletes or teams suddenly lose ground in a competitive event, or, on the contrary, suddenly start outperforming the opponent. Such changes in the flow of a game are commonly called momentum or psychological momentum (PM; see below a description of these two terms and how they are used in the present dissertation).

From a historical perspective, the word momentum was introduced by Descartes (1596–1650) and Newton (1642–1727). The latter described momentum as a physical phenomenon that is defined as the product of mass and velocity. However, it was only in the last quarter of the 20th century when Adler and Adler (1978) started to translate this phenomenon into the social sciences. In this perspective, the phenomenon refers to the *perceived* velocity, or changes of it, with which actions are accomplished (see e.g., Adler, 1981). Since then, research on momentum has been conducted within sports, but also in other areas such as academia (see e.g., Attewell, Heil, & Reisel, 2012), financial markets (see e.g., Crombez, 2001), and everyday activities such as shopping (see e.g., Dhar, Huber, & Khan, 2007).

From the beginning of momentum research in social sciences, it has been proposed that there must be an opposite of momentum, which has been labelled negative momentum (Adler, 1981). Nowadays, many researchers label both correspondents,

calling them positive and negative psychological momentum (PM), respectively positive and negative momentum (see e.g., Briki, Den Hartigh, Markman, & Gernigon, 2014; Briki, Den Hartigh, Markman, Micallef, & Gernigon, 2013; Gernigon, Briki, & Eykens, 2010; Jones & Harwood, 2008). As a general description, positive momentum is supposed to aid movement towards the directed goal, whereas negative momentum moves the goal further away (Adler, 1981). In competitive sports, the goal is always to win a match or competition. Thus, positive momentum in sports describes periods where a team performs well and approaches the win. Negative momentum refers to periods in a competitive event where the athlete or team performs poorly and thus erases from the win. In everyday language, positive momentum can be described as periods where one seems to take off, or where everything just goes smoothly. Negative momentum on the other hand can be described as periods where things go from bad to worse, or where everything seems like an uphill struggle.

Momentum research focuses on describing performance changes of a single athlete or team within a specified time frame. In other words, momentum research tries to answer the question why an athlete or a team performs at a certain level at one point in time, but performs at a much higher or lower level at another point in time. The time frame of momentum can be either within or between matches (see Iso-Ahola & Dotson, 2014): The latter refers to the experience of having a number of consecutive matches over the season where an athlete or a team performs either well or poorly. Meanwhile, within-match momentum refers to periods of outstanding, respectively poor, performance of an athlete or team during one single game. The present dissertation focuses on within-match momentum.

Definitions

Even though momentum is a commonly used terms in the athletic community, it is still considered an elusive concept that is poorly understood from a scientific perspective (Burke & Houseworth, 1995; Crust & Nesti, 2006). One point of concern refers to the use of different terms for the phenomenon. It has been labelled momentum (e.g., Adler, 1981; Taylor & Demick, 1994), psychological momentum (e.g., Gernigon et al., 2010; Iso-Ahola & Mobily, 1980), or behavioural momentum (BM; e.g., Mace, Lalli, Shea, & Nevin, 1992; Roane, 2011). So far no consensus on the content of these terms has been reached, and they have been used interchangeably in the literature (see e.g., Briki, Doron, Markman, Den Hartigh, & Gernigon, 2013; Young, 2011). To overcome that problem, Briki, Doron, et al. (2013) recently suggested that PM should be used to refer to the emotional experience a person has when everything goes well (positive PM) or bad (negative PM), and Young (2011)

postulated that a distinguishing feature of PM is the presence of a change in the psychological state of the athlete. Momentum, on the other hand, is proposed to describe the contextual factors that initiate this psychological perception (Briki, Doron, et al., 2013). Even though BM is more distinguishable due to a definition proposed by Nevin (1996), this very narrow concept has received only little attention in the sport psychology literature. However, some researchers grasp momentum from a behavioural perspective, without neither referring to the definition of Nevin (1996), nor using the term BM to name it. Therefore, it is an impossible endeavour to use these three terms stringently in the present dissertation. A proposition to grasp the phenomenon from a psychological and from a behavioural perspective will follow below. When it comes to naming the phenomenon, I decided to use the term that was originally used by the respective author when referring to their work, but to use the terms momentum and PM interchangeably in all other cases. The term BM will only be used if referring to the definition of Nevin (1996).

Another distinction that seems important is if the phenomenon refers to an individual athlete or to a team. Most of the literature does not explicitly label PM as "individual PM", but usually refers to it. Some researchers have specifically labelled the term "team momentum" (Briki & Gernigon, 2009; Den Hartigh, Gernigon, Van Yperen, Marin, & Van Geert, 2014). An attempt to capture team momentum follows below.

Momentum as a psychological experience

One of the first definitions of PM was proposed by Iso-Ahola and Mobily (1980), describing the phenomenon as "an added or gained psychological power which changes interpersonal perceptions and influences an individual's mental and physical performance" (p. 391). Only recently, Iso-Ahola and Dotson (2014) went into more detail and named specific cognitive factors that were forming this psychological power, for example a sense of competence, confidence, efficacy, control, and a perception of superiority. Adler (1981) defined momentum as "a state of dynamic intensity marked by an elevated or depressed rate in motion, grace, and success" (p. 29). Vallerand, Colavecchio, and Pelletier (1988) offered a broader definition, including more specified psychological factors associated with PM. According to Vallerand et al. (1988), PM is considered as the "perception that the actor is progressing toward his/her goal" (p.94). Further, these authors postulate that "such a perception of progression toward the goal is associated with heightened levels of motivation and enhanced perceptions of control, confidence, optimism, energy, and synchronism" (p. 94). Taylor and Demick (1994) defined momentum as "a positive or negative change in cognition, physiology, affect, and behaviour caused by a precipitating event or series of events that will result in a shift in performance" (p. 51). They pinpointed the notion that momentum was often associated with an abrupt

change caused by a precipitating event. Interestingly, this issue is questioned by Adler (1981), who proposed that momentum could develop either suddenly (explosive momentum) or gradually (placid momentum). The most recent definition stems from Gernigon et al. (2010): These researchers focused on both the individual's psychological experience, which has been considered an aspect of PM, but also on the factors that lead to such experiences, which are considered aspects of momentum (Briki, Doron, et al., 2013). Gernigon et al. (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 towards or away from either an appetitive or aversive outcome" (p. 397), and suggested that such a perception "might emerge from the feedback and feedforward that are provided by the specific ongoing history of events" (p. 397).

These definitions all show a clear focus on the idiosyncratic perception of the athlete and specify cognitive, emotional, and/or motivational variables associated with experiencing PM. Moreover, all definitions relate PM to subsequent performance changes, or to moving towards or away from a target goal, thus postulating that PM is directly linked to the athlete's performance. The scientific evidence about this relationship, however, is ambiguous, as will be shown below.

Momentum as observed behaviour

Another approach to momentum focuses not primarily on the athlete's idiosyncratic experience, but rather on the behaviour, or most commonly on the outcome of behaviour (i.e., performance) in different periods of a competition. Doing so, researchers using this approach avoid the ambiguous PM-performance relationship, and consider instead observed behaviour as an indicator for operationalising the phenomenon.

Besides mentioning the individual's experience of momentum, Adler (1981) further defined momentum as the tendency of an effect to be followed by a similar effect. Following that premise, he proposed that positive momentum would predict that successful actions (e.g., scoring) increased the chances for subsequent success, whereas during negative momentum, unsuccessful actions (e.g., missing a shot) increased the risk for subsequent failure. In line with that approach, Hughes, Fenwick, and Murray (2006) defined positive momentum as a player hitting successive winners, and negative momentum as a player hitting successive errors. In that approach, momentum is defined once a player is extremely successful (positive momentum) or extremely unsuccessful (negative momentum) in consecutive attempts, without focusing on the psychological experience of the athlete. Jackson and Mosurski (1997) focused in their definition on the dependency structure that can arise between

attempts: They suggested that PM arises when winning a trial increases the probability of winning the next trial.

These definitions show a clear shift towards a focus on the overt behaviour (i.e., successful or unsuccessful actions) of the involved athlete, rather than on the athlete's idiosyncratic experience related to it. This approach to momentum is closely linked to the concept of hot hand, as originally defined by Gilovich, Vallone, and Tversky (1985; see a description of this concept below).

Linked with the behavioural view on momentum, the term behavioural momentum (BM) has found its way into sport psychology research (see e.g., Roane, 2011). According to Nevin (1996), the term BM is used to describe the tendency of a reinforced behaviour to persist in the face of disruptors. In team sports, reinforced behaviours include successful performances (e.g., scoring, blocking the opponent), whereas all successful behaviours from the opponent team as well as all mistakes from the own team become disruptors of momentum (Mace et al., 1992; Roane, Kelly, Trosclair, & Hauer, 2004). A few studies have been done in sports using this approach.

Merging the psychological approach with the behavioural approach, Schilling (2009) finally defined the term momentum as a condition in which psychological factors cause players or teams to achieve a higher (or lower) than normal performance over a period of time due to a positive correlation between successive successful (or unsuccessful) outcomes. Adopting a similar approach, Young (2011) pointed to the fact that PM can include both internal and external indicators. The latter refer to factors that affect the way athletes perceive PM, and is categorised into behaviours such as winning and losing or performing skills successfully. Internal indicators focus on how athletes experience PM in regard to specific thoughts and feelings, and is further divided into thinking momentum and feeling momentum.

Team momentum

Some researchers have used the term team momentum to describe PM in team sports (e.g., Briki & Gernigon, 2009; Den Hartigh et al., 2014), whereas others hold on the terms momentum or PM when referring to the phenomenon in a team context (e.g., Eisler & Spink, 1998; Jones & Harwood, 2008). So far, no definition for team momentum has been proposed. When it comes to momentum in team sports, two possible scenarios can be proposed: It could be assumed that all players in a team experience momentum individually. This would mean that one or several players experience momentum while playing a match, whereas the other teammates do not. However, it can also be assumed that more complex processes are activated when momentum is about to develop on a team level, and that the individual players do not experience momentum isolated without influencing each other. In fact, already from

the very beginning of research on momentum it has been acknowledged that momentum not solely exists for individual athletes, but also for teams (Adler, 1981; Adler & Adler, 1978). Specifically, Adler (1981) proposed that momentum can be spread to others, and proposed for highly cohesive sport teams that this is most probably done through the "unified form of contagion" (p. 59): Here, the complete team experiences momentum, moving from one stage to the next (referring to the Cross-Sectional Model of Momentum, see below), carrying out the spiralling process together. However, Adler (1981) did not further specify the process of contagion, or how the momentum experience was dispersing within a team. Briki and Gernigon (2009) proposed that the specificity of a team is the way in which cognitions and emotions are spread among the members. Such interpersonal processes seem therefore important and should be considered when investigating momentum in a team context.

So far, not much knowledge exists on team momentum: The models developed within momentum have not taken into account team-related aspects, and mainly focus on how the individual (be it as an individual athlete, or an athlete in a team) experiences the phenomenon. Moreover, only few studies have investigated specific team-related aspects, such as collective efficacy (Den Hartigh et al., 2014; Stanimirovic & Hanrahan, 2004), cohesion (Den Hartigh et al., 2014; Eisler & Spink, 1998), or interpersonal coordination (Den Hartigh et al., 2014). Some studies were done that investigated perceptions of PM specifically in a team sport context (Miller & Weinberg, 1991) or investigated observers' judgment of precipitating events and behaviours during team momentum in basketball (Burke, Aoyagi, Joyner, & Burke, 2003; Burke, Burke, & Joyner, 1999; Smisson, Burke, Joyner, Munkasy, & Blom, 2007), and still others focused on investigating team momentum from a qualitative approach (Jones & Harwood, 2008). Yet another author theoretically conceptualised the concept of collective collapse (Apitzsch, 2006, 2009), which can be considered as an extremely negative team momentum (see below a more thorough description of collective collapse). Despite these efforts, the state of knowledge when it comes to team momentum is very sparse. One reason might be the complexity of all possible variables and processes lying behind team momentum that makes it difficult to investigate more in-depth.

The present dissertation focuses on PM in handball, and thus PM in a team sport context. However, as research is sparse, the introduction will take into account theories and research from both individual and team sports in order to deliver a complete picture of the phenomenon in focus. If accessible, specific aspects of team momentum are emphasised.

Models of momentum

Besides the search for clear definitions, researchers have also tried to explain momentum from a theoretical point of view. As a result, different models have been proposed that will be described below.

Early models of momentum

The first approach to theoretically gather momentum stems from Adler and Adler (1978). They described momentum from its development until its interruption based on observations and verbal and written accounts by athletes, fans, and coaches. They proposed three different stages: momentum starters, momentum maintenance, and momentum breakers (Adler & Adler, 1978). The first stage of the momentum process, momentum starters, is also called the impetus. This stage includes factors that potentially trigger momentum, and the authors listed different suggestions for such starters, for example charismatic plays, or taking a chance successfully. The second stage of the momentum process is its maintenance over time, which the authors explained as the ability to sustain the original movements and the attained energy level. Several factors were proposed by the authors to affect the maintenance of momentum, such as confidence, perseverance, will power, and concentration. The final stage of the momentum process is its interruption. The authors postulated that anything that disturbs the rhythm and tempo of the game could reverse the advantage, and named examples such as a loss of a key player, or release of tension as factors for it. Such interruption can come from internal or external factors, and might even be triggered by the opponent's starters of momentum (Adler & Adler, 1978).

Based on this seminal work, Adler (1981) proposed a model for momentum, the Cross-Sectional Model of Momentum, with five steps that are assumed to build up momentum: A personal meaningful goal (e.g., winning a match) forms the basis. This goal serves as a standard to which subsequent performance is measured. The decisive question is whether the player or the team is approaching the goal (by winning rallies or scoring), or erasing from this goal (by losing rallies or getting scored). Whether an athlete or team is approaching or erasing from the goal has an effect on motivation, which fosters energy for action (e.g., feeling more motivated after winning a point, as this increases the chances for a victory). As a result of the perceived distance from the goal, as well as the motivation arisen, the athlete experiences specific emotions (e.g., positive emotions such as joy and pride). These emotions trigger a corresponding arousal level (e.g., optimal arousal level), which subsequently leads to corresponding behaviour. The specificity of momentum, however, is not given by these five steps alone, but by a circular feedback system where achieved accomplishments develop further impetus.

Another aspect that Adler and Adler (1978) initiated, and Adler (1981) carried on with is the question in which time frame momentum starts. Firstly, Adler and Adler (1978) proposed momentum to start either as "rapid ascension" or "gradual rise" (p. 172). Adler (1981) renamed these types of momentum as "explosive" and "placid" momentum (p. 34). The former is described as an intense, charismatic spark with a rapid increase in the upward spiral of momentum, whereas the latter displays a less dramatic but steady development of momentum.

The contribution of Adler and Adler (1978) and Adler (1981) offered a first theoretical conceptualisation of momentum from a social science perspective, which provided a reference point for following research. However, some criticism has arisen: The authors offered only a superficial discussion on how the different parts of the model in fact affect momentum. Taylor and Demick (1994) criticised the fact that the model did not allow making predictions about the effect of each factor on momentum or performance. Moreover, Adler (1981) did not mention any form of cognitive factors in his model. Another problem that arose with the model is the fact that due to its circularity, it was not clear which factors led to momentum and which factors were outcomes of momentum. Vallerand et al. (1988) argued that due to that, the causes and effects of the very same phenomenon were confounded. Therefore, they proposed another model of PM that takes that factor into account.

Antecedents-Consequences Psychological Momentum Model

The Antecedents-Consequences Psychological Momentum Model (ACM) was proposed by Vallerand et al. (1988) with the aim to tackle the cause-effect ambiguity in PM. The novelty in that model is that it proposes a temporal distinction between antecedents, perceptions, and consequences of PM. The antecedents consist of personal factors such as an individual's need for control, and situational factors such as the intermediate result or the sequence of events in a match. These personal and situational factors, then, are proposed to influence the perception of PM. The impact of these perceptions on subsequent performance, which is considered as a consequence of PM, is moderated by contextual (e.g., the crowd, characteristics of the task) and personal variables (e.g., the actor's skill level, competitive anxiety).

Interestingly, even though these authors assumed an underlying relation between perceptions of PM and performance, they also stated that certain factors (e.g., an athlete having high competitive anxiety, or a crowd being totally against a competitor) can hinder that relationship. In an experimental study, Vallerand et al. (1988) found support for the notion that score configuration (one player catches up from behind vs. no player prevails) as a situational variable influenced PM perception, and that score configuration, level of experience, and subsequent perception of PM were found to influence subjects' prediction of players' performance.

Novel in this model, the authors also stressed the fact that both participants and spectators could perceive PM: While the actors (i.e., athletes) would experience the complete range of PM including cognitions, affects, and motivation, observers (i.e., fans, spectators, coaches) would perceive that actors have changed in these dimensions, without experiencing them themselves.

The model of Vallerand et al. (1988) significantly contributed to the understanding of PM, with the most important point of proposing a temporal framework for the development of PM. Moreover, in contrast to the work of Adler and Adler (1978) and Adler (1981), the model of Vallerand et al. (1988) explicitly pinpoints cognitive factors, such as perceived control. Moreover, the ACM emphasises the importance of situational variables for the development of PM. However, Vallerand et al. (1988) hold on to terms such as energy and synchronism that are difficult to operationalise, and did not consider more specifically the influence of emotions and arousal on PM (see Taylor & Demick, 1994).

Multidimensional Model of Momentum

Taylor and Demick (1994) proposed a sequential model of momentum called the Multidimensional Model of Momentum (MMM). As for the ACT, the MMM describes momentum as a result of personal and situational factors. However, the MMM emphasises much more the importance of affective, cognitive, and physiological variables. Specifically, the MMM suggests a momentum chain starting with a precipitating event, which is comparable to the antecedents in the model of Vallerand et al. (1988). Depending on the subjective perception of the precipitating event, this event is proposed to trigger affective, cognitive, and physiological changes in the athlete. Those changes are supposed to affect each other reciprocally, and result in a behavioural manifestation observable to others. The change in behaviour will result in a corresponding change in performance, which will change the immediate outcome of the competitive event. However, in order for the momentum chain to result in an immediate outcome, an opposing momentum chain must occur for the opponent. This series of changes is supposed to result in the development of PM. Positive with this model is the fact that the different stages of the model can be operationalised, which facilitates the possibility for empirical testing. Results of empirical studies supported the first stages of the model, indicating that the suggested psychological variables mediated the sequential development of momentum (Mack, Miller, Smith, Monaghan, & German, 2008; Mack & Stephens, 2000; Stanimirovic & Hanrahan, 2004; Taylor & Demick, 1994).

Projected Performance Model

As was the case for ACM and MMM, the Projected Performance Model (PPM; Cornelius, Silva, Conroy, & Petersen, 1997) focuses on the relationship between PM and performance. However, in contrast to the previous models, the PPM postulates that positive and negative PM are the *result* rather than the *cause* of performance changes, suggesting that performance fluctuations rapidly get the label positive or negative PM, when in fact they may be normal variations of performance around a mean level[1]. Based on their results, Cornelius et al. (1997) proposed that perceptions of positive and negative PM are the result of extremely good, respectively extremely bad performance: If performance increases above the mean level, athletes are likely to experience positive PM, whereas when performance is decreasing below the mean level, players will report negative PM. However, contrary to previous assumptions, they further found that attributions of positive or negative PM had little to no effect on subsequent performance. In case of a head to head competition between competitors of equal ability, they proposed "additional forces that are likely to return exceptional performance to more average levels" (p. 483). They referred to two mechanisms initially proposed by Silva, Hardy, and Crace (1988) called positive inhibition and negative facilitation. The former refers to negative changes that can occur after previous successful performance, such as a team decreasing in successful attacks after having outperformed the opponent team by many goals in the first half. Negative facilitation refers to a positive change in performance after initial poor performance. For example, a team having played badly in the first quarter of a match may go out on the court more motivated and focused after a time-out, starting to outperform the opponent. Cornelius et al. (1997) suggested that competitors' cognitions and attributions could affect the length of positive, respectively negative PM, but they also considered factors connected with the opponents as influential. The opponent is likely to react on a player's or a team's exceptional performance by increasing effort, or alter tactics to break the run. Cornelius et al. (1997) stated that the PPM explained many of the research findings done so far within PM that had been unable to demonstrate an effect of perceptions of PM on subsequent performance. A recent qualitative study revealed support for positive inhibition: Some athletes reported a decrease in effort once they were convinced they would win at the end of a positive PM (positive inhibition), but were – contrary to the assumptions of

1 Only very recently, Iso-Ahola and Dotson (2014) proposed in an updated conceptualisation of the basic tenet of PM (Iso-Ahola & Blanchard, 1986) that PM can be both a result and a cause of performance, thus combining the view of the ACM and MMM with the view of the PPM: They stated that initial success (or failure) creates perceptions of PM, which in turn influence subsequent performance in the respective direction, and suggested that mediation or moderation processes can take place in that relationship between prior and subsequent performance.

negative facilitation – likely to reduce effort after having resisted in vain to negative PM (Briki, Den Hartigh, Hauw, & Gernigon, 2012). In contrast, another recent study revealed that the power output of cyclists was higher in the negative momentum scenario than in the positive momentum scenario, thus supporting the notion of negative facilitation (Briki, Den Hartigh, et al., 2013).

Contemporary approaches to momentum: PM from a dynamical system approach

Already Adler and Adler (1978), in their conceptualisation, emphasised that momentum is a dynamic phenomenon that can either start abruptly or gradually over time, and that is embedded in an ongoing history of events. Adler (1981) formulated this last point as follows: "A circular feedback system develops through which accomplishments already achieved are instrumental in aiding further propulsion" (p. 33). More recent research further strengthened the assumption that PM might be more than a simple linear chain from its start until its end: The results of Jones and Harwood (2008), for example, revealed a recursive relationship with confidence being both a trigger for, and an outcome of PM. Based on that knowledge, a group of researchers applied the dynamical system approach for PM (e.g., Briki, Den Hartigh, et al., 2014; Briki, Den Hartigh, et al., 2013; Gernigon et al., 2010).

Presenting the dynamical system approach, Nowak and Vallacher (1998) postulated three core features, namely complexity, nonlinearity, and history-dependence. More specifically, they suggested that the interactions among elements of a dynamical system were so complex that a causal mechanism alone was inadequate to characterise the phenomenon in its entity. Moreover, in opposition to linear causality, one of the main characteristics of dynamical systems is that they are composed of recursive relations (e.g., Nowak & Vallacher, 1998), which would strengthen the fact that one variable (e.g., confidence in the study of Jones & Harwood, 2008) could be both a cause and a consequence. So far, some models of PM have been conceived in terms of a cause-consequence process (ACM; Vallerand et al., 1988) or in the form of a causal chain (MMM; Taylor & Demick, 1994). In contrast to them, the dynamical system approach proposes that the relationship between the elements of a dynamical system and its behaviour is nonlinear. Specifically, a variation in many elements of the system may lead to no change in behaviour, whereas a little change in one element can lead to a tremendous change in behaviour. Another main determinant of a dynamical system is its dependence on its history (Nowak & Vallacher, 1998). The actual state of a system is proposed to be dependent on the history of its prior states, or, in other terms, dependent on what has happened in the preceding time frame. Within PM, this idea has been commonly used in research, for example when manipulating feedback or performance scenarios to trigger perceptions of PM or to investigate

subsequent behaviour (e.g., Perreault, Vallerand, Montgomery, & Provencher, 1998). A recent study by Den Hartigh et al. (2014) confirmed the importance of history-dependence, revealing that team momentum is not only dependent on the static situation, but also on the history of progressing towards or regressing from a goal. Likewise, the study of Briki, Den Hartigh, et al. (2013) indicated that PM perceptions indeed possess the dynamical properties of history-dependence and nonlinearity.

Research within momentum

Experiences of momentum: triggers and characteristics

Some of the existing research has focused on investigating how PM is experienced. Specifically it has been studied what athletes and fans consider to be triggers and characteristics for PM.

Triggers

Already Adler and Adler (1978) proposed several factors considered as starters of momentum, such as charismatic plays or taking a chance successfully. Since the publication of Adler and Adler (1978) some other studies have focused on possible triggers for PM. Jones and Harwood (2008), investigating the experience of five university soccer players using semi-structured interviews, listed a plethora of triggers for positive and negative PM. For the former, the participants proposed factors such as the opponents' weakness, mistakes, or negative body language, but also scoring goals oneself and the encouragement from teammates, the coach, the crowd, or the captain. Negative PM was, according to the soccer players, triggered by factors such as the opponents' strength, reputation and high ability, by conceding goals, questionable referee decisions, fatigue, or pressure. Young (2011) interviewed seven athletes from different sports. He concluded that at times, a single event prompted instantaneous perceptions of PM, while at other times it was the culmination of several events or components of performance that triggered athletes' perceptions of PM.

Taylor and Demick (1994) focused on the individual's perception of a precipitating event: A trigger for one person might not have the same effect for another athlete. This discussion questions the approach of looking for triggers of momentum on a general level. Nevertheless, these same authors asked athletes (tennis and basketball players) to list different precipitating events: These events were classified as pertaining to internal (e.g., different psychological states, fatigue), environmental (e.g., scoring configurations, dramatic actions, referee decisions), and social (e.g., team cohesion,

staff and crowd influence) factors. Due to methodological consideration only focusing on environmental factors for their study, they found that the most common type of precipitating event was a dramatic shot (Taylor & Demick, 1994). Winning and losing basketball teams did not differ in the amount of positive and negative precipitating events experienced. Winning tennis players exhibited, however, more positive precipitating events and fewer negative precipitating events than losing players. Furthermore, winning players were also better able to successfully act on positive precipitating events and resist on negative precipitating events.

A qualitative study conducted by Briki, Den Hartigh, Hauw, et al. (2012) using video based self-confrontation interviews with four table tennis players and four swimmers revealed three different factors to be significant triggers: dissonance (i.e., an unexpectedly occurring event or performance state contrasting the previously established situation or performance expectation) triggering both positive and negative PM, consonance (i.e., a confirmation of the previously established expectation) for triggering negative PM, and fear of not winning (i.e., upcoming maladaptive thoughts that replace previous adaptive thoughts) for triggering negative PM. Overall, the results of Briki, Den Hartigh, Hauw, et al. (2012) revealed that negative PM can be triggered in more ways than positive PM, which is in line with Adler (1981) and Gernigon et al. (2010). A more recent quantitative study by Briki, Den Hartigh, et al. (2013) further found that negative PM is more easily triggered than positive PM. This result is in line with findings made in many different areas of human experiences, where bad events have a stronger impact than good events (for an overview see Baumeister, Bratslavsky, Finkenauer, & Vohs, 2001).

The study conducted by Burke, Edwards, Weigand, and Weinberg (1997) included two experiments within tennis and basketball. The 78 participants who were observing matches were asked to report when starting and ending points of momentum in videotaped competitions appeared. The results revealed a wide variety of momentum starters and breakers clustering around factors regarding increased performance and accompanying emotional changes. However, it was most often a combination of starters, rather than one alone, which was perceived as an antecedent of momentum. The analyses of Burke et al. (1997) resulted, however, in a low agreement regarding starting and ending points of PM between the participants.

In the study of Burke et al. (1999), a trained observer identified 50 momentum acts in 14 basketball matches. In general, the beginning of momentum was characterised by good performance of one team with simultaneously poor performance of the other team. More specifically, the five most frequently occurring actions at the beginning of a momentum sequence were three-point shots, defensive stops, steals, fastbreaks, and turnovers. A similar approach was taken by Smisson et al. (2007) investigating momentum triggers from a spectator's perspective. Their results showed that the four most frequent events starting momentum were crowd noise, two-point lay-ups, three-

point shots, and steals. Burke et al. (2003) asked eight observers of basketball matches about perceived game events that started momentum. The results revealed that three-point shots, caused turnovers, two-point lay-ups, steals, two-point jump shots, and defensive stops were the most common events occurring at the start of a momentum sequence. However, confirming the results of Burke et al. (1997), there was only a 60% agreement as to what started momentum.

Characteristics

The results of Jones and Harwood (2008) revealed that participants experience positive PM as a state where one was thinking ahead, had high confidence or feelings of invincibility, perceived success, and where players were doing things they usually don't do. Briki, Den Hartigh, Hauw, et al. (2012) summarised the 83 contents that arose from the participants on positive PM into four dimensions. Perceptions, as one dimension, were further divided into seeing the opponent having negative PM, having control over the situation, gaining psychological advantage, and efficiency. The dimension called affects and emotions consisted of the themes self-confidence, elation and satisfaction, and worries about losing PM. The dimension cognitions included anticipation of a negative scenario for opponents, anticipation of a positive scenario for oneself, adopting performance-approach goals, adopting mastery-approach goals, and adopting mastery-avoidance goals to protect one's advantage. The last dimension proposed by Briki, Den Hartigh, Hauw, et al. (2012) pertained to behaviours, including increasing effort, checking positive momentum, and coasting (i.e., self-regulation strategies such as managing effort to save energy).

The analysis of Jones and Harwood (2008) revealed that participants described negative PM as a state where different emotions such as anger, feelings of threat, disappointment, frustration, and hopelessness were felt. Furthermore, the participants stated they experienced reduced confidence, and showed negative body language when being in a state of negative PM. The 59 contents on negative PM presented by Briki, Den Hartigh, Hauw, et al. (2012) were divided into the same four dimensions as the characteristics for positive PM. In a negative PM, perceptions refer to collapsing, seeing the opponent in a positive PM, and inefficiency. Affects and emotions were further divided into getting self-doubts, worries about being defeated, displeasure and dissatisfaction, regrets, and discouragement. The dimension cognitions included the themes adopting mastery-approach goals to cope with negative PM, adopting mastery-avoidance goals to resist negative PM, adopting performance-avoidance goals, and anticipating a negative scenario. Lastly, the dimension behaviours consisted of resisting and dropping.

A slightly different approach was taken by Young (2011): This author focused more on the question of how athletes become aware of PM. It emerged that there were both internal and external indicators for PM. The former, focusing on what athletes themselves experience when detecting positive, respectively negative PM, was further

divided into feeling momentum and thinking momentum. Feeling momentum included appraisal of internal physiological processes, such as increased levels of adrenaline and energy, or feelings of relaxation. Thinking momentum included increased levels of confidence and thoughts about being unstoppable, which were considered as a sign for the athletes that they were in a positive PM. Young (2011) also pinpointed confidence as an important ingredient in the experience of PM, as did Briki, Den Hartigh, Hauw, et al. (2012) and Jones and Harwood (2008). External indicators, as proposed by Young (2011), might not be considered pure characteristics of PM. Rather, they represent external sources that athletes take, indicating that they are likely in a state of PM. External objects or people are used as reference points that serve, together with one or more internal indicators, as an indication of PM. Three external indicators emerged: The athletes' awareness of the score or the final outcome is considered a powerful indicator of momentum (a category called winning or losing). Moreover, athletes described how they used small successes within their performance, as for example executing an exceptional forehand or giving a perfect pass, as signs for PM. Thereby, not only the overall outcome and the measured performance, but also small personal successes are considered to indicate athletes' positive PM (a category called executing skills). The last category, seeing it in others, is based on athletes' descriptions of how they use people around them as reference point for their own PM. For example, cheering teammates or a quiet home crowd were considered as indicators of positive, respectively negative, PM.

These studies give an interesting overview on how athletes experience periods of positive and negative PM. Another line of research focused on what spectators see in a team that has positive PM. Obviously, from a spectator perspective, it can only be investigated what kind of overt behaviours the athletes show in such periods. The studies done with that research question, all within basketball, focused solely on what sport-specific behaviours were shown, and did not go into further detail about other behaviours displayed during PM (e.g., exerted effort, body language). In the study of Smisson et al. (2007), the most common actions during positive momentum were caused turnovers, three-point shots, and steals. In the study of Burke et al. (2003), the most common events were caused turnovers, two-point lay-ups, three-point shots, steals, defensive stops, and two-point jump shots. In the study of Burke et al. (1999) the four most frequently occurring actions during momentum sequences were turnovers, defensive stops, steals, and strings of unanswered points.

This overview shows that there is research about triggers and characteristics of PM done with athletes (Briki, Den Hartigh, Hauw, et al., 2012; Jones & Harwood, 2008; Young, 2011) and spectators (Burke et al., 2003; Smisson et al., 2007). Interestingly, though, so far no research has been done about coaches' perceptions about their teams' PM. Investigating perceptions of coaches has been proposed as an interesting and important step to further explore PM (Crust & Nesti, 2006). Investigating coaches' perceptions offers insight into an observer's perspective, which is proposed to

be less affectively biased than the actors' (e.g., players') perspective (Vallerand et al., 1988).

Perceptions of momentum

Many studies have focused on investigating participants' perception of PM to be able to analyse how these perceptions are experienced during the game, and, within the sport context most importantly, if such perceptions are related to performance. Even though this research area is not directly related to the studies of this dissertation, an overview will be presented due to its centrality to the momentum concept.

The state of knowledge will be summarised regarding the impact that different situational factors (e.g., coming from behind, winning parts of a competition) have on athletes´ perceptions of PM, and how these perceptions of PM in turn influence subsequent performance. Some studies investigated if situational factors directly affected subsequent performance. Lastly, a group of researchers focused on investigating PM perceptions as they unfold over time.

The cited studies have used the following methods: Perceptions of PM were measured by using the questionnaire on perceptions of PM proposed by Vallerand et al. (1988; see Briki, Doron, et al., 2013; Perreault et al., 1998; Shaw, Dzewaltowski, & McElroy, 1992; Stanimirovic & Hanrahan, 2004), by asking who of the participants had momentum (Miller & Weinberg, 1991), by investigating if the athlete perceived positive momentum, no momentum, or negative momentum (Mack et al., 2008), or by asking other questions regarding participants´ perceptions of PM (Cornelius et al., 1997; Silva, Cornelius, & Finch, 1992). Positive PM has been induced by scenarios such as taking the lead on the opponent (Shaw et al., 1992; Silva et al., 1992), coming from behind to tie (Perreault et al., 1998; Vallerand et al., 1988), or repeated success in tasks (Kerick, Iso-Ahola, & Hatfield, 2000; Stanimirovic & Hanrahan, 2004). Negative PM has been induced by exposing participants to lying behind (Perreault et al., 1998; Shaw et al., 1992; Silva et al., 1992) or repeated failure in tasks (Kerick et al., 2000). Performance was measured through points won during the momentum period (Burke et al., 2003; Burke et al., 1999; Miller & Weinberg, 1991; Shaw et al., 1992; Smisson et al., 2007), through exerted power in endurance sports (Briki, Den Hartigh, et al., 2013; Den Hartigh et al., 2014; Perreault et al., 1998), through sport specific performance in shooting (Kerick et al., 2000), or through performance in an experimental task (Silva et al., 1992).

The impact of induced PM on PM perception

Many studies could confirm the assumption that positive momentum scenarios were positively related to perceptions of positive PM (Eisler & Spink, 1998; Kerick et al., 2000; Mack et al., 2008; Mack & Stephens, 2000; Miller & Weinberg, 1991;

Perreault et al., 1998; Shaw et al., 1992; Silva et al., 1992; Stanimirovic & Hanrahan, 2004; Vallerand et al., 1988). Likewise, there is support that negative momentum scenarios are positively related to perceptions of negative PM (Kerick et al., 2000; Mack & Stephens, 2000; Perreault et al., 1998; Silva et al., 1992; Stanimirovic & Hanrahan, 2004). In line, the study of Mack et al. (2008) revealed that winners of preceding competitions felt that they had positive momentum, meanwhile losers reported to possess no or negative momentum. Briki, Doron, et al. (2013) found that PM perceptions were higher following the positive momentum sequence than following the negative momentum sequence, and the results of Cornelius et al. (1997) suggested that information about winning and losing was a significant predictor of athletes' perception of momentum. In contrast to these findings, Briki, Den Hartigh, et al. (2013) found that the development of PM perceptions did not significantly differ between the positive and the negative PM scenario.

The impact of induced PM on subsequent performance

Studies adopting a momentum conceptualisation through observer(s) judgment generally found that the team that was perceived to have positive momentum scored more than the opponent team (Burke et al., 2003; Burke et al., 1999; Smisson et al., 2007). When taking match scenarios to conceptualise momentum, Miller and Weinberg (1991) found that in noncritical situations, the momentum team won a significantly bigger amount of the next five points in volleyball than did the opponent team. Investigating endurance sports, positive momentum sequences were shown to be positively related with energy expenditure in cycling (Perreault et al., 1998).

Negative momentum sequences were related to increases in performance in basketball shooting (Shaw et al., 1992), volleyball drills (Stanimirovic & Hanrahan, 2004), and in energy expenditure in cycling (Perreault et al., 1998). This unexpected effect of negative momentum sequences on performance can be explained with negative facilitation (Cornelius et al., 1997; Silva et al., 1988), corresponding to a behavioural response (i.e., increase in effort) to a failure that is still perceived to be changeable. In a similar vein, Briki, Den Hartigh, et al. (2013) found that exerted power was higher for cyclists in the negative PM scenario compared with cyclists in the positive PM scenario, but slowly decreased in both conditions. However, the decrease was faster at the beginning of the negative PM sequence.

A recent study of Den Hartigh et al. (2014), investigating the exerted effort of rowing teams, showed that the teams' effort rapidly decreased during the negative momentum scenario, whereas during positive momentum scenario, the exerted effort was high at the beginning, decreased towards a stable level, to finally increase again towards the end of the positive momentum scenario. Lastly, the studies of Shaw et al. (1992) and Kerick et al. (2000) did not find any differences in performance between participants in positive or negative PM sequences, and the results of Silva et al. (1992) revealed that PM sequence did not predict subsequent performance.

The impact of PM perceptions on performance

The results of Perreault et al. (1998) showed that when participants' perceptions of PM were highest, they performed at the highest level, thus being the first study to provide support for the assumptions of the ACT (Vallerand et al., 1988) and the MMM (Taylor & Demick, 1994). However, their results also showed that when participants' perceptions of PM were lowest, they pedalled faster than when they were tied with their opponent (Perreault et al., 1998). In contrast, Silva et al. (1992) revealed that perceptions of PM did not significantly predict subsequent performance. In line, Stanimirovic and Hanrahan (2004) showed that teams that experienced repeated success displayed enhanced perceptions of PM but did not significantly increase performance. The findings of Cornelius et al. (1997) revealed that change in performance was significantly predicted by situational variables (i.e., winning or losing), but not by perceptions of PM. These authors concluded that attributions of positive and negative PM function simply as a labelling process in the evaluation of performance, with little or no effect on subsequent performance.

Dynamics of PM perception over time

Briki, Doron, et al. (2013) investigated if actors (players who watched a match on video) and observers (fans who watched a match on video) differed in their perceptions of PM. Their results revealed that observers' perceptions were lower than actors' perceptions following a negative momentum sequence. When it comes to interrupting momentum, the results showed that interrupting positive PM lowered PM perceptions, whereas interrupting negative PM increased them. The PM perceptions of cyclists being exposed to either a positive or negative momentum sequence abruptly increased after the middle of the positive momentum sequence and abruptly decreased in the negative momentum sequence (Briki, Den Hartigh, et al., 2013). Lastly, a recent study of Briki, Den Hartigh, et al. (2014) revealed that PM perceptions changed rapidly in the hypothesised direction (more positive in the positive momentum sequence, and more negative in the negative momentum sequence), but then remained stable. This change of PM perceptions happened faster in the positive momentum sequence. All cited studies followed the dynamical system approach.

Investigating PM perceptions as they unfold over time at different points in time, Stanimirovic and Hanrahan (2004) showed that participants in success and failure conditions differed in their perceptions of PM at trial 2, with participants in the success condition having higher perceptions of PM than participants in the failure condition. For the participants in the success group, increases in perceptions of PM were shown from trial 2 to 3. The participants of the failure condition, however, showed a decline in perceptions of PM from trial 1 to 2.

Research investigating perceptions of momentum has revealed many interesting results. However, it is still difficult to make conclusions about the impact of momentum scenarios or momentum perceptions on performance, as the results are not consistent. This can be due to the fact that many different kinds of measurement of momentum have been used. In addition, it can be critically reflected how much information studies with experimental designs provide when one is interested in how momentum unfolds during high stake elite sport competitions. Many studies use novice or untrained participants who are asked to do unfamiliar tasks, which is a completely different situation than the one a highly trained athlete faces in a competition. Other studies induce momentum by reading hypothetical scenarios, where it can be questioned if they trigger similar reactions as do real competitive situations. Such research approaches seem detached from what happens in elite sports. I would argue that the emotional, cognitive, and behavioural responses to repeated success or failure, or to approaching or regressing from one's goal (as features of momentum), are very different in competitive athletes, who are under pressure to succeed, than they are in participants in an experimental study design. The ecological validity of the results mentioned above must therefore be questioned. Several researchers have expressed their criticism on the research design adopted, for similar reasons as mentioned above (Stanimirovic & Hanrahan, 2004; Taylor & Demick, 1994). There is a strong need to shift to research approaches investigating momentum on the field and in high stake competitive situations. Only knowledge about what really happens on the field in competitive events, where highly valued goals are at stake, can give athletes and coaches the knowledge about momentum that can help them to develop strategies for optimising momentum to their own advantage.

Behavioural approaches to momentum

One of the first attempts to define and empirically test PM was done by Iso-Ahola and Mobily (1980), who stated that the competitor winning the first of three sets in racquetball is having PM. Their results confirmed that the player winning the first set was more likely to win the match; however, differences existed between males and females, and competitors on different levels (Iso-Ahola & Mobily, 1980). This study has led to the early success approach, stating that momentum arises after having been successful in the beginning of a competitive event. This premise was confirmed by a subsequent study of Iso-Ahola and Blanchard (1986), who again found that the winner of the first set in a racquetball game most often won the match. The results further revealed that psychological variables, such as confidence and the perception of likelihood to win the next game were significantly bigger for players who won the first game compared to players who lost the first game. Gayton, Very, and Hearns (1993) also found that scoring first, respectively outperforming the opponent in the first period, is related to winning the game in hockey. The study of Silva et al. (1988)

confirmed that result with tennis players. However, after controlling for participants' ability level, the predictive relationship vanished. Subsequently, Silva et al. (1988) offered an alternative explanation, stating that higher ability of the player who won the first set rather than PM might lead to the fact that they won the complete match. Taken together, defining PM only by the fact of winning the first set, respectively the first part of a competition, might be oversimplified. However, only recently Young (2011) revealed that participants used a sequence of early success in performance to build up what he labelled "created momentum" (p. 47). The athletes in this study also stated that early success was associated with feelings of control within a competition, which in turn prompted them to play the way they were used to play, resulting in better performance and positive PM. The results of Young (2011) thus pinpointed the importance of being successful early in a competitive context.

Based on the evidence of the early success approach, subsequent research holds on to the approach of defining momentum through behaviours, for example within the framework of BM (see e.g., Roane, 2011). An initial study in basketball following that perspective revealed a more beneficial response to adversity as the rate of reinforcement increased three minutes prior to adversity, and that calling time-outs was an effective means to reduce opponent's rate of reinforcement, and through that their BM (Mace et al., 1992). However, following studies could not confirm these results to the same extension (Roane et al., 2004; Wanzek, Houlihan, & Homan, 2012).

Another line of research moved over to investigate archival data on the level of goals or points within a match, instead of the macro level (e.g., sets, games) used in studies following the early success approach. Moreover, instead of solely focusing on success in early stages of the competition, these studies take into account data of the entire match. This approach to momentum was tested in the form of several assumptions: One question that was investigated was if runs of positive or negative match data existed that were longer than expected by chance (e.g., O`Donoghue & Brown, 2009). Other researchers focused on investigating if data showed patterns of non-identical distribution and/or non-stationarity during matches (e.g., Dumangane, Rosati, & Volossovitch, 2009).

This area of research uses similar methods and statistical tests as research within hot hand (see below a more thorough description of hot hand). The review article of Bar-Eli, Avugos, and Raab (2006) listed 14 studies not supporting the existence of hot hand, 12 studies supporting the existence of hot hand, and one inconclusive study. A recent meta-analytic review by Avugos, Köppen, Czienskowski, Raab, and Bar-Eli (2013) showed evidence against the existence of the hot hand. As is the case for the hot hand research, also the results of studies focusing on the behavioural momentum perspective are rather inconclusive, both for individual and team sports. Klaassen and Magnus (2001), investigating 481 tennis matches played at Wimbledon, found that

winning the previous point has a positive effect on winning the current point. The deviation from independence and identical distribution is, though, smaller for better players. In line, Hughes et al. (2006), investigating eight matches of six male and six female top 40 players in squash, found that both the male and female ranked number one in the world showed significantly longer averages of peak length than players ranked lower. For women, the peak length had a high correlation with the world ranking, whereas no such result could be found for men. However, there is also evidence against momentum in individual sports. O`Donoghue and Brown (2009) analysed 13 Grand Slam matches in tennis from both the winners' and losers' perspectives: The results of the runs test turned out to be non-significant in either of the 26 data files, indicating that there are not more long runs than would be expected by chance. Further, there was no significant association between the outcome of a point and the outcome of the previous point for the winner when serving or receiving. These results indicated that there is no momentum in point sequence in elite men's tennis. Likewise, on a team level there is both evidence for and against momentum: Analysing 224 matches from three consecutive World Championships in handball, Dumangane et al. (2009) showed that the dynamics of handball violate both the assumption of independence and identical distribution. The probability of scoring was not directly dependent on the past performance of the own team, but indirectly through the opponents' past performance and the point difference between the teams' score. In contrast, the analysis of Schilling (2009) on 55 games from 16 matches from collegiate volleyball revealed that runs observed in volleyball games were a natural consequence of play involving rallies whose outcomes were affected solely by the ability of the teams and by which team that was serving. Thus, this result showed no evidence for momentum. A recent study investigating winning and losing streaks revealed that fencers were not more likely to win the subsequent point after winning the prior point (Doron & Gaudreau, 2014). However, the authors also found that winning streaks are related to changes in psychological factors (i.e., higher levels of perceived control and of task-oriented coping and lower levels of negative affectivity), but these psychological advantages were in turn not related to an increased or decreased likelihood of winning the next point.

Two conclusions can be drawn regarding research following the behavioural momentum approach: First, there is far less research done on the behavioural perspective on momentum than on the psychological perspective on momentum. Possibly, this is due to the fact that momentum has so far received most attention as a psychological experience. Second, the results found within the behavioural perspective to momentum are very inconsistent, and no clear conclusions can be made. Therefore, some authors debate if momentum is real or illusionary (Burke et al., 2003; Burke et al., 1997; Cornelius et al., 1997; Cotterill, 2013; Kerick et al., 2000; Vergin, 2000), and terms such as cognitive illusion (Gilovich et al., 1985) and misperception (O`Donoghue & Brown, 2009) in relation to forms of streakiness in

athletic performance have been mentioned. Several methodological concerns can be named that could at least partly explain the inconsistent results, such as a dominance of studies investigating momentum on a macro-level (i.e., solely focusing on games and sets won), definitions of positive and negative events that are based on researchers' judgments (compared to the judgment of the involved athletes), and a lack of studies investigating momentum on a team (compared to an individual) level. There is a need for more research in this area, optimally by taking these methodological concerns into consideration.

Momentum and related psychological variables

So far, much focus has been laid on how athletes experience PM, and how perceptions of PM change in different contexts or during the course of a competitive event. However, many researchers emphasise the importance of a range of psychological variables in addition to mere PM perceptions that change according to approaching or erasing from one's goal (Adler, 1981; Gernigon et al., 2010; Taylor & Demick, 1994; Vallerand et al., 1988), or according to prior success or failure in a competition (Iso-Ahola & Dotson, 2014). For example, the model of Taylor and Demick (1994) describes the process of momentum to develop after a precipitating event, leading to changes in cognitions, affect, physiology, and finally behaviour. Likewise, the definition of Gernigon et al. (2010) pinpoints a range of cognitive, affective, motivational, physiological, and behavioural changes that happen as a consequence of the athlete's prior history of events. These authors, thus, equal PM with changes in different psychological variables. Furthermore, some researchers investigating team momentum have focused on different team-related aspects that were proposed to alter when a team is progressing towards or regressing from its goal (Den Hartigh et al., 2014; Eisler & Spink, 1998). These psychological factors can be considered as couplings of PM that are supposed to operate as mediators or moderators in the relationship between prior and subsequent success, respectively failure (Iso-Ahola & Dotson, 2014).

Cognitive factors

Factors often mentioned by researchers investigating PM are confidence and self-efficacy (e.g., Gernigon et al., 2010; Iso-Ahola & Blanchard, 1986; Jones & Harwood, 2008; Taylor & Demick, 1994). The latter is defined as an individual's belief in his or her ability to succeed in specific situations (Bandura, 1977). Thus, self-efficacy is a more situation-specific form of self-confidence (Feltz, Short, & Sullivan, 2008). A possible path from performance to self-efficacy beliefs is assumed, in that

mastery experiences (such as performing successfully) are considered the most powerful sources of self-efficacy beliefs (Bandura, 1997). The reinforcement of positive self-efficacy by a positive turn of events is in turn considered to activate cognitive and motivational processes that elevate the intensity and level of performance. Bandura (1997) summarised that positive momentum occurs when self-efficacy and performance build on each other in an upward cycle, and conversely, negative momentum occurs when negative performance and self-doubt interact. In the view of Bandura (1997), successful streaks as they happen during momentum are thus the product of a transactional, rather than a unidirectional causation. Efficacy beliefs have been mentioned in the progression of the momentum chain as specified in the Multidimensional Model of Momentum (Taylor & Demick, 1994). These authors proposed that a precipitating event activates, among others, changes in cognitions, as, for example, self-efficacy. It is further specified that the precipitating event, depending on how the athlete experiences it, can trigger or inhibit self-efficacy beliefs.

The findings of Iso-Ahola and Blanchard (1986) showed that winners of the first set were significantly more confident about winning the next game, than were losers of the first set. In line, participants experiencing repeated success showed increased confidence over time in the study of Shaw et al. (1992). Focusing on the reaction of athletes who move towards or away from their goals, a relationship between increases and decreases in self-efficacy after success and failure, respectively, could be found in the study of Gernigon and Delloye (2003). More recent studies investigating the dynamics of PM and related psychological factors further strengthen the assumption that confidence is an important factor: Gernigon et al. (2010) found that the mean score of self-confidence was higher in the increasing scenario (i.e., when athletes are gaining momentum) than in decreasing scenarios (i.e., when athletes are losing momentum). Likewise, Briki, Den Hartigh, Bakker, and Gernigon (2012) found that self-confidence increased during positive PM. Their results further showed that confidence was found to change abruptly as soon as PM was triggered.

Bandura (1997) introduced the concept collective efficacy as an extension of self-efficacy in order to better describe the interactive dynamics of group functioning. Collective efficacy is defined as a ''group's shared belief in its conjoint capability to organise and execute the courses of action required to produce given levels of attainment'' (Bandura, 1997, p. 477). As is the case for individuals when it comes to the mechanisms of self-efficacy, it is hypothesised that teams enter a positive efficacy-momentum spiral during performance after repeated success, where positive collective efficacy beliefs lead to positive performance, which in turn further strengthens the positive beliefs about the teams' ability and enhances perceptions of positive momentum (or vice versa in a negative spiral). In a team context, the importance of vicarious experiences was emphasised: Bandura (1997) suggested that seeing significant others (i.e., teammates) performing well influenced an individual's self-

efficacy beliefs. This means that a successful teammate can impact the cognitions of another player, and in turn influence his or her affect, motivation, and effort.

Investigating the relationship between collective efficacy, respectively confidence, and momentum, Stanimirovic and Hanrahan (2004) found that manipulation of repeated success (failure), as a measure of PM, led to increases (decreases) in collective efficacy in volleyball players. In line with these findings, the study of Den Hartigh et al. (2014) also found an increase in collective efficacy in positive momentum scenario and a decrease in collective efficacy in the negative momentum scenario in competitive rowing teams. The authors proposed that the upward and downward dynamics of collective efficacy characterised the psychological experience of positive respectively negative team momentum. The study of Den Hartigh et al. (2014) further found that the decrease in collective efficacy during negative momentum was steeper than the increase during positive momentum. Investigating confidence in a team sport setting, the findings of Miller and Weinberg (1991) showed that teams coming from behind to tie score (momentum team) reported more confidence than non-momentum teams.

The fact that self-efficacy, respectively collective efficacy, and confidence are important factors in PM was even supported by results of qualitative studies, where athletes emphasised the importance of confidence for PM to develop (Briki, Den Hartigh, Hauw, et al., 2012; Jones & Harwood, 2008; Young, 2011). However, counter to the above described findings, the results of Cornelius et al. (1997) revealed that personal variables, such as trait and state confidence, were not significant predictors of neither perceptions of PM nor of performance changes. The authors explained this controversial finding with the fact that the design of the study involved investigating PM in an experimental situation, with students executing a novice task, which might have triggered less pressure than do normal competitive situations and therefore could have led to this result.

Emotional factors

Emotional factors have been highlighted in relation to PM by many researchers (Briki, Den Hartigh, Bakker, et al., 2012; Briki, Den Hartigh, Hauw, et al., 2012; Cornelius et al., 1997; Gernigon et al., 2010; Jones & Harwood, 2008; Taylor & Demick, 1994). The focus has mainly been on negative emotions, specifically competitive anxiety, and it has been hypothesised that the absence of such emotions would generate positive, and the presence of them negative momentum (Adler, 1981). Some studies could confirm this preliminary hypothesis: The findings of Gernigon et al. (2010) showed that cognitive and somatic anxiety decreased during the positive momentum scenario, but increased in the negative momentum scenario. Likewise, the results of Briki, Den Hartigh, Bakker, et al. (2012) found a decrease of

competitive anxiety during positive PM. Qualitative studies also pinpointed the importance of emotional factors: Both Jones and Harwood (2008) and Briki, Den Hartigh, Hauw, et al. (2012) listed several positive and negative emotions which are considered relevant in PM. Mostly, athletes reported positive emotions in relation to positive PM, and negative emotions in relation to negative PM. Only the study of Cornelius et al. (1997) revealed a contrary result: They found that cognitive and somatic anxiety was neither a significant predictor of perceptions of PM nor of performance change. To summarise, most research pinpoints a relationship between positive or negative momentum and corresponding emotions.

Emotions are not only important from an individual's perspective, but are also considered to be a social phenomenon (see e.g., Parkinson, 1996). Emotions are expressed and communicated to others through nonverbal behaviour, which includes cues from several modalities such as facial expressions, posture, gestures, or touch (Riggio & Riggio, 2012). In sports, typical emotions and associated nonverbal behaviours observed are, for example, pride and triumph by the player(s) who succeed, that can be displayed by raising ones' arms, or holding ones' hands in fists (Matsumoto & Hwang, 2012; Tracy & Robins, 2007), or happiness, which is proposed to be communicated through touch (Hertenstein, Holmes, McCullough, & Keltner, 2009; Hertenstein, Verkamp, Kerestes, & Holmes, 2006). Touch is very common in team sport contexts. It has been proposed 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, Huang, & Keltner, 2010). Other common emotions in sports are shame after failure, sadness after losses, or fear related with competitive events of high importance. Shame is supposed to be expressed by a combination of different body codes, such as having the shoulders slumped forward (Tracy & Robins, 2007), whereas sadness and fear are proposed to be predominantly communicated via facial expressions (App, McIntosh, Reed, & Hertenstein, 2011).

Due to the communicative function of nonverbal expressions of emotions they deserve special attention in a team sport context: For example, the concept of emotional contagion (for an overview see Hatfield, Cacioppo, & Rapson, 1994) postulates that players are influenced by a teammate's emotional expression, which in turn can have a meaningful impact on themselves, and as a consequence on group functioning (Felps, Mitchell, & Byington, 2006). For example, a player who plays well and scores celebrates this success, expressing positive emotions by showing gestures of triumph, smiling, displaying a positive body language, and encouraging teammates by giving them high fives. This positive emotional expression can then, according to the theory of emotional contagion, infect other players, who in turn also adopt a positive emotional state. Contrary, a player who is playing below his or her level and fails in attempts to score will display more hopeless nonverbal cues, which again will be noticed by teammates, and in turn influence their emotional state. The

contagion of emotional states between teammates could serve as a valuable hypothesis in how positive and negative PM develop in a team and maintains over time. However, even though the theory of emotional contagion offers many interesting avenues for the sport context in general, and PM in specific, it has only been investigated to a very limited extent: Focusing on displaying emotions through nonverbal behaviours, Moll, Jordet, and Pepping (2010) showed that celebrating successful penalty shots with behaviours such as raising both arms was associated with winning the shootout. Their findings were interpreted in terms of emotional contagion, in that teammates can transfer the emotions displayed by their nonverbal behaviours to teammates, who in turn have better odds to take a successful penalty kick. Such a process could in turn lead to an upward spiral of team performance that is comparable with positive team momentum. Totterdell (2000), investigating mood linkage between teammates in cricket, found significant associations between the average of teammates' moods and the player's individual mood and performance, thus confirming the assumption that moods can be spread within a sport team.

Emotional expressions are, though, not only noticed by the teammates (the "in-group", see Sherif, 1966), but also by the players of the opponent team (the "out-group", see Sherif, 1966). Warr and Knapper (1968) suggested that people form perceptions of others based on their nonverbal expressions. The nature of these expressions (i.e., positive or negative) influences their judgment about the opponent's ability, and in turn impact their own affective response (Warr & Knapper, 1968). A qualitative study by Ronglan (2007) indeed showed that handball players believed that positive nonverbal behaviour intensified the opponents' feeling of defeat, as commented by a player: "cheering may demoralize the opponent" (Ronglan, 2007, p. 86). Several studies support the importance of different nonverbal cues on forming an impression of opponents in different sports (Furley & Dicks, 2012; Furley, Dicks, & Memmert, 2012; Greenlees, Bradley, Holder, & Thelwell, 2005; Greenlees, Buscombe, Thelwell, Holder, & Rimmer, 2005). The study of Furley and Schweizer (2014a) showed that observers could reliably identify which team was leading or trailing based solely on the nonverbal behaviour shown by the athletes. In line, another study recently showed that, even though not knowing the actual score, athletes were more confident to beat a trailing team, and less confident to beat a leading team (Furley & Schweizer, 2014b), thus pinpointing the fact that emotional expressions of one team influence the opponent players' cognitions. These results show how revealing nonverbal expressions can be to others. In the case of impression formation, however, in contrast to the concept of emotional contagion, nonverbal emotional expressions influence the opponent team, and in the opposite way.

To summarise, the display of emotions through nonverbal behaviours during team sport matches is supposed to influence both teammates and opponents. The processes of emotional contagion within a team, as well as the fact that athletes tend to catch nonverbal cues from opponents seem to be plausible mechanisms that could, at least

partly, explain the development and maintenance of positive, respectively negative team momentum. However, so far not much research exists in this domain.

Team-related factors

A team factor that has received much attention within sport psychology is cohesion, which is defined as a force that attracts players to their team (Carron & Eys, 2012). A meta-analysis of Carron, Colman, Wheeler, and Stevens (2002) revealed a moderate to large positive relationship between cohesion and performance. Cohesion has been linked with momentum by several authors, assuming that positive and negative changes in cohesion may accompany the development of positive and negative momentum (Adler, 1981; Eisler & Spink, 1998). The study of Eisler and Spink (1998) showed that members of high cohesive teams rated their team as possessing more positive PM than members of less cohesive teams. This result confirmed the suggestion of Adler (1981) that cohesion is favourable for the perception of positive PM. However, the study of Eisler and Spink (1998) only examined positive momentum scenarios, and it must be questioned how highly cohesive teams react in negative momentum scenarios (e.g., falling behind the opponent team). Den Hartigh et al. (2014) investigated changes in cohesion at different points in time during an experimental competition. They found an increase in cohesion during positive momentum, and a decrease in cohesion during negative momentum. Interestingly, the decrease in cohesion during negative momentum was steeper than the increase in cohesion during positive momentum.

Another team-related factor appeared recently in the study of Den Hartigh et al. (2014), who investigated how interpersonal coordination is related to different momentum scenarios. Their results revealed that the quality of interpersonal coordination was higher during positive momentum than during negative momentum.

Research on team-related factors in connection with team momentum is sparse. Many areas, such as communication, team roles, and leadership behaviour have not yet been subject to empirical testing in connection to momentum, but would give fruitful insights into the complexity of team momentum. For example, it could be assumed that the role structure may change when teams are facing repeated failure, and that such a change in accomplishing one's role would give further impetus for negative performance, leading to a negative team momentum. The amount and content of interpersonal communication is another aspect that is assumed to change when teams are performing above or below their ability, and such changes in the communication between the players in turn affect individual performance and subsequent team performance. The reaction to and handling of positive and negative momentum sequences by the team captain, and his or her subsequent interaction with the team

might also have an impact on the team's performance. All those proposed mechanisms are even supposed to be highly intertwined with changes in the cognitive and affective experience of every individual athlete, revealing that team momentum is a highly complex phenomenon.

Related constructs of momentum

Hot hand

In their seminal paper, Gilovich et al. (1985) defined hot hand as the belief that a player's chance of succeeding is bigger following a hit than following a miss. Nowadays, researchers define hot hand as a belief of players and fans that after a run of successful shots, a player is more likely to succeed in the following shot as well (Avugos et al., 2013), thus pinpointing what can be called streaks in performance. Such streaks are also part of PM: PM has often been induced by streaks of positive or negative attempts in experiments (see e.g., Briki, Doron, et al., 2013; Vallerand et al., 1988). However, streaks are neither sufficient nor necessary to trigger PM because a large variety of events are supposed to precipitate the perception that one is progressing towards one's goal (Jones & Harwood, 2008; Taylor & Demick, 1994). Other differences exist between the two concepts: For example, the impact of situational variables has been proposed to play a crucial role in the development of PM (Vallerand et al., 1988), but has not been considered in research related to hot hand. The hot hand concept has mainly been developed within basketball, and most (early) research has been done within that sport. PM, on the other hand, has been discussed in many different sports, both individual and team sports. Moreover, the hot hand phenomenon is merely investigated on an individual level, whereas PM has been considered both on an individual and on a team level. The scope of investigation has been narrower in hot hand, where solely shots to the goal (respectively basket) have been in focus, whereas performance in momentum research has been defined from a broader angle. For example, PM is supposed to develop through small successes (e.g., executing an exceptional forehand or giving an excellent pass, see Young, 2011), and not necessarily only through shots to the goal. On the other hand, the behavioural perspective on momentum investigates similar claims (e.g., non-stationarity, serial correlations) and uses similar methods to analyse data (e.g., runs tests, χ^2 tests) as research within hot hand. To summarise, PM can be considered as a broader and more faceted phenomenon than hot hand, but the research methods used to investigate momentum from a behavioural perspective are very similar to the ones adopted to investigate hot hand.

Flow

Flow is a construct proposed by Csíkszentmihályi (1996) and is defined as a mental state where individuals are completely absorbed in an activity, and during that activity immersed in a feeling of full focus, full involvement, and high enjoyment. Thus, this concept seems very similar to that of positive PM. For both, the question arose whether they are a matter of automatic or controlled process. Csíkszentmihályi (1996) highlighted the distinction between actually having control, versus having the possibility to control when difficult situations arose. Within PM, some authors suggest that momentum is predominantly an automatic experience (Adler, 1981; Markman & Guenther, 2007), whereas others postulate that a feeling of control over the situation is one of the most crucial characteristics of momentum (Taylor & Demick, 1994; Vallerand et al., 1988). The latter authors also pinpoint the fact that some form of control in the situation is necessary for the inevitable evaluations of the individual regarding one's stand in relation to the pursued goal. Adler (1981) considered the beginning of momentum as a process mainly manipulated by control, but on the other hand proposed that the maintenance of momentum was liable to automatic processes. Likewise, Markman and Guenther (2007) suggested that, although precipitating events could originate either from within or outside the person, momentum subsequently operated outside of the individual's consciousness and outside of internal control.

However, PM differs from flow in some aspects. The concept of flow emphasises the total immersion in the task (Csíkszentmihályi, 1996). This total absorption in the task also excludes any thoughts or worries about oneself or time (Csíkszentmihályi, 1996), whereas individuals experiencing positive PM are hypothesised to have a representation of themselves considering past, present, and future (Markman & Guenther, 2007). PM can be experienced while being engaged in both intrinsically and extrinsically motivated actions (Markman & Guenther, 2007), meanwhile flow specifically refers to intrinsically motivated activities. Another difference is that PM is considered to include even an observer perspective (Vallerand et al., 1988), whereas flow is considered exclusively a personal experience. However, despite these differences, flow has been considered to be "an important contributor to the phenomenological experience of PM" (Markman & Guenther, 2007, p. 809).

Collective collapse

Collective collapse is another construct that is related to PM. Collective collapse has been described to happen "when a majority of the players in a team suddenly perform below expected level in a match of great, often decisive, importance in spite of normal or good start of the match or when a team underperforms right from the start of a

match" (Apitzsch, 2006, p. 38). The focus of collective collapse lies thus clearly on underperformance; whereas PM can be considered to lie on some point on a continuum from extremely negative to extremely positive performance. Collective collapse has therefore been compared with extremely negative PM (Granér, 2010).

Interestingly, the first definition of collective collapse focused solely on the performance by players experiencing a collective collapse, which is similar to the behavioural perspective of momentum. Later, Apitzsch (2009) revised this definition, including characteristics such as a loss of control which is accompanied by negative thoughts and feelings. This more recent definition thus also includes different psychological experiences that are supposed to be related to the occurrence of a collective collapse, which in turn is comparable with the psychological perspective of momentum. Based on two qualitative studies with four coaches, respectively nine handball players, Apitzsch (2009) summarised that inappropriate behaviour, failure of the role system, negative communication, a change of tactics of the opponents and goals being received are major causes of collective collapse. Lastly, Apitzsch (2009) proposed a contagion effect to be active when negative emotions arise in the team. More specifically, he mentioned emotional contagion, and the risk that individual players spread negative emotions to teammates. Even though an appealing hypothesis, it has to date not yet become subject to empirical testing.

Handball

For this doctoral dissertation, it was decided to focus on one single sport, namely handball. This decision was based on the fact that some authors have postulated that perceptions of PM are dependent on the sport context (Briki, Den Hartigh, Hauw, et al., 2012; Higham, 2000). A recent study confirmed this by showing that dynamical patterns differed between athletes of different sports (Briki, Den Hartigh, Bakker, et al., 2012). Moreover, Roane (2011) suggested that one must choose a single sport for investigating BM, as different sports involve different forms of reinforcers and adversities.

Handball is a very popular and widespread sport in Sweden. In handball, there are normally many goals during a match, and the score can shift quickly from one team to the other. This allows seeing the ebb and flow of the match, as displayed by PM, more clearly in the score, than would be the case in team sports where less goals happen (e.g., soccer). The court size of handball is 40 x 20 metres, which means that all six field-players and the goalkeeper forming one team are in reasonable distance to be able to see and communicate with each other. The last point was important for the third study of this doctoral dissertation.

Aim of the doctoral dissertation

As emerges from the introduction, PM has still to be considered an elusive concept from a scientific perspective (see also Crust & Nesti, 2006). The overall aim of the present dissertation is therefore to further study this phenomenon within the context of team sports, in specific within handball. Based on the exposition of the current state of knowledge, three main questions are addressed:

1) The debate about the existence of momentum is still unsolved, and some methodological concerns have been raised that might have led to the inconsistent results obtained so far. The first aim of the present dissertation is to investigate if momentum, defined from a behavioural perspective and measured through autocorrelation and non-stationarity, can be detected on a team level in data from elite handball matches.

2) Knowledge has been gathered about triggers and characteristics of PM from both the athletes' and spectators' perspectives, but so far no research has endeavoured to answer the question about how coaches perceive PM in their teams. Moreover, research focusing on strategies that can be implemented by teams and coaches is very sparse. A second aim of this doctoral dissertation is therefore to investigate handball coaches' perceptions of positive and negative PM in their teams. Moreover, it is further aimed at getting knowledge about what strategies that coaches consider important in the development of positive and negative PM.

3) Several psychological factors have been proposed to be related to PM that may influence the relationship between prior and subsequent success, respectively failure. For example, emotional states and their expression through nonverbal behaviour have been linked with PM. From a team sport perspective, such emotional expressions have an important impact as they may influence both teammates and opponents. However, research in this domain is sparse. The third aim of this doctoral dissertation is therefore to explore the impact of nonverbal behaviours displayed after scoring on subsequent team performance.

Research studies

Study I

Introduction and aim

Momentum is a well-known concept in the athletic community. When looking at the existing literature, two different approaches can be detected: In one perspective of momentum, which is best portrayed with the label psychological momentum (PM), focus is laid on the idiosyncratic perception of the athlete at a given point in time in the match (e.g., Burke et al., 1997). A qualitative study investigating that approach to momentum revealed that athletes reported distinct experiences for positive and negative PM (Jones & Harwood, 2008), and experimental studies showed evidence for the existence of perceptions of PM, and the fact that they do change during a match (Perreault et al., 1998; Stanimirovic & Hanrahan, 2004). However, the question if perceptions of momentum cause or result from performance changes is so far unanswered. Therefore, another perspective of momentum shifted towards focusing on observed behaviour (i.e., successful or unsuccessful attempts during a match) as an indicator for operationalising the phenomenon. Studies following this approach have, similar to research within the related hot hand phenomenon, investigated if deviations from normally expected random variations within a match could be detected. Such deviations can take the form of serial dependence (i.e., an event is dependent on the adjacent event) or non-stationarity (i.e., fluctuations in the success rate over the course of a match that exceed what is expected by chance; see e.g., Bar-Eli et al., 2006; Dumangane et al., 2009). Empirical studies testing such variations in matches revealed inconclusive results, with some studies supporting evidence for the existence of momentum (e.g., Dumangane et al., 2009), meanwhile other studies ended in non-significant results (e.g., Schilling, 2009). This exposition reveals a gap between a sport person's belief about momentum, and inconclusive results when testing the assumptions of momentum in a quantitative way. This incongruity raises the question if operational (e.g., the expected length and/or prevalence of momentum) or methodological shortcomings (e.g., the question of what actions that are underlying the analyses) have hampered the detection of momentum. The aim of this study is therefore to investigate how many per cent of

female elite handball matches show signs of momentum, and if matches include five-minute periods that exceed the expected baseline rate.

Method

A time series design with archival data that was extracted from a program called *Clientware* (Jilsén System AB) was chosen. Clientware offers data about all match events (e.g., goals, saved shots, missed passes, rule faults) from matches in the highest Swedish handball league in a timely order. Prior to the main study, a pre-study was conducted in order to investigate how players experienced different match events. The results of this pre-study were used for the main analyses.

The main analyses were based on 22 (2009/2010), respectively 21 (2010/2011), matches of the play-off round of two consecutive Swedish handball championships. All matches were analysed from the perspective of the home and the away team, thus resulting in 86 data files that were included in the analyses.

To test serial dependency, lag-1 autocorrelations were counted (Bar-Eli et al., 2006; Raab, Gula, & Gigerenzer, 2011). To investigate non-stationarity, χ^2 tests were used (see e.g., Gilovich et al., 1985). For all analyses, the significant level was set at .1, as there have been doubts about the efficiency of such tests to detect non-random patterns (see e.g., Bar-Eli et al., 2006; Miyoshi, 2000; Wardrop, 1999).

Results

For the season 2009/2010, 13.6% of the data files showed significant serial dependence with a positive autocorrelation, while 9.1% of the data files showed a significant negative autocorrelation. In 9.1% of the data files, a significant χ^2 test implied a significant fluctuation of the success rate over time. Likewise, from the 532 five-minute periods, 8.5% showed a significant result. These significant periods occurred in 16 of the 22 analysed matches (72.7%).

The results for the season 2010/2011 revealed 9.8% data files with a significant positive autocorrelation, and 4.8% of the data files with a significant negative autocorrelation. Looking at the non-stationarity analyses, the results revealed 23.8% data files with significant fluctuations during the match course. On a five-minute period level, 9.8% of the periods exceeded variations that could be assumed from random, and these significant periods happened in 15 of the 21 matches of that season (71.4%).

Taken the results of the two seasons together, it emerged that 11.6% of all data files showed a positive autocorrelation, and 7% of the data files a negative autocorrelation.

The occurrence of momentum in form of non-stationarity was 16.3%, and in total, 72.1% of all matches showed at least one five-minute period where the success rate lay significantly higher or lower than the base rate.

Discussion

Despite taking into account several methodological shortcomings from previous research, the results of this study show a low prevalence of momentum on a match level in elite handball, which was only slightly higher than could be assumed from random. The study both confirmed (e.g., Schilling, 2009) and disconfirmed (e.g., Dumangane et al., 2009) previous results from team sports. The results show how difficult it is to consistently detect momentum in match data, and further provokes the debate if momentum is real or illusionary (Cotterill, 2013; Gilovich et al., 1985). However, it has to be questioned if it is appropriate to disregard momentum just because it does not regularly appear in qualitative investigations. Most importantly, the negation of momentum would directly undermine the fact that athletes believe that momentum is a powerful determinant in athletic competitions (Cornelius et al., 1997). Moreover, it has been assumed that a bare belief in momentum can affect players' behaviour through affective and cognitive changes (Cotterill, 2013), and research within the hot hand phenomenon supports that notion (Raab et al., 2011). Furthermore, both cognitive (e.g., confidence), and emotional factors (e.g., anxiety, hopelessness) have been related to perceptions of momentum (e.g., Gernigon et al., 2010; Jones & Harwood, 2008). Such changes may be too subtle, and – contrary to the assumptions of this study – only happen on an individual level, and do therefore not necessarily lead to a change in performance of the whole team that would emerge in the results.

Another possible explanation for the difficulty in detecting momentum in behavioural data are the processes proposed by Silva et al. (1988) called negative facilitation and positive inhibition. It is proposed that several factors work against maintaining a high (or low) performance level, and that increasing effort after initial failure (Perreault et al., 1998; Stanimirovic & Hanrahan, 2004), or losing concentration after initial success (Silva et al., 1992) could lead to a performance that lies around a normal mean level. Moreover, the impact of the opponent team (i.e., changing tactics, calling time-outs) could hinder the maintenance of a team's extremely high performance. In fact, an interesting result from the present study showed that some matches even ended in a significant negative autocorrelation, which means that positive events were more likely to be followed by negative events, and vice versa. This phenomenon has tentatively been called "anti-momentum". The results of the present study thus pinpointed the fact that both match courses (i.e., one following the momentum hypothesis, and one following the anti-momentum hypothesis) existed in matches of

the highest elite level, but that most matches ended in non-significant results. One possible explanation for this result is that the sample size for the present study was too small. Another explanation could be that these processes compensate for each other within a match. In fact, the results of the present study showed that 72% of all matches contain five-minute periods of momentum. Even though this amount equalled what can be expected from a random probability model, it still showed that such significant periods existed, but that these periods probably were too short to render significant results on a complete match level. Moreover, it can be hypothesised that the strong belief that athletes have about the existence of momentum may stem from such short periods within the match. In such, the results offered a viable explanation for the discrepancy between the general belief of athletes in momentum, and the rather inconsistent results found in behavioural data.

Study II

Introduction and aim

Psychological momentum (PM), defined as "an added or gained psychological power which changes interpersonal perceptions and influences an individual's mental and physical performance" (Iso-Ahola & Mobily, 1980, p. 391), is a frequently referred concept in the athletic community. On a theoretical level, different models have been proposed that aim at explaining the onset and the development of PM in a sport context (Adler, 1981; Cornelius et al., 1997; Taylor & Demick, 1994; Vallerand et al., 1988). Of special interest for the present study is the Antecedents-Consequences Model of Psychological Momentum (Vallerand et al., 1988) that postulates a temporal distinction between antecedents, perception, and consequences of PM. On an empirical level, however, the status quo regarding PM is less clear: When using quantitative methods in order to investigate if match data show pattern of PM, the results are so far inconsistent. However, there is evidence that players, coaches, and spectators strongly believe in such a psychological force that affects performance (Cornelius et al., 1997; Hamberger & Iso-Ahola, 2004). This belief in PM is further supported by a qualitative study showing that athletes report different experiences during positive respectively negative PM (Jones & Harwood, 2008). However, so far qualitative research has focused on PM experiences of athletes (e.g., Jones & Harwood, 2008) or observers (e.g., Burke et al., 2003). To date no study exists investigating coaches' experiences, even though this has been proposed as an interesting approach (Crust & Nesti, 2006), offering an observer's perspective that is proposed to be less affectively biased than the actor's (i.e., player's) perspective (Vallerand et al., 1988). The aim of the present study is therefore to explore handball

coaches' perceptions of PM. In specific, it is investigated how coaches describe positive and negative PM in their team, and what triggers and strategies coaches consider crucial for the development of positive and negative PM.

Method

Semi-structured interviews were conducted with one female and eight male coaches that were working as main or assistant coach with a team in the highest female handball league in Sweden in the season 2008/2009. An interview guide, based on previous literature (Vallerand et al., 1988), the interview guide used by Jones and Harwood (2008), and insights from a pilot study with two male elite handball coaches, directed the interviews. Specifically, coaches were asked how they characterise their teams in positive and negative PM, and what triggers and strategies they perceived to heighten the chances/risks for their team to end up in positive/negative PM. The interviews resulted in 146 pages of transcribed data that were analysed using a qualitative content analysis (Elo & Kyngäs, 2008; Hsieh & Shannon, 2005). Trustworthiness was checked with three different methods.

Results

Coaches' answers about triggers of positive PM were divided into four categories: confidence, players' individual factors (including players' attitude, personality, behaviour, and motivation), team factors, and team-opponent factors (which refer to either the own players' excellence or opponent players' mistakes). Moreover, the coaches perceived different strategies to be useful for developing positive PM during the match: Strategies applied by coaches included among others to give players positive feedback or to make tactical changes at the right point in time. A plethora of strategies that were considered useful for players and teams were proposed by the coaches, such as preparing well for the matches, having game plans and goals for the match, and showing positive reactions within the team. When describing their teams in a positive PM, the coaches' answers focused on behavioural factors (e.g., high activity level), cognitive factors (e.g., having a high focus), confidence, positive emotions, and team factors (e.g., clear role distribution). From the analyses of the coaches' answers about triggers of negative PM emerged five categories: coach factors (e.g., the coach being passive), confidence, external factors (e.g., referee decisions), team factors, and players' individual factors. The analyses of the coaches' answers revealed that both unsuccessful coaching strategies (e.g., unsuccessful substitution), and strategies that were unbeneficial (e.g., focus on results) or not used by or available to the players (e.g., not having made game plans, not knowing strategies that potentially can change the situation) can lead a team into negative PM. The coaches'

answers about characteristics of negative PM could be categorised into behavioural factors (e.g., negative body language), cognitive factors, confidence, emotional factors (e.g., negative emotions), and team factors (e.g., not taking responsibility).

Discussion

The results revealed different behavioural aspects that were considered important for PM. Interestingly, coaches described positive and negative PM with performing successfully, respectively unsuccessfully, but they even considered unsuccessful actions to be a trigger of negative PM. This result raised the question if (un)successful actions resulted from a positive respectively negative PM, or if (un)successful actions cause perceptions of PM. The link between behaviour and PM gets even more complex when considering the impact of the opponent. The results of the present study revealed that coaches considered the performance of the opponent as an important trigger for positive and negative PM, which thereby supports several authors that stress the impact of the opponent for the onset and development of PM (Bandura, 1997; Taylor & Demick, 1994).

Coaches perceived signs of high, respectively low, confidence in players as both a trigger and a characteristic of positive, respectively negative, PM, thereby confirming another study with soccer players (Jones & Harwood, 2008). Self-efficacy, which is commonly defined as a situation-specific form of confidence (e.g., Feltz et al., 2008) and possibly a more appropriate concept in the context of a competitive match, has been considered as both an antecedent (e.g., high efficacy beliefs enhance performance due to higher effort) and an outcome of success (i.e., mastery experiences as the most powerful source of self-efficacy beliefs; see Bandura, 1997). Merging the aspect of self-efficacy with the above mentioned behavioural aspect, it can be hypothesised that performing well increases self-efficacy for the next tasks, triggering willingness to put in full effort, which in turn heightens the chances for further success in an upward cycle (or vice versa in a downward spiral).

As could be anticipated, and in line with the study with soccer players by Jones and Harwood (2008), coaches connected positive PM with positive emotions, and negative PM with negative emotions, while the latter even were considered to be a trigger for a team to end up in a negative PM. Expressing emotions needs special attention in a team sport context, as such expressions are assumed to have a powerful impact on teammates (Felps et al., 2006) through a mechanism called emotional contagion (Hatfield et al., 1994). This mechanism could serve as an interesting explanation for the mechanisms underlying PM: Players expressing strong emotional states may infect their teammates with similar emotions and thereby increase the chance, respectively risk, for the team to end up in a corresponding PM.

Several team factors emerged from the coaches' answers to be important for the onset and the development of PM, such as (not) sticking to one's role and (not) taking responsibility, individualism, and egoism. Both role distribution and taking responsibility have been considered important factors for team functioning (Felps et al., 2006; Steiner, 1972), and it can be hypothesised based on the current results that such factors are most likely important for the development of PM in sport teams.

The coaches mentioned a plethora of strategies for both themselves (e.g., using positive reinforcement, making correct judgments and decisions regarding the match) and players and teams (e.g., being well prepared for the match, setting goals for the match, regulating one's arousal). Interestingly, the strategies mentioned by the coaches are commonly known for performance enhancement with only few being specifically dealing with PM, which raises the assumption that there is a rather vague difference between trying to control PM and traditional performance enhancement.

The results of the present study clearly revealed that PM is a complex phenomenon. It can be assumed that PM is not a linear process as suggested in existing PM models (Taylor & Demick, 1994; Vallerand et al., 1988), but is better portrayed as a circular process with behavioural, emotional, and team factors and confidence influencing each other reciprocally. This assumption is in line with the model presented by Adler (1981), and is also more recently postulated by Gernigon et al. (2010) who advocated the dynamical system approach.

Study III

Introduction and aim

Nonverbal behaviours, as they are shown after successful trials in team sport matches (i.e., nonverbal post-shot celebrations), are an important area of investigation. Such nonverbal behaviours can have an impact on the emotional state of the athlete him- or herself through internal feedback loops (see e.g., Price, Peterson, & Harmon-Jones, 2012), but may also influence others: For example, it is postulated that players form perceptions of the opponent based on nonverbal cues, which in turn influence their judgment about the opponent's ability, and finally their own affective response (Warr & Knapper, 1968). Moreover, teammates are affected by the emotions shown by a player through a mechanism called emotional contagion (Hatfield et al., 1994). The latter has been proposed to influence the development of PM (Moesch & Apitzsch, 2012), and there is evidence that nonverbal behaviours and PM are connected to each other (Adler & Adler, 1978; Jones & Harwood, 2008; Young, 2011). PM is defined from a dynamical system approach, and focus is laid on the importance of both

situational and individual factors. The individual variable in focus is the display of affective responses through nonverbal behaviour. The situational variable in focus is the history of events, which represents the team's previous performance in the match. The most important question in elite sports is how PM and nonverbal behaviour are related to subsequent performance. Regarding PM, there is a strong belief in athletes that PM affects performance (Cornelius et al., 1997), but existing findings are contradicting. Only little research has been done investigating the impact of nonverbal behaviour on performance. This is due to the fact that no coding scheme exists that offers a reliable and valid way of assessing nonverbal behaviours in athletes during matches. Moesch, Kenttä, and Mattsson (2015) have tackled this issue by recently proposing a coding scheme that includes gestures and touch. Based on a PM framework, the present study investigates the relationship between the team's history of events, nonverbal behaviours in the form of gestures and touch by the shooter after scoring, and subsequent team performance during ongoing handball matches.

Method

Systematic observation was chosen as the design for the study. Eighteen high stake matches from the women's highest handball league in Sweden were filmed exclusively for the purpose of this study. These 18 matches resulted in 616 coding situations that include the complete sequence from the moment the player scores until she is back in her defence position. The coding situations were analysed using the "Handball Post-Shot Behavior Coding Scheme" (H-PSB-CS) proposed by Moesch, Kenttä, and Mattsson (2015), that includes gestures and touch. Data coding consisted of registering all behaviours shown by the shooter during the coding situation. The amount of all behaviours in the category gesture, respectively touch, was aggregated within each five-minute period, resulting in a mean value for each team's nonverbal post-shot celebrations for gestures, respectively touch. Additionally, the relative performance of both teams in each five-minute period was assessed. The relative team performance reflects the amount of goals done in a specific period minus the amount of goals done by the other team, and is not related to the overall match score. Of importance for the present study were the performance of the team in 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). To estimate the contribution of the predictor variables on the criterion variable, multiple regression analyses using the Enter method were performed.

Results

Prior performance was a significant predictor ($\beta = 0.14$) for gesture ($F(1,335) = 6.70$, $p < .05$), 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. For touch, the model was not significant and prior performance was a non-significant predictor. Both the amount of displayed gesture and touch were not significant predictors for subsequent team performance.

Based on literature on PM, 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 team performance. Regression models were calculated where prior, respectively current, team performance, one of the variables on nonverbal post-shot celebrations (gesture or touch), and the respective interaction of the two variables were predictor variables, and subsequent team performance the criterion variable. The findings revealed significant coefficients for the interaction variables touch and prior team performance ($\beta = 0.14$, $p < .05$) and touch and current team performance ($\beta = 0.14$, $p < .05$). However, the regression models were in both cases slightly above the significant threshold (model with prior team performance: $F(3,304) = 2.21$, $p > .05$; model with current team performance: $F(3,304) = 2.19$, $p > .05$), and the amount of explained variance in both models was small. The findings showed that low prior (or current) team performance (i.e., a negative history of events) and a low amount of displayed touch by the shooter were related to positive subsequent team performance, while high prior (or current) team performance (i.e., a positive history of events) and a high amount of touch were related to positive subsequent team performance. Performing well, but displaying only a low amount of touch was related to poor subsequent team performance. Finally, poor prior (or current) performance while showing a high degree of touch predicted poor subsequent team performance. The results for the two models including gesture, as well as the interaction variables, were non-significant.

Discussion

The results showed that prior team performance predicted the amount of gesture shown by the shooter after scoring. A possible explanation for this result is that good team performance enhances athletes' feeling of pride, an emotion generally displayed through gestures (see Tracy & Robins, 2007). The results further revealed that the amount of gesture or touch displayed by the shooter after scoring did not significantly predict subsequent team performance. This means that celebrating goals in general cannot be considered a sufficient strategy to enhance a team's performance, which is

contrary to qualitative research (Moesch & Apitzsch, 2012; Ronglan, 2007), and a quantitative study on touch (Kraus et al., 2010). However, the amount of displayed touch is related to subsequent team performance when the team's history of events is taken into account: Displaying much touch after scoring in periods with good team performance, and displaying little touch after scoring in periods with poor performance are related to positive subsequent team performance. Meanwhile, a high amount of displayed touch during bad periods, and a low amount of displayed touch during good periods are related to negative subsequent team performance. In such, the player's display of touch should be matching the team's performance: Good performance should be celebrated with much touch, and poor performance with little touch, otherwise the team risks negative subsequent performance. This finding can be discussed in light of several theoretical frameworks, for example cognitive dissonance (see Festinger, 1957), emotional dissonance (Middleton, 1989), or emotion regulation research (see e.g., Richards & Gross, 2000).

One interesting fact in the current finding is that no matter if the history of events is defined as the five-minute period before, or the ongoing five-minute period, the analyses revealed the same result, which can be considered as a replication. Moreover, together with the finding that prior team performance predicted the display of gesture, it emphasised the importance of this situational variable when team performance during ongoing matches is investigated.

Interestingly, the finding with the interaction variables only emerged for the analyses with touch, but not for the analyses with gestures. Possibly, celebrating with touch leads to more emotional contagion in teammates than celebrating with gestures. Or, touch does simply help teammates to feel more united.

The results give raise to the assumption that the display of touch after scoring might be a possibility to maintain positive PM, which is in line with the statement of Adler and Adler (1978) that the display of emotions is a means of maintaining PM. A possible strategy for the applied work would be to make team athletes more attentive to this form of celebration, and to teach them when it is most beneficial to use it. However, teams that are in periods with poor play should be encouraged to keep their attention to specific technical or tactical behaviours, and should not lose their time with celebration behaviours.

When making inferences from the results of the present study, it should be kept in mind that the effect sizes were small. On the other hand, already small effects can make a difference in elite sports where the marginal between winning and losing is minimal.

General discussion

Momentum is a common concept in sports. It has been defined from a psychological perspective by focusing on the individual's perceptions, cognitions, and emotions (see e.g., Gernigon et al., 2010; Vallerand et al., 1988), and from a behavioural perspective by emphasising overt behaviours (e.g., successful points) shown by the athlete (see e.g., Hughes et al., 2006; Roane, 2011). Psychological momentum (PM) has received most attention when it comes to individual athletes; meanwhile the definition and conceptualisation of team momentum is trailing. Since the beginning of the 1980s, several models have been proposed with the aim to better conceptualise this complex phenomenon. Moreover, research has been conducted on different aspects of momentum, though with results that still are inconsistent and difficult to unite into a bigger picture (see e.g., Cotterill, 2013). Thus despite the increased knowledge, describing and understanding momentum remains a challenge and momentum still has to be considered an elusive concept that needs further investigation (Crust & Nesti, 2006; Mack et al., 2008). The aim of this doctoral dissertation is therefore to shed further light on specific aspects of momentum.

The results of Study I revealed that momentum occurred to a low degree when analyses were made on a match level. This result both confirmed (O`Donoghue & Brown, 2009; Schilling, 2009) and disconfirmed (Dumangane et al., 2009; Hughes et al., 2006; Klaassen & Magnus, 2001) previous research, and questioned if momentum regularly happens on a match level. However, it seems too simplistic to call the phenomenon an illusion (Gilovich et al., 1985) or misperception (O`Donoghue & Brown, 2009), due to several reasons: Already in the beginning of momentum research, Adler (1981) stated that it was not decisive for the development of momentum if it really occurs, but much more if it is *perceived* to occur by the subject. It has been argued that the pure belief in momentum is powerful enough to affect behaviour through influencing players' cognitive and affective responses (Cotterill, 2013). Vallerand et al. (1988) postulated that "perceptions of PM are subjective, and as such may not be representative of the real world. However, whether based on objectivity or not, these perceptions have real consequences for the person who holds them" (p. 94). In fact, studies within the related hot hand phenomenon revealed behavioural changes as a result of a hot period: Raab et al. (2011) showed that the bare belief in hot hand significantly affected subsequent behaviour, specifically by passing to the players who were supposed to have a hot hand. Csapo,

Avugos, Raab, and Bar-Eli (2014) reported that players chose more difficult, respectively easy, shots, the more consecutive shots they made, respectively missed. Interestingly, also coaches' behaviour was found to be influenced by the hot hand belief: Csapo, Avugos, Raab, and Bar-Eli (2015) found that coaches increased the defensive pressure significantly more often on players that were considered hot.

Moreover, looking at the results of Study II, it emerged that the interviewed coaches (and participants in other studies, see e.g., Jones & Harwood, 2008) had very specific and detailed perceptions of their teams being in a positive or negative PM, respectively, and they listed very differing factors for triggers, characteristics, and strategies for these two states. Even though not directly confronting the coaches with the question whether PM actually existed, the results of Study II implied that the coaches had a very clear perception of positive and negative PM as two different states that could occur during matches.

Another fact to question if momentum is solely an illusion stems from the results of Study I that showed that in nearly three quarters of the matches, five-minute periods existed where the success rate of the team significantly differed from baseline. Based on that result, the conclusion can be drawn that momentum might not be a phenomenon that lasts for a complete match, but that it rather happens during short periods within a match. Interestingly, Cornelius et al. (1997) argued differently, stating that positive and negative performance fluctuations are quickly labelled as momentum when in fact they are solely normal variations around a mean performance. These authors suggested that a more interesting approach would be to investigate how "a true momentum effect" (p. 484) was maintained over a longer period (without, though, further specifying a time frame). For example, they suggested investigating which factors were responsible for resisting to the forces that draw back performance to a mean level (i.e., opponents' reaction, negative facilitation, positive inhibition). Cornelius et al. (1997) thus argued that true momentum lasts for a relatively long period, but that the term has been misused by quickly naming short above-mean performance as positive, and short below-mean performance as negative momentum. In contrast to that view, Iso-Ahola and Dotson (2014) postulated that PM is short-lived and temporary in nature, and also considered PM to happen on an infrequent basis only. The results of Study I confirmed this latter view, revealing that in reality, short periods of momentum actually happen during matches, meanwhile only few long lasting momentum periods (i.e., lasting for a complete match) could be found in the investigated handball data. Based on these reflections, it is proposed that future investigations on momentum further try to specify in which time perspective momentum is likely to happen. Information about the length of momentum is not part of any of the existing definitions, and has neither been specified in the existing models, nor investigated in research done so far on the topic.

An interesting, yet unexpected result from Study I revealed that some few matches even showed a negative autocorrelation, which implied that positive events were more likely to be followed by negative events and vice versa. This phenomenon was tentatively called anti-momentum. One possible way of explaining this result stems from the processes called negative facilitation (performance increase after failure) and positive inhibition (performance decrease after success; Silva et al., 1988). According to these authors, these processes work against maintaining a high, respectively low, performance level (i.e., positive or negative PM). Referring to the predictions made within BM (Nevin, 1996), anti-momentum could be explained by the fact that many disruptors break the flow of reinforcers, and such a constant change between reinforcers and disruptors led to the negative autocorrelation in the analyses. Looking at the results of Study II, such periods of anti-momentum might be a result of a rapid change of triggers of positive and negative PM within one team, or a change of positive triggers between the opposing teams. In such, being confident, having a high level of communication, and being highly motivated (which are possible triggers for positive PM), might be abruptly stopped by a questionable referee decision or exceptional performance of the opposing team (which are possible triggers for negative PM), and in turn offer the other team the possibility to level out performance. The impact of the opponent has been emphasised by different authors (e.g., Cornelius et al., 1997; Taylor & Demick, 1994). It can be assumed that when a team performs above average, the opponent team will automatically try to counteract the other team's advantage, for example by changing tactics, increasing effort, or taking a time-out. Raab et al. (2011) highlighted this issue within hot hand, arguing that the hotness of a player might not be observable due to increased efforts in the defence of the opposing team.

The results of Study II revealed that positive and negative PM were characterised by factors regarding behaviour, cognition, confidence, emotions, and team factors. The results of Jones and Harwood (2008) also contained the four first mentioned factors, but did not specifically mention team-related factors. Also the results from a qualitative study with athletes from individual sports are comparable: Briki, Den Hartigh, Hauw, et al. (2012) summarised their findings about contents of PM into four different areas, of which three – affects and emotions, cognitions, and behaviours – were similar to the results of Study II. In contrast, their findings also revealed perceptions of PM as the fourth content that characterised PM, which has not been mentioned by the coaches that were interviewed in Study II. Novel with the results of Study II is the focus laid on team-related issues. Neither the study done on team athletes from Jones and Harwood (2008), nor current models of PM take into account the impact of team-related issues, as for example cohesion, team roles, or communication. This is interesting, as specific team-related factors clearly emerged from Study II to be observable in both positive and negative PM. Likewise, the importance of team-related factors, such as a failure of the role system and negative

communication, emerged as major causes for collective collapse in a qualitative study of Apitzsch (2009). Based on these insights, it seems important to include such team-related factors in future models, definitions, and empirical studies on PM.

The results of Study II further revealed that triggers for positive PM were categorised into confidence, players' individual factors, team factors, and team-opponent factors, whereas triggers for negative PM related to coach factors, confidence, external factors, players' individual factors, and team factors. Many of the emerged categories were also highlighted in the study of Jones and Harwood (2008), who did, though, again not mention team-related factors as possible triggers for PM. The results of Briki, Den Hartigh, Hauw, et al. (2012) offered a different approach: They divided their themes into dissonance, consonance, and fear of winning, and they suggested the first factor to be a trigger of both positive and negative PM, and the last two factors to be triggers of negative PM. By doing so, they did not provide a detailed description of specific events and states that might trigger PM as did Jones and Harwood (2008), and as was done in Study II. In contrast, they stayed on an abstract level and proposed more general mechanisms that trigger PM.

It has been questioned if one single factor is enough to start PM, or if several factors need to be activated to develop PM: Young (2011) concluded that sometimes a single event prompted instantaneous perceptions of PM, while at other times it was the culmination of several events or components of performance that triggered athletes' perceptions of PM. Burke et al. (1997) concluded that it was most often a combination of events that triggered PM. The recently proposed conceptualisation of Iso-Ahola and Dotson (2014) considered initial success as a trigger for PM, and further distinguished between intensity, frequency, and duration effects of initial success. Intensity effects refer to how great the initial success is perceived as, frequency effects refer to how often and close-by successes are, and duration effects are a combination of intensity and frequency effects over time. This view thus postulates that the more triggers (i.e., success) that an athlete experiences, the more likely is the chance to end up in PM, but that also one single trigger that comes with a big bang effect might initiate PM. Neither Study II, nor the study of Jones and Harwood (2008) further investigated if several triggers are needed to start PM, or if one trigger would be enough. An important aspect in connection with triggers has been raised by Taylor and Demick (1994): They pinpointed the fact that the individual's idiosyncratic perception of a specific trigger was important, and that the same trigger may not lead to the same consequence for different athletes. However, that issue could not be targeted in Study II, as participants were coaches and not athletes. Taking that argumentation into account, one should be careful to claim certain triggers to inevitably start PM, as the individual's interpretation of the situation is decisive. Moreover, there is still no consensus on whether one or several triggers are needed to start positive or negative PM.

A lack of knowledge on strategies to develop, maintain, or overcome PM has been expressed, followed by a call for more applied research (Jones & Harwood, 2008). Study II addressed that topic. A plethora of strategies emerged that were considered beneficial for increasing chances for positive PM, but also some strategies that seemed to increase the risk for a team to end up in a negative PM. The strategies proposed by the coaches showed many similarities with the ones proposed by the athletes in the study of Jones and Harwood (2008). However, probably due to the different participant perspectives (athletes versus coaches), the results in Study II also revealed specific strategies that coaches can adopt, whereas the study of Jones and Harwood (2008) solely focused on individual and team strategies. Another difference is that Jones and Harwood (2008) differentiated between maintaining positive and overcoming negative PM, whereas the results emerging from Study II clustered around strategies that could either increase the chance for positive PM, or increase the risk for negative PM. Interestingly, most of the strategies proposed to increase the chances of positive PM are commonly applied in the context of performance enhancement (e.g., creating optimal arousal levels, goal setting, match preparation), and only few strategies were specifically dealing with PM (e.g., educate players about the phenomenon, learn from previous PM experiences). Taking that difference into consideration, Briki, Moesch, and Chtourou (2014) differentiated "general psychological strategies" and "PM-related strategies" when writing about possible strategies that taekwondo players can use to deal with PM.

In general, the results emerging from Study II showed many similarities with the study done with soccer players by Jones and Harwood (2008). In such, persons involved in team sports, no matter which, and no matter if as players or coaches, describe the phenomenon in a similar way, which suggests generalising the results obtained in Study II to similar team sports.

Study II showed that emotional states and their expression through nonverbal cues were an important part in PM. For example, the coaches interviewed in Study II referred to negative body language and anxiety and stress as triggers for negative PM, and described negative PM as a state where players showed negative body language, hopelessness, fear to fail or succeed, and other negative emotions. Similarly, athletes that experience positive PM are considered to show positive body language, positive emotions, and a positive climate within the team. Perceiving negative body language in opponents (as a trigger for one's own positive PM) and showing negative body language (as a trigger for one's own negative PM) were also raised by Jones and Harwood (2008). These authors recommended sport psychology consultants to actively work with body language for situations where negative PM is perceived. The results from Study II further revealed that the coaches considered high engagement from substitutes and showing positive reactions within the team as strategies that increased the chances to end up in a positive PM. Also Young (2011) pinpointed the importance of teammates showing positive reactions, such as clapping and cheering,

or providing energy off the bench, as cues for an individual player to identify positive PM. The results of Jones and Harwood (2008) are less concrete, mentioning more general encouragement from different persons (such as teammates and coaches) as team strategies to develop and maintain positive PM, and to overcome negative PM. These results, together with the knowledge that nonverbal behaviour influences opponents' impressions (Warr & Knapper, 1968) and teammates emotional state (Hatfield et al., 1994), raised the assumption that nonverbal behaviours may have a crucial impact for PM.

Study III revealed contradicting findings regarding the above-mentioned issues: Neither gestures nor touch displayed by the shooter after scoring significantly predicted subsequent team performance. That result contradicted the coaches' view from Study II and the result found by Ronglan (2007) showing that handball players generally think that celebration behaviours are positively related to subsequent performance. However, the results of Study III showed that the interaction between the history of events and the displayed amount of touch by the shooter after scoring significantly predicted subsequent team performance. More specifically, in successful periods (i.e., during positive PM), the display of much touch by the shooter following goals is positively related to the team's performance in the next period. Likewise, in unsuccessful periods (i.e., during negative PM), displaying little touch is related to positive performance in the subsequent period. On the other hand, teams that played a successful period but only displayed little touch after scoring, or teams that have played poorly but displayed much touch after scoring had an increased risk for negative performance in the subsequent period. In such, consonance between the outcome of the played period and the shown emotional reactions seems most beneficial for positive subsequent team performance. Based on this result, the strategy mentioned by the coaches in Study II must be adapted: Showing positive reactions in the form of celebrations with touch seems to be a good strategy to increase the chances for subsequent good performance when a team is performing well. But showing positive reactions in the form of touch when a team is in a negative period increases the risk for subsequent negative performance. In other words, the results from Study III nurture the assumption that it is possible to maintain positive PM by showing much touch, but that it is not possible to overcome negative PM by showing much touch. Interestingly, the result was only significant when the interaction between history of events and touch, but not gesture, was analysed, thus suggesting that touch has a higher impact on team performance than gesture. One possible explanation is that touch – as opposed to gesture which is an individual way of showing one's own achievement – is a more social form of celebrating by sharing positive emotions with others. Potentially, the social form of celebrating with touch leads to more emotional contagion in teammates. Or, touch simply helps teammates to feel more united. In fact, several authors pinpointed the positive impact of touch in a team context: For example, touch is a means of positive reinforcement, fosters

intimacy, encourages compliance, communicates liking, and is vital to trust, cooperation, and group functioning (Hertenstein et al., 2006; Kraus et al., 2010). Again, this result challenges the statement of the coaches in Study II, saying that showing positive emotions is a good strategy to create positive PM: Based on the result of Study III, only one of the two investigated channels of emotional expression, namely touch, has such a positive impact.

Another finding of Study III showed that prior performance was positively related to the degree of gestures in the following period. Athletes displayed many gestures when having been in a positive period (i.e., positive PM). Gestures are commonly considered to be an expression of pride (see Tracy & Robins, 2007). Interestingly, no such relationship was found for touch. The result partly supported the assumption of the dynamical system approach on PM, emphasising the importance of previous match events on the psychological state of the athletes. In fact, it seems obvious that athletes do not act within a vacuum, going from one match event to the next with a reset mind, but are influenced by the outcome of previous match events. For future studies and further development of PM models, it seems warranted to focus on history dependence instead of conceptualising PM as a linear phenomenon that develops through different stages from the start until the end.

For the applied work, the results of Study III have several implications. For example, it can be advised to coaches and sport psychology practitioners that focus should be laid on teaching athletes how to optimally exploit periods of positive PM, namely by celebrating with much touch following goals. This would go in line with the statement done by Adler and Adler (1978), and also strengthen the results of Study II (i.e., where showing positive reactions emerged as a strategy to develop positive PM). However, the results of Study III also revealed that it is more beneficial to show little touch following goals when having been in an unsuccessful period. In case a team finds itself in a period with poor play, players should be encouraged to focus on the task at hand instead of celebrating goals. For example, teams could elaborate different game plans that can be adopted in times of poor play, and that help them to focus on specific technical or tactical behaviours. Coaches could support athletes by pinpointing specific behaviours that are under the athletes' control, and help them build up positive PM through small successes.

Even though the results of Study III ended in small effect sizes, several points need to be acknowledged that increase the impact of these findings: The design adopted in Study III, rather unique in sport psychology research, offers high ecological validity that excels experimental designs that are detached from what is happening on a court in an important match. Moreover, behavioural observation studies investigate what players actually *do* in high stake matches. Many other designs (e.g., interviews or questionnaires) depend on players' or coaches' belief of what they did, or on reports of their thoughts and feelings in important stages of a game, but these insights might

be highly biased by the outcome of the respective game or the overall performance of the team at the point of investigation. Above all, the most important outcome in sports is overt behaviour, wherefore behaviour-focused research should be encouraged in sport psychology.

Limitations

It has to be acknowledged that all studies include several limitations that need to be considered when inferences are made. Those limitations are discussed in detail in the respective articles, and therefore, only some overall issues are raised more thoroughly.

One of the more severe limitations is the issue of situation specificity, which has emerged from Studies I and III. Vallerand et al. (1988) pinpointed the fact that situational variables play a crucial role in the development of PM. These authors stated that "… making three steals in a row in basketball while you are winning by 30 does not greatly affect PM perceived in the situation. However, three steals in a row to tie the score is a different situation." (p. 95). Based on that, the ACM (Vallerand et al., 1988) claims that situational variables and personal variables interact to form perceptions of PM. Similarly, contemporary approaches of PM based on the dynamical system approach also emphasise that the ongoing history of events is an important factor for the development of PM (e.g., Briki, Den Hartigh, et al., 2014; Gernigon et al., 2010). Therefore, it seemed an important step to incorporate such variables in Study III, where it was specifically taken into account if a team had been in a positive or negative period. However, even in Study III it can be argued that other factors may interact and bias the results. For example, no information is available about the actual score in the match, the importance of the match, and the exact point in time of the match. These three factors were analysed and found to be correlated with the amount of nonverbal behaviour (Moesch, Kenttä, Bäckström, & Mattsson, 2015). Also other match-related factors, as for example injuries of teammates, coaches´ inputs, and halftime breaks, might have changed the psychological experience of the athletes and could have biased the results. However, it has to be recognised that team sport matches are incredibly complex making it unrealistic to rule out all possible biases.

Another limitation that has to be acknowledged when making inferences from Study III is the fact that the coding scheme described by Moesch, Kenttä, and Mattsson (2015) has not yet been used by other research groups. This is due to the fact that it has only very recently been published. It can be hoped that other researchers will test it in the near future. This would strengthen the method used in Study III.

Future research

The three studies of the present dissertation revealed some interesting results; however, many new questions have arisen. One interesting line of investigation would be to merge the behavioural and psychological perspective of momentum. To do so, behavioural data similar to the data in Study I need to be gathered. Simultaneously, players and/or coaches need to be interviewed about their perceptions of PM during a match. This could for example be done by using video-assisted recalls and self-confrontation interviews (e.g., Lix & Lièvre, 2010). Such data could then be compared to investigate if the results of the behavioural data and the results of players' or coaches' perceptions of PM match, which would mean that perceptions of PM develop simultaneously when match data show deviations from baseline performance. This design would further offer to explore if the players of one team perceive PM at the same time, which would strengthen the assumption of team momentum.

Study III offered some evidence for the importance of celebrating goals when in a good period, respectively not celebrating goals when in a bad period. Study II revealed a plethora of strategies that can be used by teams and individuals who want to exploit PM to their own advantage. However, none of these suggestions have been confirmed in applied studies. Therefore, it is necessary to conduct intervention studies testing if specific strategies lead to changes in players' experiences of PM, and ultimately in their performance.

The present dissertation sheds more light on the impact of nonverbal behaviours and emotional expressions, considered essential ingredients of PM, on performance. However, it would be of interest to investigate other PM-related psychological variables. In specific, research within PM focusing on team factors is very sparse. Study II revealed a plethora of possible team-related factors that coaches considered triggers and characteristics of PM. Future research could focus on obtaining more knowledge about such factors: An interesting research question, for example, would be to investigate if the role behaviour of team players changes during different stages in the match. Likewise, exploring if the amount of verbal communication differs during positive and negative PM would offer important insights. Such knowledge would be specifically useful for sport psychology consultants in order to set up interventions aiming at increasing the chances for a team to get into a positive PM.

Conclusions

- Momentum has been defined from a psychological and a behavioural perspective. Several terms have been used in the domain (momentum, psychological momentum, behavioural momentum), but these terms are not used stringently in the existing literature.
- When looking at the behavioural approach, the results from existing research are inconsistent and there are discussions about whether momentum is real or illusionary. The findings of Study I give rise to believe that momentum is not a phenomenon that lasts for complete matches, but that momentum develops in short periods in a match where one team performs significantly above or below its normal performance.
- From a psychological momentum perspective, studies have shown that athletes and spectators report different characteristics for positive and negative PM. Study II offered a new approach by investigating coaches' perceptions of PM in their teams. Positive and negative PM were characterised by factors related to behaviour (e.g., body language), cognitions (e.g., focus), confidence (e.g., (not) believing in oneself), emotions (e.g., positive emotions, hopelessness), and the team (e.g., communication, roles). Moreover, the interviewed coaches mentioned several possible triggers of positive and negative PM. However, the question is so far unsolved if one or several triggers are needed to start PM.
- To date, applied recommendations about PM that can be used by coaches and sport psychology practitioners when working with teams are sparse. The results from Study II revealed a plethora of potential strategies for individual players, the team, and coaches for developing positive PM. Interestingly, many of those strategies are commonly used for performance enhancement, and only few PM-specific strategies emerged.
- Nonverbal behaviour has been mentioned as both a trigger and characteristic of PM, and is considered an important channel for expressing emotions. Important for social interactions is the fact that displayed emotions can spread to others, a mechanism called emotional contagion. Emotional contagion is assumed to be related to the development of PM.
- Study III confirmed that the history of events, i.e., how the match develops for a team, has an important impact on the emotional reactions of the athletes and on subsequent performance. This variable should be emphasised when research is done on phenomena such as PM that investigate intra-individual or intra-team performance changes during a match.

- In contrast to the coaches' belief raised in Study II, stating that showing positive reactions in teammates would be a good strategy to create positive PM in a team, the results of Study III revealed that the amount of displayed gesture or touch by the scorer did not significantly predict subsequent team performance. However, the amount of displayed touch after scoring predicts subsequent performance when the history of events is taken into account. In short, consonance between the history of events and the display of touch is needed (e.g., good performance and much touch, or poor performance and little touch) in order to increase the chances for positive subsequent performance.
- The results of the studies included in the present doctoral dissertation underline that PM, and team sport matches in general, are very complex in nature, thus supporting the assumptions of several models of PM. This complexity renders investigation of the phenomenon in question very difficult, and diminishes the chances of getting results with large effect sizes.

Svensk sammanfattning

Psykologiskt momentum i handboll

Avhandlingen handlar om ett fenomen som det ofta refereras till inom sporten, nämligen ”psykologiskt momentum” (PM)[2]. På svenska, jämfört med engelskan, är den termen inte så vanlig, utan man refererar då ofta till fenomenet med att säga att ”man har flyt” eller ”man har oflyt”. Fastän det är ett fenomen som många idrottare, tränare, kommentatorer och journalister ofta nämner, så är det fortfarande ganska oklart definierat utifrån ett vetenskapligt perspektiv.

PM kan beskrivas som en kraft som leder till att man antingen närmar sig, eller avlägsnar sig från sitt mål (som oftast är att vinna). När allt går bra och man närmar sig sitt mål, så talar man om positivt PM. Händer dock motsatsen att man misslyckas med allt man än gör och förtvivlat försöker utan att lyckas och man därmed avlägsnar sig från sitt mål, så pratar man om negativt PM.

På grund av problematiken som existerar i detta område kring termerna föreslår jag en uppdelning i två olika perspektiv av momentum. Ett som siktar på att fånga fenomenet utifrån ett psykologiskt perspektiv, som refererar till idrottarnas individuella upplevelser (t.ex. tankar, känslor) när de befinner sig i positivt eller negativt PM. Dessutom kan fenomenet definieras utifrån ett beteendeperspektiv. Här avgör själva beteendet, eller snarare idrottarens prestation, om han eller hon befinner sig i positivt (framgångsrikt agerande) eller negativt (misslyckat agerande) momentum, utan att ta hänsyn till idrottarens upplevelse av dessa perioder. När PM definieras ur ett psykologiskt perspektiv finns det en stark *övertygelse* om att dessa psykologiska förändringar leder till bättre (positivt PM) respektive sämre (negativt PM) prestation (se t.ex. Cornelius, Silva, Conroy, & Petersen, 1997). Dock är forskningsläget kring denna relation mycket oklart. När det refereras till hur ett helt lag förändrar prestationen under loppet av en match så har även termen

2 Förutom termen psykologiskt momentum har även termen momentum och i viss mån beteendemomentum använts i litteraturen. I avhandlingen diskuteras svårigheten att avgränsa dessa olika termer. För enkelhetens skull används psykologiskt momentum och momentum synonymt.

”lagmomentum” nämnts. Tyvärr finns inte mycket forskning kring det och inga modeller har hittills försökt förklara momentum på lagnivå.

Över tid har olika modeller föreslagits, som syftar till att förklara hur PM utvecklas och i vissa fall hur PM hänger ihop med prestationen (Adler, 1981; Adler & Adler, 1978; Cornelius et al., 1997; Gernigon, Briki, & Eykens, 2010; Taylor & Demick, 1994; Vallerand, Colavecchio, & Pelletier, 1988).

Kvalitativ forskning har lett till en lista över möjliga utlösare för positivt respektive negativt PM (t.ex. motståndarens missar, uppmuntran från tränaren, domarbeslut), samt gett kunskap kring hur en spelare eller ett lag karakteriseras under perioder av positivt eller negativt PM (t.ex. effektivitet, visa högt respektive lågt självförtroende, hög insats). Däremot finns det hittills bara en studie av Jones och Harwood (2008) som har försökt få fram vilka strategier som är rekommenderbara för att påverka PM på ett fördelaktigt sätt.

En stor del av forskningen inom ämnet har undersökt uppfattningar av momentum, till exempel hur de påverkas av olika matchförlopp, hur de påverkar den följande prestationen och även hur olika matchförlopp påverkar den följande prestationen. Resultaten har inte varit entydiga, vilket gör det svårt att dra en allmän slutsats. Intressant är att de resultat som finns tillgängliga är motstridiga i frågan om uppfattningar av momentum har en effekt på följande prestation eller inte.

När momentum undersökts utifrån ett beteendeperspektiv är forskningsläget också otydligt: Det finns evidens för momentum (t.ex. Dumangane, Rosati, & Volossovitch, 2009) när man tittar på matchdata i form av statistiskt signifikanta avvikelser av prestationen från det som kan förväntas (alltså betydlig bättre respektive sämre prestation av ett lag jämfört med dess normala prestation), men det finns också studier som inte finner statistiska tecken på momentum under matcher (t.ex. Schilling, 2009). Det sistnämnda stärker antagandet att momentum bara är en illusion.

I samband med momentumforskningen har ett antal variabler nämnts som anses vara relaterade till uppkomsten av momentum. Till exempel har föreslagits att självförtroende är en viktig del i uppkomsten och vidmakthållandet av momentum. Bandura (1997) föreslog en momentum-självförtroendespiral som uppstår när positivt självförtroende och positiv prestation, respektive negativt självförtroende och negativ prestation, bygger på varandra. Intressant är att samma författare även föreslog begreppet kollektivt självförtroende, som syftar på övertygelsen i laget om att kunna prestera på topp. Hittills gjord forskning visar att det kollektiva självförtroendet höjs, respektive sänks i samband med positivt respektive negativt PM (Den Hartigh, Gernigon, Van Yperen, Marin, & Van Geert, 2014). Två andra lagfaktorer - lagsammanhållning och interpersonal koordination – har kunnat relateras till PM. Emotionella faktorer har också kopplats till PM. Detta är speciellt intressant ur ett

lagperspektiv, då det sägs att icke-verbala emotionella uttryck kan sprida sig till andra: Hatfield och kollegor (1994) påstår att människor tenderar att smittas av de känslor som närstående har. I ett lag skulle det betyda att en spelare som presterar bra och visar sin glädje genom emotionella uttryck kan sprida sin glädje till lagkamraterna. Denna mekanism kan vara en möjlig förklaring till PM. Det finns dock hittills ingen forskning kring detta inom PM och bara två studier kring emotionell smitta inom idrotten. Vidare finns det evidens för att människor tar upp icke-verbala uttryck från andra för att skapa sig ett intryck av hur duktiga de är. Dessa intryck kan sedan påverka ens egna tankar och känslor (Warr & Knapper, 1968). Även denna mekanism kan vara intressant inom lagidrotten. Ett lag som uppträder mycket självsäkert och som visar glädje eller stolthet över sina framgångar under matchen anses därmed kunna påverka spelarna i motståndarlaget. Denna hypotes bekräftas av en kvalitativ studie inom handbollen av Ronglan (2007). Sammanfattningsvis verkar icke-verbala emotionella uttryck vara av störst intresse för lagsporten, då dessa påverkar både det egna laget och motståndarlaget.

I avhandlingens första studie undersöktes om momentum, definierat utifrån ett beteendeperspektiv, existerar i data från elithandbollsmatcher. Mer specifikt var målet att utreda hur många matcher inom elithandboll som visar tecken på momentum i form av olika statistiska mått. Vidare undersöktes om det finns korta perioder i matcherna där prestationen är signifikant över eller under den förväntade prestationen, vilket skulle vara ett tecken på kortvarigt momentum. Resultaten visar att i 11,6% av matcherna är händelserna korrelerade med föregående (alltså en positiv respektive negativ händelse är mer sannolikt följd av ytterligare en positiv respektive negativ händelse). Dock pekar även 7% av matcherna på motsatsen, att en positiv (negativ) händelse är mer sannolik följt av en negativ (positiv) händelse. Avvikelser från baslinjeprestationen förekommer i 16,3% av alla matcher. Det visar sig även att det i 72,1% av alla matcher finns minst en fem-minuters period där prestationen skiljer sig signifikant från baslinjen.

Resultaten demonstrerar att momentum bara sällan inträffar under en hel match, vilket ger ytterligare anledning att ifrågasätta om momentum verkligen existerar. Dock finns det olika skäl för att avvisa detta. Det finns forskning som visar att själva övertygelsen av att vara i momentum leder till förändringar bland annat i självförtroendet eller i känslotillståndet och dessa förändringar kan i sin tur leda till förändringar i prestationen, utan att det upplevda momentumet faktiskt existerade i verkligheten. Studier i den relaterade hot-handforskningen visar att beteendet förändras på grund av att man tror att en spelare är ”het” (se t.ex. Raab, Gula, & Gigerenzer, 2011). Det kan dock vara så att dessa förändringar i prestationen är för svaga, eller händer mer på individuell nivå (och inte som antogs i denna studie på lagnivå), varför det inte visades på ett starkare sätt i matchdata. En annan möjlig förklaring till varför det är så svårt att hitta momentum i matchdata är de två processerna ”negative facilitation” (prestationshöjning efter misslyckandet) och

”positive inhibition” (prestationsminskning efter framgång; se Silva, Hardy, & Crace, 1988). Dessa författare föreslår att det finns olika faktorer som leder till att prestationen dras tillbaka till baslinjeprestationen (t.ex. då man förlorar koncentrationen efter framgång, eller då motståndaren börjar reagera på ens framgång genom förändringar i taktiken). Intressant nog visar resultaten av studien att det faktiskt finns några få matcher där en positiv händelse mer sannolikt följs av en negative händelse (eller vice versa). Detta förlopp förslagsvis kallas för ”anti-momentum” och bör has i åtanke för kommande studier. Sammanfattningsvis visar resultaten på helmatchnivå att det finns matcher som innehåller tecken på momentum och i lite mindre antal även matcher som visar tecken på anti-momentum, men att de flesta matcher resulterar i icke-signifikanta resultat. Eventuellt förekommer dessa två olika förlopp under en och samma match och därför jämnar ut varandra. Resultaten i studien ger dock även en egen förklaring till varför det vore olämpligt att påstå att momentum inte existerar. Det förekommer nämligen i nästan tre av fyra matcher minst en fem-minuters period där prestationen är över förväntan bra eller dålig, vilket antyder att korta momentumfaser förekommer i relativ många matcher. Det är möjligt att just dessa korta perioder upplevs av spelarna och är grunden till varför de är övertygade att momentum finns. Det är dock sällan så att momentum håller i sig i en hel match.

Avhandlingens andra studie syftar till att undersöka hur tränare karakteriserar sina lag när de är i positivt, respektive negativt PM och vidare söker efter svar till vilka utlösare som sätter igång PM och vilka strategier som kan användas för att optimera PM i ett lag. Intervjuer gjordes med nio handbollstränare från damelitserien under säsongen 2008/2009. Resultaten visar att utlösare av positivt PM kan delas i följande kategorier: förtroende, spelares individuella faktorer (t.ex. motivation, personlighet), lagfaktorer (t.ex. tydlig rollfördelning, hög andel av kommunikation) och lag-motståndare faktorer (t.ex. hög prestation av eget lag, svaghet hos motståndare). När det gäller utlösare för negativt PM så kom följande faktorer fram: tränarfaktorer (t.ex. en passiv tränare), förtroende (t.ex. att inte ha förtroende för sig själv eller laget), externa faktorer (t.ex. domarbeslut), individuella faktorer (t.ex. spelarnas beteende) och lagfaktorer (t.ex. inte ta sitt ansvar i laget). Strategier som tränarna anger för att höja chanserna för positivt PM delades upp i tränarstrategier (t.ex. tydliga instruktioner till spelare) och lag- och individuella strategier (t.ex. göra planer och sätta mål för matchen, visa positiva reaktioner inom laget). Analysen av tränarnas svar visar vidare att laget kan hamna i ett negativt PM genom misslyckade tränarstrategier (som t.ex. misslyckade utbyten, felaktiga taktiska beslut), eller genom individuella eller lagstrategier som är ofördelaktiga (som t.ex. att fokusera på resultatet) eller som spelarna inte kan eller vill använda sig av (t.ex. att inte ha en klar plan för matchen, att inte ha följt en bra förberedelse för matchen). För att beskriva sina lag i positivt respektive negativt PM nämner tränarna karakteristika som kan delas upp i beteendefaktorer (t.ex. framgångsrika försök och positivt kroppsspråk, respektive

misslyckade försök och negativt kroppsspråk), kognitiva faktorer (t.ex. uppfattning av makt och kontroll, respektive feluppfattning av spelet och felaktiga beslut), förtroende (att klara stressfulla situationer, förtroende för sig själv, laget eller spelplanen, respektive inget förtroende för sig själv, laget eller spelplanen), emotionella faktorer (t.ex. positiva emotioner, respektive negativa emotioner) och lagfaktorer (t.ex. mycket och klar kommunikation, klar rollfördelning i laget, respektive negativ och lite kommunikation, inget ansvarstagande).

Intressant i dessa resultat är att vissa faktorer nämndes som både utlösare av PM och karakteristika för PM. Till exempel när det gäller framgångsrika aktioner, så kan dessa vara en utlösare för PM, men även något som händer under tiden spelarna är i ett positivt PM. Likadant förhåller det sig med förtroendet. Det kan därför antas att PM är ett cirkulärt fenomen och att de olika faktorerna bygger på varandra. Som exempel kan en bra prestation leda till att man får bättre självförtroende, vilket i sin tur höjer chanserna för en följande bra prestation och ytterligare bättre självförtroende, varvid en uppåtgående spiral har satts igång. Emotionella faktorer framkommer som en viktig del i PM. Emotionerna uttrycks genom icke-verbalt beteende och fångas upp av bl.a. lagkamrater genom en mekanism som kallas för emotionell smitta (Hatfield, Cacioppo, & Rapson, 1994). Att sprida positiva, respektive negativa emotioner bland lagkamrater kan anses som en viktig del i utvecklingen och vidmakthållandet av PM. Intressant är att det tydlig framkommer i resultaten att lagfaktorer spelar en viktig roll i utvecklingen av PM, något som inte nämndes i samma utsträckning i jämförbara studier. I socialpsykologin betraktas faktorer som rollfördelning och ansvarstagandet som viktiga delar i ett lags fungerande och baserad på de föreliggande resultaten är sådana faktorer även viktiga för att skapa och vidmakthålla PM. När det kommer till de föreslagna strategier för att bygga upp positivt PM så framkommer tydligt att en stor del av de nämnda strategierna är sådana som har lyftas fram inom idrottspsykologin med syfte att höja prestationen. Det verkar som om interventionerna med syfte att uppnå positivt PM är jämförbara med allmän prestationshöjning.

Avhandlingens tredje studie undersöker om lagets tidigare prestation och emotionella uttryck genom gester och beröring av målskytten påverkar lagets resulterande prestation. Studien genomfördes med hjälp av systematiska observationer. Sekvensen mellan att spelarna gör mål, hemspringet och fram tills dess att de är tillbaka i försvaret analyserades baserat på ett kodningsschema. Summan av alla gester, respektive beröringar per mål under varje fem-minuters period lades ihop och genomsnittet användes för följande analyser. Lagets relativa prestation beräknades genom att räkna lagets antal mål minus det andra lagets antal mål. Detta prestationsindex är oberoende av ställningen i matchen och beräknades för den föregående perioden (lagets tidigare prestation), den aktuella perioden (lagets aktuella prestation) och den efterföljande perioden (lagets resulterande prestation).

Resultaten visar att ju bättre prestationen var i föregående period, desto fler gester (men inte beröring) visas per mål. Varken gester eller beröring var en signifikant prediktor för lagets resulterande prestation. Resultaten visar dock att lagets tidigare prestation verkar vara viktig i dessa analyser: Om laget har presterar bra och målskyttarna visar mycket beröring, eller om laget har presterat dåligt och målskyttarna visar lite beröring, så är detta relaterat till positiv resulterande lagprestation. Är det däremot så att laget presterade dåligt, men mycket beröring visas, eller laget presterade bra men att lite beröring visas så är detta relaterat till negativ resulterande lagprestation. Med andra ord, så är det fördelaktigt att lagets prestation tidigare i matchen och antal beröringar av målskytten är kongruenta för att skapa bästa förutsättningar för en bra resulterande lagprestation. Samma analyser med gester resulterade i icke-signifikanta resultat.

Dessa resultat tyder på att visa positiva reaktioner i laget, som föreslås som strategi i avhandlingens andra studie och som nämndes i studien av Ronglan (2007), inte är en strategi som generellt påverkar prestationen positivt. Snarare så ska denna strategi användas när laget väl är i en positiv period och reaktionerna bör helst visas genom beröring. Det kan tänkas att beröring, i motsats till gester, är ett socialt sätt att fira, som förenar laget och som därigenom skapar bra förutsättningar för framtida framgång. Gester, som är ett sätt att uttrycka stolthet, är en mer egocentriskt form av firande som tydligen inte har samma effekt på lagets prestation. Resultaten stärker påståendet av Adler and Adler (1978) att uttrycket av emotioner kan vidmakthålla PM. Intressant med de föreliggande resultaten är att lagets tidigare prestation verkar vara en viktig faktor, vilket stärker antagandet i olika modeller av PM. Det verkar rimligt att anta att spelarnas psykologiska tillstånd påverkas av det som händer under matchen och att de inte går in ”nollställda” i varje ny situation under en match. I praktiken betyder detta att målskytten ska visa mycket beröring under perioder då laget presterar bra, medan att fira mål med beröring i perioder med dålig prestation inte är att rekommendera. I sådana fall kan det vara mer fördelaktigt att fokusera på själva spelet och hitta tillbaka till de tekniska och taktiska beteenden som är viktiga i just denna situation istället för att sprida uppmärksamheten genom firandet. När resultaten tolkas bör beaktas att effektstorlekarna är små, vilket kan förklaras på olika sätt. Det bör dock betonas att även små effekter kan ha ett stort inflyttande i elitidrotten, där marginalerna mellan att vinna och förlora oftast är minimala.

Denna avhandling presenterar några nya inslag i momentumforskningen. Första studien visar att momentum i handboll sällan inträffar under en hel match, men att det förekommer under korta perioder i ett stort antal matcher. Momentumsekvensers längd är något som inte har diskuterats hittills. Andra studien lyfter fram många olika faktorer som är utlösare av och karakteristika för PM, och styrker därigenom annan tidigare forskning. Dock betonar de intervjuade tränarna även lagrelaterade faktorer som viktiga i PM, något som inte har fått mycket uppmärksamhet i forskningen hittills. Dessutom presenterar avhandlingens andra studie ett flertal möjliga strategier

som rekommenderas för att skapa positiv PM. Tredje studien stärker antagandet att lagets tidigare prestation är en viktig faktor när lagprestationen undersöks och visar att icke-verbala emotionella uttryck i form av beröring har någon, om än liten, effekt i lagidrotter.

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