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Momentum sequence and environmental climate influence levels of perceived psychological momentum within a sport competition

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Abstract
The present study examined the influence of momentum sequence (positive vs. negative) and environmental climate (hot–wet vs. neutral) on supporters’ (i.e. virtual observers’) reported levels of perceived psychological momentum (PM) during a simulated cycling competition. Participants supported one of two competing cyclists involved in a race that was displayed on a screen in a lecture hall. The race scenario was manipulated so that the supported cyclist appeared to undergo either a positive or negative momentum sequence. In addition, participants were either exposed to a hot–wet environmental climate or to a neutral environmental climate while observing the race scenario. According to the results, reported levels of PM were higher in the positive momentum sequence condition than in the negative momentum sequence condition, consistent with the notion that supporters’ PM is influenced by a positivity bias, and reported levels of PM were also found to be higher in the hot–wet climate condition than in the neutral climate condition, consistent with the notion that environmental climate is a contextual factor that influences PM through the operation of a causal augmenting mechanism.

Keywords: Psychological momentum; positivity bias; environmental context; supporters

The phenomenon of psychological momentum (PM) – described broadly as a “heightened state of force” (e.g. Adler & Adler, 1978, p. 154) – is thought to operate in a wide variety of life domains, but has been most closely examined within competitive contexts. In the psychological literature, PM is characterized as a bidirectional force that influences the perceptions and cognitions of actors (e.g. Briki, Den Hartigh, Markman, Micallef, & Gernigon, 2013), as well as the perceptions and cognitions of observers (e.g. Briki, Den Hartigh, Markman, & Gernigon, 2014). The term positive PM is used to describe periods during which individuals perceive that almost everything is going right, whereas the term negative PM is used to describe periods during which individuals perceive that just about everything is going wrong.

PM bears a superficial resemblance to other concepts such as flow, the hot hand and the gambler’s fallacy. However, a clear distinction exists between PM and these other phenomena. Flow describes an experiential state of complete immersion in a task that is characterized by a loss of self-awareness and a distorted sense of time (e.g. Csikszentmihalyi, Abuhamdeh, & Nakamura, 2005). The hot hand and the gambler’s fallacy, on the other hand, refer to misperceptions of random, sequential events, with hot hand perceptions being related to performance, and the gambler’s fallacy being related to misperceptions about the nature of chance (Ayton & Fischer, 2004). PM differs from these in the sense that it reflects a dynamical system of cognitive, affective and physiological processes that are elicited by perceptions of movement either towards or away from goals (e.g. Gernigon, Briki, & Eykens, 2010). More concretely, PM can be characterized as a psychological impetus that influences an actor’s ability to reach a desired goal.
Positivity biases in supporters’ PM perceptions

Briki et al. (2014) recently examined how observers (i.e. virtual supporters) perceive the PM of athletes over time. Participants were instructed to support one of two competing cyclists involved in a race that was reflected by two moving avatars displayed on a screen. The movement of the avatars was manipulated in such a way that one cyclist appeared to be experiencing a negative momentum sequence (i.e. evolving from lagging behind to leading), while the other cyclist appeared to be experiencing a negative momentum sequence (i.e. evolving from leading to lagging behind). The results of Briki et al.’s (2014) study showed an early shift in PM perceptions in response to ascending (i.e. positive momentum) and descending variations (i.e. negative momentum) of the time-gap threshold, and the anticipatory tendency reflected by this dynamical pattern was found to be stronger during the positive momentum sequence than during the negative momentum sequence. Studying light of these results, then, positive PM appears to be easier to trigger than negative PM.

Briki et al. (2014) argued that the asymmetry observed between positive and negative PM might be a manifestation of wishful thinking – the tendency for observers to overestimate the success likelihood of those they support (e.g. Babad & Katz, 1991). Given that fan-ship is a source of positive self-identity for those who root for specific individuals and teams (e.g. Hirt, Zillman, Erickson, & Kennedy, 1992), it stands to reason that supporters should be particularly sensitive to upticks in positive PM because such increases can potentially enhance self-esteem. Alternatively, the asymmetry between positive and negative PM among supporters might be attributable to framing (e.g. Tversky & Kahneman, 1981). Thus, positive PM may be more easily triggered than negative PM because supporters are typically in a win frame (i.e. focused on achieving success) when they are cheering for the team they prefer. In all, supporters’ stronger tendencies to anticipate upward vs. downward trajectories suggests the operation of a positivity bias that precipitates expectations of winning on the basis of a prior or ongoing sequence of events (e.g. Markman & Hirt, 2002).

Contextual influences on PM perceptions

Drawing an analogy to Newtonian physics, Markman and Guenther (2007) proposed a velocity ($v$) × mass ($m$) formulation ($v \times m$) that attempts to capture the phenomenological experience of PM. In line with Taylor and Demick (1994), $v \times m$ posits that precipitating events, or a series of such events, initiate perceived movement towards some (desired or undesired) end-state where the speed of perceived movement towards that end-state is experienced as velocity (see also Freyd & Finke, 1984; Thornton & Hubbard, 2002). Moreover, and consistent with Vallerand, Colavecchio, and Pelletier (1988), velocity combines with mass, which is conceptualized in $v \times m$ as a composite of personal and situational variables conveying immediacy or value that give rise to the experience, intensity and duration of PM. Notably, this conceptualization is reminiscent of earlier theorizing by Lewin (1935). Lewin posited that any movement of the self from one’s current position towards or away from some terminal focus or position corresponds to locomotion in the life space, defined as the set of force fields that influence an individual. The life space includes any real or imagined meaningful life event aspects for the individual such as knowledge, needs and environmental features. Consistent with the $v \times m$ conceptualization of PM, locomotion indicates evolution towards either approach targets (i.e. positive momentum) or avoidance targets (i.e. negative momentum).

Two assumptions are critical to $v \times m$: (a) people hold naïve beliefs about the existence of PM and (b) there are conditions under which PM waxes and wanes. Psychologists conceptualize naïve beliefs and implicit theories as knowledge structures comprising explanatory components that people use to understand how the world around them functions (e.g. Dweck & Leggett, 1988; Heider, 1958). To illustrate, one implicit theory noted by Markman and Guenther (2007) is that PM is an extra-personal force (e.g. “the wind at your back”) that builds in intensity over time if it is uninterrupted, but is difficult to regain if it is interrupted.

$V \times m$ assumes that individuals possess implicit theories about how a given personal or situational variable affects velocity. Among the variety of contextual variables that have received attention in the literature (e.g. Markman & Guenther, 2007; Miller & Weinberg, 1991; Taylor & Demick, 1994), early conceptual frameworks (Adler & Adler, 1978) stressed how environmental conditions such as climate might significantly influence the experience of PM. For instance, Adler and Adler (1978) speculated how “… a seemingly innocuous element like weather may be decisive to momentum” (p. 169). Critically, however, no empirical study to date has directly examined the possibility that climate (and one’s corresponding level of comfort) might influence observers’ PM perceptions.

Causal inferences related to environmental conditions

Studies of building occupants have revealed that thermal comfort correlates positively with performance
perceptions (e.g. Humphreys & Nicol, 2007; Leaman & Bordass, 2006; Smith & Orfield, 2007), and that participants attribute their perceived performance to climate (e.g. de Dear et al., 2013). In light of these results, it appears that people tend to share the implicit theory that a comfortable climate facilitates performance whereas an uncomfortable climate debilitates performance. How might thermal sensation be related to comfort? Zhang et al. (2008) examined this question by exposing individuals to different temperature conditions (from 18°C to 29°C). Using scales designed to measure thermal sensation and comfort, the authors observed an inverted-U relationship: The highest levels of comfort were reported when the thermal sensation was experienced as neutral, whereas the highest levels of discomfort were reported when the thermal sensations were experienced as either cold or hot. On the basis of these findings, we hypothesize that supporters may tend to share the implicit theory that a cold or hot (i.e. “hard”) climate can handicap an athlete’s performance. In turn, we also hypothesize that supporters may come to perceive closing a performance gap (i.e. between the athlete they support and his or her closest competitor) as being more decisive for the final outcome when they find themselves situated within a harder (less comfortable) rather than a less hard (less uncomfortable) climate.

By what mechanism might environmental climate influence PM perceptions? According to attribution theory (e.g. Kelley, 1972), causal augmenting occurs when social perceivers are aware of the constraints that are involved in taking an action and thereby attribute that action more to the actor than would otherwise be the case. Thus, a supporter who observes an athlete experiencing a momentum sequence within a competition under difficult circumstances (i.e. a hard climate) may perceive more PM because, in their view, the athlete has managed to succeed “in spite of” the difficult conditions (e.g. “She is coming from behind in spite of the oppressive weather!”). Overall, then, it is hypothesized that uncomfortable viewing and performance conditions will elicit intensified PM perceptions during those segments of a competition when a supported athlete is experiencing a momentum sequence.

**Study overview**

The present study sought to examine whether different momentum sequences (positive vs. negative) and climates (hard vs. neutral) influence perceptions of PM among observers who are instructed to support a particular athlete during a simulated cycling competition. Two specific predictions were formulated. First, and consistent with the notion that supporters’ PM tends to be influenced by a positivity bias (e.g. Babad & Katz, 1991; Briki et al., 2014), it was predicted that perceived PM levels would be higher during a positive momentum sequence than during a negative momentum sequence. Second, and consistent with the notion that people tend to share the implicit theory that uncomfortable climates debilitate performance (e.g. de Dear et al., 2013), during competition segments when the supported athlete is observed to be experiencing a momentum sequence it was predicted that perceived PM levels would be higher when performance was observed in a hard climate than when performance was observed in a neutral climate. A hot–wet environmental climate was used to operationalize “hard” climate in the present study because research in the domain of sport has confirmed that it is one of the most arduous climates in which to perform (e.g. Grantham et al., 2010; Hue, Antoine-Jonville, Galy, & Blone, 2010).

**Method**

**Participants**

Ninety-two sport sciences students who reported having substantial experience in sports competitions volunteered to participate in the study (20 females, 72 males; $M_{age} = 20.00$ years, $SD_{age} = 2.59$ years). Only participants who reported that they had experienced competing in sports other than cycling (e.g. volleyball, soccer, swimming) were retained for analyses. Accordingly, the final sample included 91 participants (19 females, 72 males; $M_{age} = 19.97$ years, $SD_{age} = 2.59$ years) who were randomly assigned to one of four experimental conditions.

**Experimental set-up and design**

The study was conducted in a university lecture hall (between the hours of 4–6 pm) in groups of 10 (± 3.5 SD) participants at a time because sport competitions are often viewed with other people present. Eight experimental sessions were conducted in which participants were randomly assigned to either the positive momentum sequence condition or the negative momentum sequence condition, and among these eight sessions, four were conducted in a neutral environmental climate and four were conducted in a hard environmental climate. Because past research has revealed that PM experiences are sensitive to participants’ knowledge, beliefs and expectations about the nature of PM (e.g. Markman & Guenther, 2007; Vallendar et al., 1988), we employed a between-subjects (as opposed to a within-subjects) design in order to diminish the
possibility that participants’ responses would be influenced by demand characteristics associated with their recognition of the ascending and descending momentum sequences and how they believe they “ought” to respond to such sequences.

The experimental set-up included a laptop computer, a video-projector and a projection screen (1 m × 1.3 m). Participants sat in chairs that were placed 1.5–2.5 m away from the screen. The chairs were situated in an arc and arranged in such a way as to indicate a clear separation between two groups of participants who supported different cyclists (1.5 m separated the two groups). A scenario editing software program facilitated the construction of race simulations involving two cycling avatars that appeared to experience a shifting time gap (in seconds). In addition, the software offered the option of allowing questions to appear on the screen at fixed intervals.

Momentum conditions. The race simulations were designed to induce participants to believe that the cyclist they were supporting was experiencing either positive momentum (i.e. evolving from lagging behind to leading) or negative momentum (i.e. evolving from leading to lagging behind). The race configurations included a priming period, a momentum sequence and a recovery period (see Table I). During the priming period, lasting 3 min 20 s, the avatar in the positive momentum sequence lagged behind initially until a time gap of 16 s, whereas the avatar in the negative momentum sequence initially took a lead of 16 s. The momentum sequence that followed lasted 12 min, and included a 4 s change in time gap after each 1 min 20 s interval.

Climate conditions. The temperature and humidity of the lecture hall was adjusted to correspond to either a neutral climate (temperature: $M = 23.5^\circ C$, $SD = 0.1^\circ C$; humidity: $M = 45.2\%$, $SD = 0.2\%$) or to a hard (hot–wet) climate (temperature: $M = 35.1^\circ C$, $SD = 0.1^\circ C$; humidity: $M = 74.9\%$, $SD = 0.3\%$). Four experimental sessions were performed in the neutral climate, and four were performed in the hard climate. Each session lasted 35 min. The climate conditions were counterbalanced across sessions.

Procedure

Upon their arrival at the lecture hall, participants were randomly assigned to one of the four experimental conditions after which they received and read instructions about the procedure and had their forehead temperatures measured. Participants were then told that the researchers recently recorded a race between two male national-level cyclists who had competed on home-trainers in the very same lecture hall. In addition, participants were told that:

| Table I. Manipulation of time gap (in seconds) according to time and the momentum sequences |
|---|---|
| Positive momentum sequence | Recovery period |
| Time (min) | 0 | 4 | 0 | 4 | 0 | 4 | 0 | 4 |
| Momentum sequence | 0 | 4 | 0 | 4 | 0 | 4 | 0 | 4 |
| Negative momentum sequence | 0 | 4 | 0 | 4 | 0 | 4 | 0 | 4 |
(a) the race would be projected on the screen in front of them with each of the competing cyclists being represented by an avatar, (b) the winner of the race would be the first cyclist to take a lead of 20 s (see Briki et al., 2014), (c) the cyclists were at the same competitive level, (d) the race was very important for the cyclists’ careers because it was part of a selection procedure for a national cycling stage race, and (e) the race was also highly relevant for themselves because they would be supporting one of the two competing cyclists. With regard to the climate manipulation, participants were also told that the cyclists had performed the race under the same environmental conditions that presently existed in the lecture hall.

Participants assigned to the positive momentum sequence condition were instructed to support the cyclist represented by the green avatar, whereas participants assigned to the negative momentum sequence condition were instructed to support the cyclist represented by the blue avatar. Participants then watched the race simulation (see Figure 1) and responded to the same set of four measures every 1 min 20 s (creating a total of nine time-gap thresholds). When the race simulation concluded, the experimenters once again measured participants’ forehead temperatures, after which they responded to two items assessing climate perceptions. Finally, participants were debriefed and thanked for their participation.

**Measures**

**Levels of perceived PM.** Consistent with Briki et al. (2014), PM perceptions were measured by four items (Vallerand et al., 1988) presented in random order: “Which cyclist seems to be the most confident?”, “Which cyclist seems to have the most control over the race?”, “Which cyclist seems to be making the most progress toward victory?”, and “Which cyclist seems to be the most discouraged?” (reverse coded). Each item was responded to on 9-point scales ranging from “−4” (“the opposing cyclist”) to “+4” (“my cyclist”) with a neutral midpoint of “0” (“neither the opposing cyclist, nor my cyclist”). The items showed high internal consistency (α = 0.91). An overall assessment of perceived PM was derived from the mean scores across all four items averaged across all nine time-gap thresholds. The measurement of perceived levels of PM, then, reflected the absolute value of the overall assessment of perceived PM.

**Comfort perceptions.** At the end of the experiment, participants responded to two items that assessed their own comfort level in the current climate as well as their perceptions of the comfort level of the cyclist they were supporting. These items were: “How did you perceive your own comfort level in the current climate as you were watching the race?” and “How do you believe the cyclist you were supporting perceived the current climate as he was performing in the race?” on 9-point Likert-type scales ranging from “−4” (“very uncomfortable”) to “+4” (“very comfortable”) with a neutral midpoint of “0” (“neither uncomfortable nor comfortable”). The items were well correlated (r = 0.66) and thus combined to create an index of comfort perceptions. It was expected that lower perceptions of comfort would be reported in the hot–wet climate condition than in the neutral climate condition.

**Results**

**Preliminary analyses**

Because PM is thought to utilize cognitive capacities such as attention, self-regulation, memory and perception (e.g. Gernigon et al., 2010), and research has found that changes in body temperature resulting from exposure to hot environments can impair cognitive capacities (Gaoua, Racinais, Grantham, & El Massioui, 2011), participants’ body temperatures were measured directly before and after the experimental task with a temporal scanner infrared thermometer (Scaneo TS31) applied to the forehead. A non-significant effect of climate on body temperature would therefore suggest that changes in PM perceptions were more likely attributable to the climate manipulation than to reductions in cognitive capacity. To examine whether forehead temperature was influenced by climate condition, a $2 \times 2$ repeated measures ANOVA (Climate Type [Neutral vs. Hot–wet] × Time-of-Measure [Before experiment vs. After experiment]) was conducted. Neither the main effects nor interaction were significant, all ps > .25. Thus, participants’ body temperatures were not affected by the climate manipulation.
Main analyses

Perceived levels of PM. To examine our hypotheses regarding perceived levels of PM as a function of Momentum Sequence and Climate Type, a 2 × 2 ANOVA (Momentum Sequence [Positive vs. Negative] × Climate Type [Neutral vs. Hot–wet]) was conducted. The analyses revealed the predicted main effect of Momentum Sequence, \( F(1, 87) = 3.99, p = .049, \eta_p^2 = 0.04 \) (power = 0.51), and the predicted main effect of Climate Type, \( F(1, 87) = 4.89, p = .03, \eta_p^2 = 0.05 \) (power = 0.59). As depicted in Figure 2, perceived levels of PM were found to be higher in the positive momentum sequence condition \((M = 1.03, SD = 0.67)\) than in the negative momentum sequence condition \((M = 0.78, SD = 0.55)\). Furthermore, perceived levels of PM were found to be higher in the hot–wet climate condition \((M = 1.02, SD = 0.58)\) than in the neutral climate condition \((M = 0.76, SD = 0.64)\) (see Figure 3). The Climate Type × Momentum Sequence interaction was not significant \((p = .36)\).

Comfort perceptions. A 2 × 2 ANOVA revealed the predicted main effect of Climate Type on comfort perceptions, \( F(1, 64) = 45.18, p < .001, \eta_p^2 = 0.43 \) (power = 1.00), such that comfort perceptions were lower in the hot–wet climate condition \((M = −2.08, SD = 2.02)\) than in the neutral climate condition \((M = 1.17, SD = 1.72)\) (these analyses were only executed on 68 participants because the experimenters neglected to measure comfort perceptions during the first two experimental sessions). Neither the main effect of Momentum Sequence \((p = .29)\) nor the Climate Type × Momentum Sequence interaction \((p = .76)\) was significant.

Relationships between reported levels of PM and comfort perceptions. In an attempt to provide evidence for our proposed causal augmenting mechanism, we conducted correlation analyses that examined relationships between PM levels and comfort perceptions. First, a global analysis conducted on the entire sample \((n = 68)\) revealed a negative (albeit non-significant) correlation between reported levels of PM (i.e. the absolute value of reported PM levels summed across both the positive and negative momentum sequence conditions) and perceived comfort, \( r = −0.16, d = −0.32, p = .19 \). We then conducted separate correlation analyses within each of the momentum sequence conditions. The analysis conducted within the positive momentum sequence condition \((n = 33)\) revealed a marginally significant negative correlation between PM perception levels and comfort, \( r = −0.30, d = −0.63, p = .09 \), whereas the analysis conducted within the negative momentum sequence condition \((n = 35)\) revealed no correlation, \( r = −0.03, d = −0.06, p = .87 \). In all, the results of the analysis conducted within the positive momentum sequence condition appear to provide preliminary evidence for causal augmenting because lower comfort perceptions were found to predict higher reported levels of PM.

Discussion

The present study examined whether momentum sequence (positive vs. negative) and environmental climate (hot–wet vs. neutral) would influence the PM perceptions of virtual supporters who observed a simulated cycling race. In so doing, the study sought to extend Briki et al.’s (2014) work that examined virtual supporters’ PM perceptions. Two major hypotheses were tested in the present study. First, it was predicted that virtual supporters would report higher PM perceptions during a positive momentum sequence than during a negative momentum sequence. Second, it was predicted that virtual supporters would report higher PM perceptions when they were situated in a hot–wet environment than when they were situated in a neutral environment.
Consistent with the first prediction, reported levels of PM were higher during the positive momentum sequence than during the negative momentum sequence, replicating Briki et al.’s (2014) results and supporting their speculation that the PM experience of virtual supporters is influenced by a positivity bias. Furthermore, and consistent with the second prediction, reported levels of PM were higher in the hot–wet climate condition than in the neutral climate condition.

Correlation analyses revealed a (marginally significant) negative relationship between comfort and PM perceptions in the positive momentum sequence condition, providing tentative evidence for the proposition that the effect of environmental climate on PM perceptions is driven by causal augmenting (Kelley, 1972). From the perspective of the $v \times m$ formulation (Markman & Guenther, 2007), environmental climate is a situational variable that contributes to mass. In turn, $v \times m$ assumes that individuals possess implicit theories about how a given personal or situational variable affects velocity. In the present study, participants who observed their supported athlete competing in an uncomfortable climate may have experienced higher levels of PM because they perceived their supported athlete to be performing well in spite of his discomfort. More generally, and in accord with the growing awareness that cognitions in sport may emerge from continuous interactions between the individual and the specific environment in which the individual is functioning (e.g. Araujo, Davids, & Hristovski, 2006), the climate effect reported here supports the notion that PM is ecologically embedded (e.g. Briki et al., 2014). The ecological approach, initiated and developed by Gibson (1979), posits that “…humans and other animals perceive and act on substances (e.g. water), surfaces (e.g. the ground surrounding the water), places (e.g. a swimming pool), objects (e.g. a beach ball) and events (e.g. a water polo competition) in the environment”, and that such elements “…provide opportunities for action, defined across the complementary relationship between the environment and person” (Araujo et al., 2006, p. 654).

The present study is not without its limitations. First, real-world supporters typically display a broader age range than did the present participant sample. Thus, the reported results may not generalize to all observers of real-world sport competitions. Second, comfort perceptions were found to correlate with perceptions of positive PM at only a marginal level of statistical significance, although the associated effect size, $d = -.63$, is considered moderate according to Cohen’s (1992) rubrics. In addition to boosting statistical power, we suspect that the relationship between perceived comfort and positive PM would be strengthened if future studies employ naturalistic competitive settings that even more closely capture the phenomenological experience of PM among supporters.

To conclude, examining the influence of climate on PM represents a novel avenue of research that deserves the attention of researchers in the sport sciences. Indeed, several high-stake international competitions take place in hard climates. For example the 2014 Soccer World Cup took place in Brazil (hot–wet climate), and the 2018 and 2022 Soccer World Cups will transpire in Russia (cold climate) and Qatar (hot climate). Moreover, athletes, coaches, media and supporters themselves believe that the act of supporting can be both an aid and a hindrance to athletes during competitions. Thus, future studies should examine whether and how supporters’ PM, as well as their observable reactions to it, may influence athletes’ PM.

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