Metacognitive processes and attentional focus in recreational endurance runners

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Abstract

This study examined the metacognitive processes and attentional focus of recreational endurance runners. The emphasis was on understanding the metacognitive processes important to acquire, develop, and refine cognitive strategies in novice endurance exercise participants. The potential impact of metacognitive processes and cognitive strategies on longer-term endurance activity adherence was also of interest. To meet these aims, ten recreational runners were interviewed to retrospectively explore metacognitive processes and attentional focus during running. Data were analysed using deductive and inductive content analyses. The data revealed that runners engaged in a relatively limited array of metacognitive skills and may not possess a detailed knowledge of task-specific attentional strategies to regulate cognition. Few runners engaged in metacognitive planning or reviewing by themselves, for example. Cognitive strategies were developed with experience, however, and often as a consequence of unpleasant, effort-related sensory experiences. Other, more experienced runners were also influential sources for cognitive strategy acquisition. These findings are novel within an endurance activity context. Based on our interpretation of the findings, we propose that interventions to enhance metacognitive abilities and assist novice endurance participants to acquire, develop, and refine task-appropriate cognitive strategies, may be important to longer-term endurance activity adherence.

Keywords: metacognition; cognitive strategies; self-regulation; endurance activity; exercise adherence

Introduction

Attentional focus during endurance activity has been of research interest since Morgan and Pollock (1977) first interviewed world-class and non-elite distance runners. Their findings implied that world-class runners predominantly used associative strategies; selectively attending to bodily sensations and using this information to adjust pacing and keep relaxed. In contrast, non-elite runners reported more frequent dissociation, or distraction, to direct attention away from effort sensations (Morgan & Pollock, 1977). Subsequent research has supported the contrasting attentional foci of experienced athletes and less experienced or lower performing participants. Baker, Côté, and Deakin (2005) reported that expert triathletes engaged comparatively more performance-relevant cognitions (e.g. planning transitions, tracking competitors) than mid-pack athletes, whereas back-of-the pack triathletes engaged more task-irrelevant cognitions. More recently, Boya et al. (2017) suggested that expert cyclists focused primarily on speed data to regulate performance during a simulated 16.1 km time-trial. In contrast, novice performers focused more on distance information. The findings indicated a preference for performance-related decision-making among experts, whereas novices may be more concerned with task completion.

As these studies indicate, the impact of attentional focus on acute aspects of endurance *performance* has been the primary interest in this domain. Outcomes have included time to completion (e.g. Connolly & Janelle, 2003), physiological variables such as movement economy (e.g. Schücker, Schmeing, & Hagemann, 2016), and subjective responses such as perception of effort (e.g. Stanley, Pargman, & Tenenbaum, 2007). To provide greater clarity on the performance effects of various foci, Brick, MacIntyre, and Campbell (2014) reconceptualised traditionally associative and dissociative cognitions into five attentional categories. Accordingly, associative cognitions were categorised as either *internal sensory monitoring* (e.g. breathing, muscle fatigue), *outward monitoring* (e.g. split-times, distance information), or *active self-regulation* (e.g. pacing, movement technique, cadence, relaxing). Brick and colleagues concluded that active self-regulatory thoughts optimised pace (e.g. when focused on cadence) or improved movement economy (e.g. when relaxing) without necessarily increasing effort perception. In contrast, excessive internal sensory monitoring tended to decrease pace and/or increase perceived effort. Furthermore, Brick et al. (2014) categorised dissociative cognitions as *active distraction* (e.g. conversing) or *involuntary distraction* (e.g. daydreaming). Collectively, distractive cognitions tended to reduce pace and effort perceptions, and elevated affective states such as enjoyment or mood (e.g. Connolly & Janelle, 2003; LaCaille, Masters, & Heath, 2004).

A related area that has gained less research impetus is how attentional focus might impact on longer-term exercise adherence. This may be important given that existing behaviour change techniques have a small effect (Hedges' g = 0.25) on long-term physical activity (PA) behaviour (Samdal, Eide, Barth, Williams, & Meland, 2017). Specifically, perception of effort is considered an inverse correlate of PA (Bauman et al., 2012) and a source of exercise-induced displeasure and avoidance (Ekkekakis, Vazou, Bixby, & Georgiadis, 2015). Given that one's focus of attention can alter effort perception and affective responses during endurance activity (Brick et al., 2014), it is surprising that only Martin et al. (1984) and Welsh, Labbé, and Delaney (1991) have investigated the longer-term impact of attentional focus on PA behaviour. Intriguingly, Martin et al. (1984) revealed that participants instructed to dissociate (actively distract), or "attend to the environment and other pleasant and distractive stimuli…rather than the ordinary discomfort of exercise" (p. 805) had greater attendance (76.6%) during a 12-week aerobic programme than a group instructed to attend to bodily sensations (58.7% attendance). In contrast, Welsh et al. (1991) noted no difference in exercise compliance between a positive self-statement and distraction group, and a no-instruction group during a six-week jogging programme.

The findings of Martin et al. (1984) suggest that distractive strategies may be important for endurance activity adherence. However, that study was limited by the absence of a no-intervention control. Furthermore, given the relatively short duration of both studies, the impact of active self-regulatory strategies on longer-term activity adherence remains unknown. This is important considering that distractive cognitions may be less effective at higher exercise intensities (Tenenbaum & Connolly, 2008) and self-regulatory strategies can reduce perception of effort during endurance tasks (Brick et al., 2014). As such, knowledge of the cognitive strategies implemented by recreational exercisers may provide additional insights to understand longer-term PA behaviour. Given the paucity of research in this area, the present study aims to fill this gap and determine the attentional focus of less experienced, recreational endurance exercisers who have successfully maintained their activity over a sustained period of time (e.g. 12 months).

In addition to knowledge of endurance participants' attentional focus, how individuals acquire, develop, and refine their cognitive strategies is also of interest. Recently, Brick, MacIntyre, and Campbell (2015) highlighted the importance of metacognitive processes for attentional focus and cognitive control during endurance performance. Metacognition is considered a model of cognition and basic components include *metacognitive knowledge* (e.g. knowledge of cognitive strategies to use and conditional knowledge of when to use them) and *metacognitive skills*, such as planning, monitoring, or reviewing one's cognitions (Flavell, 1979; Martini & Shore, 2008). Metacognitive skills represent the control function of metacognition and the ability to implement strategies during a task (Efklides, 2014). Finally, *metacognitive experiences* facilitate monitoring of cognitive processes and include implicit or explicit metacognitive feelings (e.g. feelings of task difficulty) and explicit metacognitive judgements and estimates (e.g. estimating the correctness of a solution) (Efklides, 2014). Metacognition is considered fundamental to effective self-regulation, or the ability to successfully control one's thoughts and actions in accordance with the demands of a task (Dinsmore, Alexander, & Loughlin, 2008; Efklides, 2014). Relevant to the present discussion, Brick et al. (2015) proposed a metacognitive framework of attentional focus and cognitive control during endurance activity. Based on interview data with elite endurance runners, the findings suggested that elite athletes monitored and controlled their cognition during running to optimise performance. Important processes included metacognitive planning of attentional strategies, monitoring task performance and controlling cognition during running, and reviewing, evaluating, and refining their cognitions after running (Brick et al., 2015).

As with cognitive strategies, however, ability-related differences in metacognition also exist (e.g. MacIntyre, Igou, Campbell, Moran, & Matthews, 2014). Martini and Shore (2008) highlighted differences in the use of metacognition in both academic and psychomotor tasks and suggested higher-level performers tended to use more planning strategies and monitored and evaluated their performance more accurately. In contrast, inexperienced performers tended not to plan, monitor, or evaluate cognitive performance. Relevant to the present study, Nietfeld (2003) reported a positive relationship between metacognitive strategy knowledge and the ability of middle-distance runners to monitor their pace during a one-mile run. Nietfeld (2003) implied that in a running context, skilled performers operate on intelligent, domain-specific strategies (e.g. active self-regulatory strategies) that are developed as a result of experience. No research has specifically focused on the metacognitive abilities of less experienced endurance participants, however. Furthermore, no studies have applied a metacognitive perspective to understand exercise activity adherence. Accordingly, this investigation sought to examine metacognition, attentional focus, and cognitive control processes in recreational endurance runners. Through individual interviews, the aims were to (i) determine the metacognitive processes of less experienced, recreational endurance runners, and (ii) determine the attentional focus and cognitive strategies used by these runners during running. Finally, based on our interpretations of the resulting data, a third aim was to (iii) explore how metacognitive processes and attentional focus may contribute to longer-term endurance activity adherence.

Method

Philosophical orientation

A relativist ontology, interpretivist perspective, and a constructivist epistemology were adopted by the researchers (Ritchie, Lewis, McNaughton Nicholls, & Ormston, 2013; Sparkes & Smith, 2014). Firstly, a relativist ontology holds that reality is humanly constructed and subjective realities exist in the form of mental constructions (Sparkes & Smith, 2014). As such, a relativist ontology and qualitative methodology were considered most appropriate for the study of cognitive and metacognitive processes, with an understanding that the research inquiry involved interpretations of participants' own interpretations of their cognitive processes. Secondly, the nature of the relationship between researcher and participant (i.e. epistemology) is constrained by the researcher's ontological approach. A constructivist epistemology holds that in qualitative enquiry the enquirer and participant are inseparable and data result from the interaction between both parties (Sparkes & Smith, 2014). Thus, from relativist ontological and constructivist epistemological perspectives, the objective of this enquiry was to present individual representations of less experienced, recreational endurance runners' metacognitive processes and attentional focus during their running activities (Ritchie et al., 2013; Sparkes & Smith, 2014).

Participants

Less-experienced endurance runners were identified as those who began running within the previous 12 months and had participated in a beginner running programme in that time. In addition, recreational runners were defined as those who practice their activity for approximately two hours per day at least three days per week (De Pauw et al., 2013). Following institutional ethical approval, a recruitment email was sent to local running clubs with beginner running programmes (e.g. *Couch to 5k*) for onward distribution. Inclusion criteria at the time of recruitment were that participants had completed the programme within the previous 12 months and were still recreationally active as runners. Accordingly, criterion-based purposive sampling (Patton, 2002) was used to ensure only runners meeting these characteristics were included. Ten runners (six women) who responded to the recruitment email, met the criteria, and were willing to participate, were interviewed ($M_{\text{age}} = 40.85 \pm 8.16$ years). At the time of interview, it had been 10.98 ± 3.52 months since participants first began to run and 9.28 ± 3.25 months since their first running event. Participants ran on average 2.80 ± 0.86 days per week for a total of 20.58 ± 9.28 km per week and were classified as recreationally trained runners (performance level 2; De Pauw et al., 2013). Most participants had completed a furthest running event of 5 km, but two had completed a 10 km event, one had completed a half-marathon, and two had completed a full marathon.

Sequential analysis of interview transcripts following each interview ensured the researchers were able to recognise when data saturation was becoming apparent (Sparkes & Smith, 2014). Following interview number seven, a reduction in new information was observed and no new or additional categories emerged in the final three interviews. Accordingly, the analysis suggested that data saturation had occurred by the tenth interview.

Data Collection

Pre-interview information

Following procedures outlined by Brick et al. (2015), participants were emailed a pre-interview information sheet one week before the interview. This information sheet outlined the interview process, the types of questions to be asked, and provided an example of cognitive strategy use during running (counting repeatedly to 100 during each mile of running; Radcliffe, 2011). This allowed participants to familiarise themselves with the area of research and potential lines of questioning, and to clarify the purpose of the study.

Qualitative interview guide

Qualitative, semi-structured interviews were employed and Brick et al.'s (2015) interview guide was adapted for use. The guide consisted of six sections that probed and explored runners' running history, their attentional focus during running, the cognitive strategies used during both training and competition (if applicable), how runners monitored the effectiveness of their attentional focus, and how cognitive strategies were acquired, developed, and refined over their running career. Questions asked of elite runners, but not applicable to the present sample (e.g. mental strategies used early in a runner's career, for example as a junior athlete), were not included in the interview guide for this study.

Interviews

All participants provided written informed consent before the interview began. The interviews consisted of two discrete phases. First, the interviewer spent time (approximately 20 min; not recorded) with each interviewee to review the pre-interview information, to confirm the purpose of the study and the interview process, and to allow the interviewee ask any questions they might have. This phase provided the opportunity to develop trust and rapport, to make the interviewee feel comfortable, and to minimise social dissonance (Myers & Newman, 2007). The formal interview (phase two; recorded) began with an initial exploration of each runner's attentional focus during running. Following this, participants were provided with a list of attentional foci typically engaged by runners. For consistency, this list was identical to that utilised with elite runners by Brick et al. (2015), was developed based on the review of Brick et al. (2014), and stimulated identification and recall of attentional foci to facilitate deeper discussion (Sparkes & Smith, 2014). The interviewer also explained any terms participants may not have been familiar with. All interviews were conducted face-to-face by the first author. The formal interviews lasted, on average, 33.10 ± 5.70 min. Each interview was digitally recorded and transcribed manually verbatim and totalled 119 pages of double-line spaced text. To ensure transcription accuracy, member-checking was performed to allow participants the opportunity to amend and clarify content (Tracy, 2010). Transcripts were returned to participants via email within seven days of interview. All participants confirmed the accuracy of transcriptions.

Data Analysis

A content analysis was deemed most appropriate given the exploratory nature of this study (Willig, 2013). Adhering to the three phases of content analysis (i.e. preparation, organising, and reporting; Elo & Kyngäs, 2008), the first author initially immersed himself in the data, listening to interview recordings repeatedly and rereading transcripts multiple times.

A categorisation matrix suitable for data analysis was developed by Brick et al. (2015) to incorporate the metacognitive processes and attentional focus of elite endurance runners. The rationale for employing this matrix was to compare and contrast the metacognitions and attentional focus of recreational runners with their elite counterparts. Accordingly, a deductive content analysis was employed. Given the idiosyncratic nature of attentional strategies, however, transcripts were screened for novel content and an inductive content analysis was also employed to fully develop and refine the categorisation matrix (Elo & Kyngäs, 2008). As such, analysis involved an abductive logic (Blaikie, 2007; Ritchie et al., 2013) using both novel information from the interview data and pre-established categories from Brick et al. (2015).

Trustworthiness and confirmability

To establish trustworthiness and enhance the rigour of the analysis, Willig (2013) recommends that qualitative researchers should refer to others' interpretations of the data. Accordingly, the second and third authors independently analysed the interview data. Through critical discussion and evaluation (i.e. peer debriefing), the authors repeatedly reviewed their analysis and interpretations to refine the matrix where necessary. The second, third, and fifth authors also ensured reflexivity by challenging the first author's assumptions on analysis and interpretation. These processes were important to ensure interpretations of the data were consistent between multiple researchers and to confirm that category labels were sufficiently inclusive of data from both elite (Brick et al., 2015) and the present recreational runners. As a further step to enhance rigour and trustworthiness, an independent analyst, familiarised with the study procedures and the categorisation matrix, analysed a random sample (20%) of the transcripts. The independent analysist acted as a 'critical friend' and offered a critique and additional insights into the data, facilitating further reflexivity on data analysis and interpretation (Sparkes & Smith, 2014). Accordingly, areas of disagreement were discussed and refinements were made to the matrix and to inclusion/exclusion criteria where necessary. Once refined, and with consensus reached, categories were established and the results were synthesised. As a final step in the quality assurance process, and to allow confirmability, all study documents including the pre-interview information sheet, the interview guide, the attentional focus list, the interview raw data, the coding frame, and inclusion/exclusion criteria for categories and subcategories are available for independent judgement (see https://osf.io/aj4k2/?view_only=b99feed29b9c4c99a1799b8e79a09cd5).

Results

In line with the first aim of the study, to determine the metacognitive processes of less experienced, recreational endurance runners, the findings are organised under two metacognitive dimensions. *Metacognitive skills* important to regulate cognition are presented first, followed by *metacognitive experiences*. Given the attentional focus and cognitive strategies endurance participants engage in during running (i.e. the second aim) are important to monitor and control cognition, the attentional foci that participants reported are integrated into the *monitoring during running* (internal sensory monitoring and outward monitoring) and *controlling cognition during running* (active self-regulatory strategies and distractive strategies) subsections of the metacognitive skills dimension. The findings are presented using interview quotations as evidence of participants own interpretations of their mental processes (i.e. a relativist ontology). The range of cognitive and metacognitive processes reported are presented fully in Fig 1.

Metacognitive skills and regulation of cognition

Planning before running

No participants reported metacognitive planning before training, whereas a few runners reported *planning tactics and pacing* before race events. Those individuals who did report planning tactics and pacing planned alone, whereas one runner also reported planning with a running partner. Tactical plans were primarily focused on task-oriented, but less competitive goals such as completing a run or setting a personal best time. In addition, no runners reported metacognitive planning of active self-regulatory strategies other than tactics and pacing before race events. One participant did report *planning other cognitive strategies*, however, and recounted planning music to listen to as a distractive strategy.

Monitoring during running

Monitoring processes consisted of both *internal sensory monitoring* and *outward monitoring*. All runners reported *monitoring bodily sensations* and the most frequently reported were *breathing* and *exertional pain and muscular fatigue*. Most runners reported sensations of exertion as unpleasant, particularly when they first began to run. One runner (Participant 7; P7) revealed how monitoring breathing sensations dominated their focal awareness early in their running career and often proved an unpleasant experience that led to negative self-statements:

> I couldn't get my breathing right at the start. My total attention was on breathing…And it was only, actually, when I ran with [my brother] one day… and he was like, 'Your breathing is *all* wrong! You've got to breathe in through your nose and out through your mouth and go slow.' I *couldn't* do it, it took me weeks to regulate it! And it was only once I had that, I was able to focus on anything else. It was totally just on being able to do my breathing, and, 'Why am I doing this, why am I putting myself through it? I hate this, I hate running! Why am I doing it?'

Outward monitoring most frequently consisted of *monitoring the course/route/terrain, monitoring other runners*, and *monitoring split-times and distance* information. Monitoring the course/route/terrain was associated with pace-related decision-making, particularly if a route contained hills. Although many participants reported monitoring *other runners*, this was mostly for less competitive or non-competitive reasons such as to avoid finishing last or to use others as a distraction. Some runners also reported monitoring specific route features (e.g. lampposts, bridges) to mentally break the distance into smaller segments (i.e. chunking), or to know if a run was almost completed. These relationships between monitoring and active self-regulatory strategies (e.g. pacing, chunking) led to the next category to emerge from the data: controlling cognition during running.

Controlling cognition during running

Most runners recounted using the active self-regulatory strategies of *pacing and tactical decisions*, *using social support*, and *chunking distance or time*. All runners indicated that the primary tactical decision was learning from unpleasant sensory experiences and slowing down during the initial stages of ensuing activities. As such, each runner reported scenarios where they began too quickly during running activities early in their running career and experienced unpleasant physical sensations as a result (e.g. breathing, muscular fatigue). Subsequently, internal sensory feedback, coupled with experiential knowledge of running distances, was vital to improve pace-related decision-making. The following quote (P5) captured the importance of these processes to consciously adapt pacing as runners gained experience:

> That has been the big factor…I know whenever I'm starting off now I'm not busting myself and I know after a couple of miles I'm not going to be exhausted…. Before it was an unknown how I was going to feel after a mile…. Now I'm taking it easy and if I feel…better…I go a bit faster. But if I know I'm going too fast, I'll slow down again. And I'm always thinking, 'How do I feel? ...Is my breathing heavy?'

The non-competitive nature of most runners was emphasised by pace-related decision-making. Specifically, many runners prioritised the intrinsic benefits of running and running too quickly often equated to reduced enjoyment, as one individual (P3) recounted:

> Even we did a 5 km run…and one of our trainers said to me, 'Stop going towards the back, you're going to run it with me!' And I ran it with him, and I did do it quite a lot quicker than normal! …And he said, 'See! See!', and I said, 'Yes, but I didn't enjoy it! I hated every minute of that because I pushed myself! If I'd stayed with those ones [slower runners], I'd have enjoyed that run!'

In addition, the majority of runners reported *using social support* to cope with the demands of running. Participants described receiving direct encouragement from fellow runners or focusing their thoughts on significant others (e.g. family members) to increase motivation, complete a run, or maintain running activity. One runner (P1) highlighted the reciprocal nature of social support between runners:

> I think one of the things I've learned is that I'm a better motivator of other people, and supporter, and encourager, more so than I would for me! For me, I would just say, 'ah sack this!' But if it's somebody with me, and they keep me going, I'll go, because I don't want to be letting them down. And vice versa, you know?

Linked to outward monitoring of route features, *chunking distance or time* allowed many runners to focus on proximal sub-goals during longer-distance running. Although one runner expressed a dislike for chunking, and experienced an urge to stop when reaching a proximal target, several runners found chunking beneficial, as typified by the following quote (P4):

> No, I'd never stop. In my own head, the last 5k that I did, I just kept focusing on the finish line. I just wanted to… it was the last one I did, and it was just lamppost to lamppost, and it was like, 'Right, I can see something', and I focused on a car…that was parked…, and once I got to that car, I focused on to the next thing I could see

Most runners reported focusing on *running technique* and often this involved basic cues to maintain posture (e.g. keep head up, back straight) or focus on their arm swing. These cues were often learned from coaches during beginner running programmes. Similarly, use of *relaxation* resulted from a focus on bodily sensations and involved strategies learned from coaches such as relaxing one's arms. Many runners also reported frequent *negative self-talk* (e.g. an urge to stop) during running. Again, this often resulted from a focus on unpleasant bodily sensations or from outward monitoring (e.g. of an upcoming incline). Some individuals, though not all, reported countering negative thoughts with motivational self-talk or mantras. One runner (P10) typified the approach to countering negative self-statements with more motivational self-talk:

> And anything else I'd be thinking of are just random things, like it could be, like, 'I hope I don't get a stitch', or I'm maybe going up a hill and I'm thinking, 'I can do this!' We're struggling up the hill and I think, 'Right, we've done this before, I *can* do it!' Just telling myself I can do it.

In addition to active self-regulatory strategies, distractive strategies were also important to cope with the demands of running. Most runners reported *using other people for distraction and conversing*. Many runners also reported *using active distraction/switching off* or using the *scenery/route as a distraction* (Fig 1). Runners' predominantly non-competitive orientation was exemplified by their use of conversing. Typically, conversing was engaged in to actively distract from bodily sensations, prevent boredom, or to reduce the self-regulatory demands of running. The following quote (P8) highlights the perceived benefits of running with others and conversing as opposed to running alone:

> Running on your own, you tend to think more when you're running on your own. When you're running with other people, if you're chatting, you're not thinking…the mental thing going on in your head isn't happening, because you're chatting to somebody…you tend not to think of the run as much as you would if you were running on your own…where you've a constant battle in your head about the run…

Other distractive strategies were also employed when running alone and often involved reflective thoughts (e.g. of family, work). In contrast, one runner reported *avoiding involuntary distraction* and suggested it might result in a loss of concentration and stopping during a run.

A few runners currently *used music* as a distractive strategy. However, it is noteworthy that many others had previously used music but no longer did (see *metacognitive judgements and estimates*). For these runners, music detracted from their ideal pacing strategy (i.e. they ran too fast) or distracted from their preferred attentional focus (both active self-regulatory and other distractive), a consideration typified by a 5 km and 10 km runner (P8):

> I know a lot of people listen to music, but I don't! I've tried it, but…it just puts me off thinking about the run and what I have to do. It distracts me! Now maybe that's a good thing…but sometimes I try to focus…I want to focus on my run.

This approach to sampling a cognitive strategy, evaluating its effectiveness, and subsequently retaining or eliminating the strategy led to the next category to emerge from the data: metacognitive reviewing and evaluating.

Reviewing and evaluating after running.

Most participants reported *acquiring cognitive strategies through experience*, typically of unpleasant sensory feedback. Of these, some acquired self-regulatory strategies other than pacing through experience. Strategies included chunking, motivational self-talk, and imagery. This excerpt from a 5 km runner (P2) recounted how their imagery and mantras evolved as a result of breathing sensations experienced early in their running career:

> It's…developed slowly over time. And I think it's because the breathing is so difficult at the start. I had to try and control the breathing. And I kept it in step with the [foot] steps... And as the breathing and the steps were together, the arms were…moving together, this visualisation of…a steam engine…that's where that came in. And with that came the repetitions of… 'I feel strong…I feel powerful!'

The majority of participants also reported *acquiring, reviewing, and evaluating cognitive strategies and performance with others*. These others were typically more experienced runners and no participants reported using a sport psychologist. Participants acquired a range of self-regulatory strategies from other runners, including pacing and tactical information, chunking, relaxing, and motivational self-talk. These cognitions were frequently judged as effective and were subsequently retained. Accordingly, metacognitive experiences that influenced both cognitive control during running and metacognitive reviewing after running were the final category to emerge.

Metacognitive experiences

Metacognitive feelings

The majority of runners' data suggested they experienced *feelings of knowing* and *feelings of difficulty*. Several participants indicated *knowing when to apply a cognitive strategy* and the choice of strategy often depended on the route distance (i.e. longer versus shorter), the type of activity (i.e. training versus a race), bodily sensations experienced, or whether running with others or alone. To exemplify, a frequent 5 km runner (P6) expanded on the decision of when to engage in conversation and when to avoid it:

> It's my run and if somebody comes and distracts me, grand. But if I'm struggling, I would stop talking. …If they're...running behind me, I would up the pace to get away from them... I've done that a couple of times, if somebody tried to make conversation, I'm thinking, 'I'm not in the mood for conversation!' But then there's a couple of parkruns that have been really good; lovely morning, nice weather, met somebody I haven't met in ages, chatted to them for a wee while, and then realised I'm a bit out of breath here, I don't want to talk to you anymore because it's distracting me!

Despite individual preferences for attentional strategies in most runners, a few runners reported *knowing one does not know a cognitive strategy to apply* in situations. Specifically, these participants reported either not knowing enough about some strategies (e.g. running technique) or described scenarios where they were unable to cope with unpleasant sensations or negative self-talk without support from others. Similarly, although running was often reported as *feeling hard*, many individuals revealed these feelings were more prevalent when running alone.

Metacognitive judgements and estimates

All participants made *judgements of effective cognitive strategies* and *judgements of ineffective attentional focus*. Specifically, socially-oriented strategies such as using social support and conversing were mostly judged as effective. Often this was because running felt easier or runners did not need to engage alternative cognitive strategies. Consequently, for some individuals running with others was perceived to reduce the *self*-regulatory demands of running activity as exemplified by runners' use of conversing (see *controlling cognition during running* subsection). Perhaps not surprisingly, negative self-talk was judged as ineffective by several runners. Importantly, context-dependent judgement of strategies was also apparent. Some runners judged conversing as effective in some situations but less effective in others, for example. Similarly, although some runners judged listening to music as effective, many others judged music as ineffective or no longer effective.

Discussion

This study examined the metacognitive processes and attentional focus of less experienced, recreational endurance runners. Previous research on attentional focus has predominantly concentrated on endurance performance (Brick et al., 2014). In contrast, this qualitative investigation attempted to gain novel insights into the metacognitive processes and attentional focus of recreational runners for whom performance outcomes may be less of a concern. In line with the first two aims of the study, the findings suggest that as novices, the present runners may not have had the well-developed metacognitive skills or possessed the intricate knowledge of task-specific cognitive strategies as their more experienced counterparts (Brick et al., 2015). No runners reported metacognitive planning of active self-regulatory strategies other than pacing and tactics, for example. Furthermore, metacognitive reviewing and evaluating after running was mostly conducted with other, more experienced runners rather than alone. These findings suggest that beginner runners may be less strategic in their thinking (Nietfeld, 2003) and less likely to plan or evaluate their attentional strategies during running (Martini & Shore, 2008). There was evidence that participants developed their metacognitive abilities and cognitive strategies as task-specific experience accrued, however. These findings are novel within an endurance activity context. As such, this discussion will concentrate on the evolution of participants' domain-specific metacognitive skills and attentional focus during their relatively brief running careers. Findings with regard to metacognitive experiences will be integrated into the discussion where relevant.

A primary focus of attention for participants when they first began to run was on internal sensory stimuli, and, specifically, on breathing and effort-related sensations. Respiratory frequency is a correlate of perceived effort (Nicolò, Marcora, & Sacchettia, 2016). Consequently, excessive attention to bodily sensations, without engagement of situationally-appropriate cognitive strategies, may exacerbate effort perception and unpleasant affective responses during endurance activity (Brick et al., 2014; Ekkekakis et al., 2015). Thus, an initial challenge for novice participants may be to develop the metacognitive knowledge and skills required to regulate cognition and reduce focal awareness of effort-related sensations (Bigliassi, 2015).

The interview data does indicate that the runners evolved their attentional focus through a number of metacognitive processes as they gained experience. First, the findings revealed that sensory cues became an important source of information for pace-related decision making. Previously, Brick et al. (2015) noted that elite runners attended most to informational aspects of internal sensory stimuli and used these cues to regulate endurance performance. Similarly, the present runners learned that adjusting pace, particularly slowing down, was important to avoid unpleasant sensory consequences. Previous research has revealed that less experienced athletes often begin endurance activities at an intensity they cannot sustain (Deaner, Carter, Joyner, & Hunter, 2015). Over time, however, experiential knowledge of running distances and perceived effort improves pace-regulation (Marcora, 2010). As such, rather than attempting to distract from bodily sensations, which may be futile at higher intensities (Tenenbaum & Connolly, 2008), beginner runners might be encouraged to learn from sensory experiences (via metacognitive reviewing and evaluating) and use these cues to regulate exercise intensity (see Fig 2a and 2b). Given that both cognitive *and* affective factors influence metacognitive monitoring and control (Efklides, 2014), unpleasant sensory experiences may facilitate the acquisition of strategies (e.g. pacing) to regulate intensity during endurance activity.

The runners also reported employing other self-regulatory strategies, such as using social support, chunking, relaxing, focusing on basic technical cues, and motivational self-talk that evolved with experience. Of these, recent research has highlighted the positive effects of social support, including family, friends, and fellow runners, on physical activity initiation and maintenance in beginner runners (Wiltshire & Stevinson, 2018). In addition, the process of chunking, or setting – and attaining – more proximal sub-goals during a longer-duration task, has been shown to increase self-efficacy perceptions and subsequent task persistence (Stock & Cervone, 1990). Finally, cognitive strategies such as relaxation, cueing running technique, and motivational self-talk have been shown to reduce perceptions of effort and/or improve endurance performance (e.g. Blanchfield, Hardy, de Morree, Staino, & Marcora, 2014; Miller & Donohue, 2003). Despite these benefits for both running participation and performance improvement, many individuals did report difficulty regulating their own cognitions during running. Specifically, these participants indicated that running with a partner often felt easier (metacognitive feeling of difficulty) and was judged as more effective as they did not have to use as many self-regulatory strategies as when running alone. This further signifies that novice runners may not have as well-developed metacognitive skills as their more experienced counterparts (Brick et al., 2015) and encounter greater difficulties controlling cognition as a result. In support, Schücker et al. (2016) proposed that inexperienced runners may need greater cognitive resources to adopt novel attentional foci. Accordingly, running with others, and distracting from the activity, may reduce the cognitive demands (e.g. working memory) associated with an endurance task by negating the need to engage self-regulatory strategies. Crucially, changes in neural connectivity can improve cognitive efficiency and self-regulatory capabilities over time. Specifically, Raichlen et al. (2016) reported that trained endurance runners have greater connectivity between brain regions associated with executive functions, attention, and motor control (e.g. frontal cortex, frontoparietal network) than non-athlete controls. These contentions provide an additional, neurocognitive basis to explain why novice endurance participants may find cognitive control more difficult and use more distractive strategies than their elite counterparts (e.g. Brick et al., 2015; Morgan & Pollock, 1977).

In line with these latter contentions, distractive cognitions (e.g. conversing, reflective thoughts) were important to cope with the demands of running and increase positive affect in the present sample. Distractive cognitions are generally considered less strategic for competitive participants because of a detrimental effect on pace and performance (Brick et al., 2014; Nietfeld, 2003). Reduced pace may be advantageous for novice runners, however, and distraction may be most effective when the primary activity goals are to maximise enjoyment and positive affect (LaCaille et al., 2004), alleviate boredom (Pennebaker & Lightner, 1980), and reduce perceptions of effort (Stanley et al., 2007). Judgements that conversing was less effective in some contexts, however, and data concerning the use of music by some runners may offer interesting insights into the longer-term evolution of attentional strategies. Specifically, although some runners reported using music as a distractive strategy during running, many other participants had used music earlier in their running career but no longer did. Substantial evidence supports the ergogenic and affect-enhancing benefits of asynchronous music during exercise tasks (Jones, Karageorghis, & Ekkekakis, 2014; Karageorghis & Priest, 2012). In line with the present data, however, untrained individuals have been shown to experience more positive affective responses than trained runners when using music at varying intensities (Brownley, McMurray, & Hackney, 1995). In addition, Hallett and Lamont (2016) presented survey data to suggest that faster runners tend not to use music during running. From a metacognitive perspective, a reduced dependence on music, and occasional inclination not to converse, may reflect an increased knowledge of, and preference for, active self-regulatory strategies as runners gain experience. These findings may also indicate improved executive functioning and attentional control (Raichlen et al., 2016) and a growing reliance on informational aspects of internal sensory cues to effectively regulate pacing during endurance exercise activity (Brick et al., 2015).

The findings that metacognitive reviewing and evaluating were engaged predominantly with others, and that more experienced runners were important sources to acquire cognitive strategy information are also noteworthy. From an evolutionary perspective, Shea et al. (2014) proposed that humans developed the ability to express their cognitions to facilitate adaptive group behaviours. In the present context, communicating task-relevant cognitive information to more experienced others (e.g. "I don't know how to cope with longer distance runs") may facilitate the acquisition of self-regulatory cognitions to engage in the future (e.g. "chunk the run into smaller segments"). Accordingly, for novice runners, supra-personal (Shea et al., 2014) or socially shared (Efklides, 2014) metacognition may be important to acquire domain-specific metacognitive knowledge of cognitive strategies to use, and conditional knowledge of when to use them. From an applied perspective, the finding that no runners accessed a sport psychologist is typical for recreational participants (McCormick, Meijen, & Marcora, 2016) and reinforces the utility of easily-assessable evidence-based psychological interventions for recreational athletes to learn task-relevant cognitive strategies (e.g. Lane et al., 2016; Meijen, Day, & Hays, 2016).

In line with the third aim of this study, the findings may also offer novel insights into the effects of metacognitive processes and attentional focus on longer-term endurance activity adherence. First, it was apparent that internal sensory stimuli (e.g. breathing sensations) dominated the focal awareness of participants at the beginning of their running career. An excessive focus on bodily sensations is associated with an elevated perception of effort (Bigliassi, 2015; Brick et al., 2014; Nicolò et al., 2016) which, in turn, is an inverse correlate of physical activity (Bauman et al., 2012). Perceived effort is also a source of exercise-induced displeasure and negative affect (e.g. Ekkekakis et al., 2015). Thus, an initial intervention with beginner runners may be to use internal sensory cues such as breathing for pace-related decision-making (see Fig 2b). This may have important implications, such as increasing positive affect during activity and, consequently, improving the likelihood of longer-term exercise adherence (Brand & Ekkekakis, 2018). Furthermore, beginner participants' interpretations of adjustments in physiological and affective states during running may also influence their perceived capability to perform or complete physical activity tasks (i.e. self-efficacy; Bandura, 1997). Self-efficacy is a strong predictor of physical activity behaviour and exercise self-efficacy is considered particularly important during the initial stages of exercise adoption (Ashford, Edmunds, & French, 2010; Higgins, Middleton, Winner, & Janelle, 2014). In support, Raedeke and Dlugonski (2017) recently demonstrated that a 10-week cognitive-behavioural intervention targeting sources of self-efficacy, including interpretation of perceived effort, monitoring feeling states, and managing exercise discomfort, increased walking step-count in overweight adults. Whether similar intervention components can improve affective responses, self-efficacy, and adherence to beginner running programmes is currently unknown and demands future research attention.

Distractive strategies (e.g. conversing, reflective thoughts, music) were also important for the present runners. At lower exercise intensities, distraction may reduce boredom and increase positive affect (e.g. LaCaille et al., 2004; Pennebaker & Lightner, 1980) and these outcomes may explain why active distractive strategies have been associated with improved adherence during shorter-term, lower-intensity physical activity programmes (Martin et al., 1984). The present data hint that acquiring and developing task-relevant active self-regulatory strategies may be important for longer-term endurance exercise adherence, however. Although stronger empirical data is needed to support this contention, recent meta-analytical evidence suggests that strategies to facilitate self-regulation may explain the positive effects of longer-term behavioural change interventions (Samdal et al., 2017). As such, a novel interpretation of the present findings is that acquiring active self-regulatory strategies other than pacing (e.g. chunking, relaxation, motivational self-talk) and using these strategies in a contextually-appropriate manner may be important to longer-term endurance activity adherence. Accordingly, future research investigating the effectiveness of active self-regulatory strategies on endurance activity adherence is an additional priority for attentional focus and physical activity researchers.

Finally, social factors may also play an important role in acquiring cognitive strategies and developing metacognitive skills. Recent research has highlighted the importance of social capital to initiate and maintain activity in beginner runners (Wiltshire & Stevinson, 2018). Social capital includes social ties (e.g. family, friends) that help to initiate running activity and provide practical and affective support, and other runners that offer information on performance strategies and motivational techniques (Wiltshire & Stevinson, 2018). Our study adds to this from a metacognitive perspective to guide future research in this domain. Specifically, we highlight the role of socially shared metacognitions with more experienced runners and coaches to help novices acquire and develop context-appropriate cognitive strategies potentially important to longer-term endurance exercise adherence.

A number of limitations should be noted for this study. First, at just over 33 min, the duration of phase two of the interviews may be considered comparatively short. The runners were relatively inexperienced, however, and had not completed many longer-distance runs or races. As a result, these runners did not recount the detailed procedural or contextual knowledge of cognitive strategies previously reported by their elite counterparts (Brick et al., 2015). In support, all participants indicated they had nothing further to add on completion of the interview. Second, the present data may also suggest a refinement of the categories and subcategories proposed by Brick et al. (2015) based on the population under investigation. Specifically, some categories, such as metacognitive planning before training, may be more relevant to elite competitors than recreational participants. Finally, interpretation of the data should also be considered in light of recent propositions (published after data acquisition and analysis in this study) to improve rigour in qualitative research. Specifically, Smith and McGannon (2017) recently suggested a need to involve activities beyond those traditionally advocated for qualitative researchers (e.g. Tracey, 2010). Important to an investigation of endurance runners' metacognitions and attentional focus, additional activities might include post-interview member reflections, for example, to fully explore potential differences in the interpretations of their cognitive and metacognitive processes (Smith & McGannon, 2017).

In sum, the findings suggest that beginner, recreational runners may not have as well-developed metacognitive skills or possess the detailed knowledge of task-specific cognitive strategies as their more experienced, elite counterparts. The present runners' metacognitive skills and attentional strategies developed and evolved as they gained more experience, however. These findings are novel in the endurance research literature and may have important implications for research and applied practice. Specifically, the findings may contribute to our understanding of the self-regulatory processes important to longer-term endurance exercise adherence. From a metacognitive perspective, it may be that augmenting cognitive strategies with additional metacognitive knowledge (e.g. conditional knowledge of when to use strategies) and encouraging the use of metacognitive skills (e.g. planning and reviewing one's attentional focus) may help to optimise strategy acquisition with novice participants (Fig 2b). This may be especially important to cope with the demands of, and improve affective experiences during, endurance activity. Comparable metacognition-augmented interventions have proven beneficial in other domains of psychology research (e.g. Moritz et al., 2015). We propose that a similar approach may enhance applied practice to improve longer-term adherence to recreational endurance activity.

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Figure 1. Cognitive and metacognitive processes in the regulation of performance and control of cognition in recreational endurance runners.

Figure 2a. Without knowledge of active self-regulatory strategies, internal sensory monitoring (1) may dominate focal awareness. Beginner runners may attempt to use distractive strategies (3), but these may be futile at higher intensities making running feel harder (2) (adapted with permission from Brick et al., 2015).

Figure 2b. Based on previous running experiences (Fig 2a), metacognitively plan a pacing strategy before running (1). Use internal sensory and outward environmental cues as a source of information (2) for pace-related decision making during running (4) via metacognitive feelings of difficulty (3). After running, use metacognitive judgements (5) for metacognitive reviewing and evaluating (6) to update metacognitive planning for future running (adapted with permission from Brick et al., 2015).

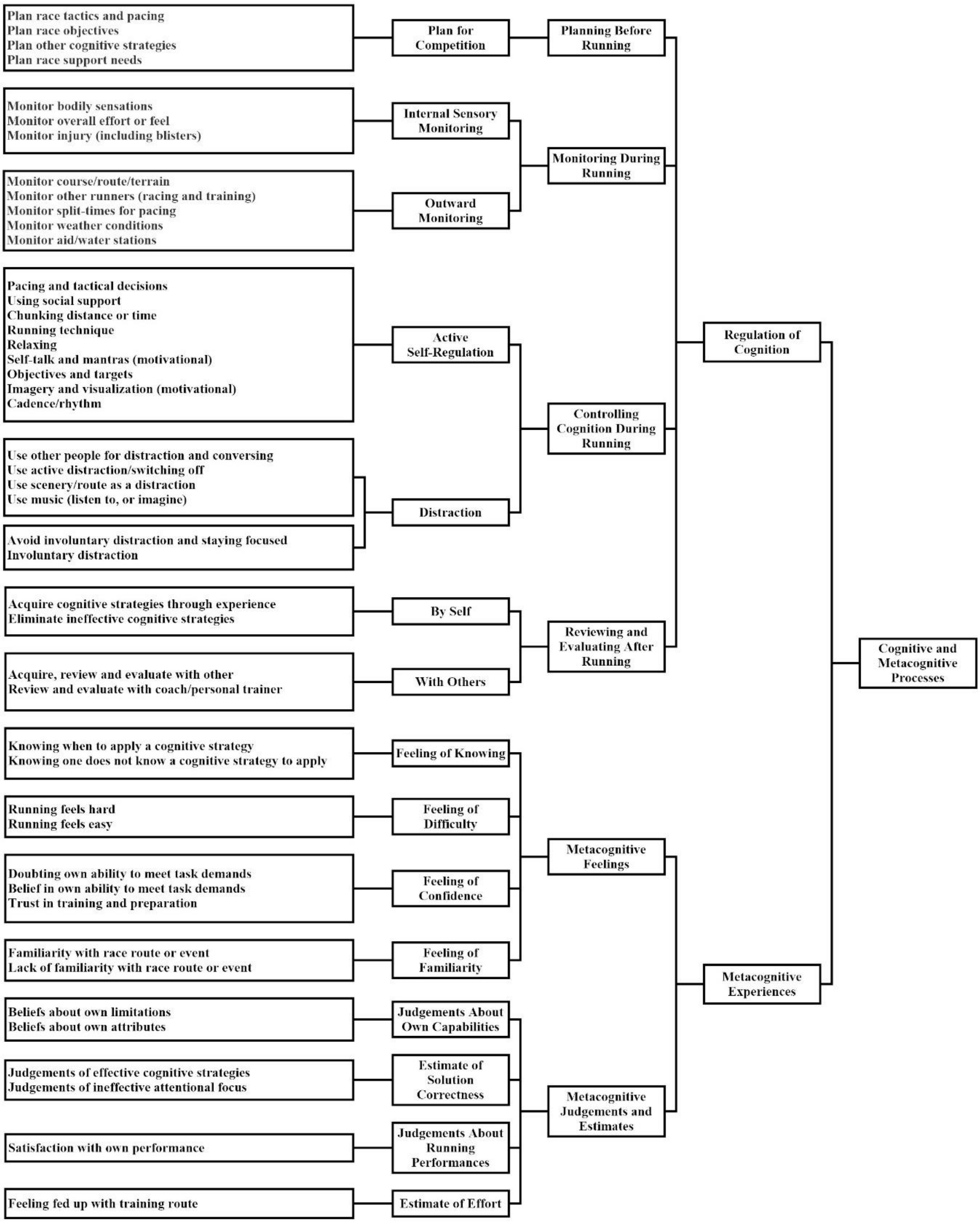
Plan race tactics and pacing
Plan race objectives
Plan other cognitive strategies
Plan race support needs
Plan for Competition
Planning Before Running
Monitor bodily sensations
Monitor overall effort or feel
Monitor injury (including blisters)
Internal Sensory Monitoring
Monitoring During Running
Monitor course/route/terrain
Monitor other runners (racing and training)
Monitor split-times for pacing
Monitor weather conditions
Monitor aid/water stations
Outward Monitoring
Pacing and tactical decisions
Using social support
Chunking distance or time
Running technique
Relaxing
Self-talk and mantras (motivational)
Objectives and targets
Imagery and visualization (motivational)
Cadence/rhythm
Active Self-Regulation
Regulation of Cognition
Controlling Cognition During Running
Use other people for distraction and conversing
Use active distraction/switching off
Use scenery/route as a distraction
Use music (listen to, or imagine)
Distraction
Avoid involuntary distraction and staying focused
Involuntary distraction
Acquire cognitive strategies through experience
Eliminate ineffective cognitive strategies
By Self
Reviewing and Evaluating After Running
Cognitive and Metacognitive Processes
Acquire, review and evaluate with other
Review and evaluate with coach/personal trainer
With Others
Knowing when to apply a cognitive strategy
Knowing one does not know a cognitive strategy to apply
Feeling of Knowing
Running feels hard
Running feels easy
Feeling of Difficulty
Metacognitive Feelings
Doubting own ability to meet task demands
Belief in own ability to meet task demands
Trust in training and preparation
Feeling of Confidence
Familiarity with race route or event
Lack of familiarity with race route or event
Feeling of Familiarity
Metacognitive Experiences
Beliefs about own limitations
Beliefs about own attributes
Judgements About Own Capabilities
Judgements of effective cognitive strategies
Judgements of ineffective attentional focus
Estimate of Solution Correctness
Metacognitive Judgements and Estimates
Satisfaction with own performance
Judgements About Running Performances
Feeling fed up with training route
Estimate of Effort

Figure 1.

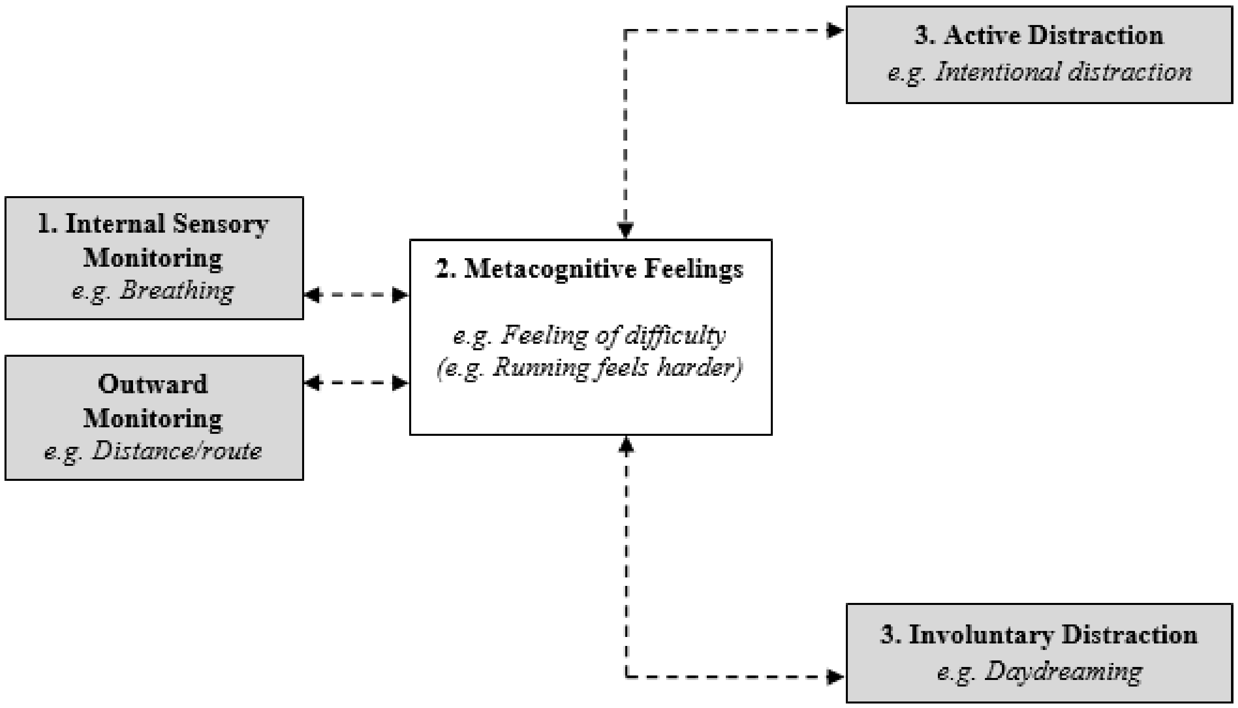
3. Active Distraction
e.g. Intentional distraction
1. Internal Sensory Monitoring
e.g. Breathing
2. Metacognitive Feelings
e.g. Feeling of difficulty
(e.g. Running feels harder)
Outward Monitoring
e.g. Distance/route
3. Involuntary Distraction
e.g. Daydreaming

Figure 2a.

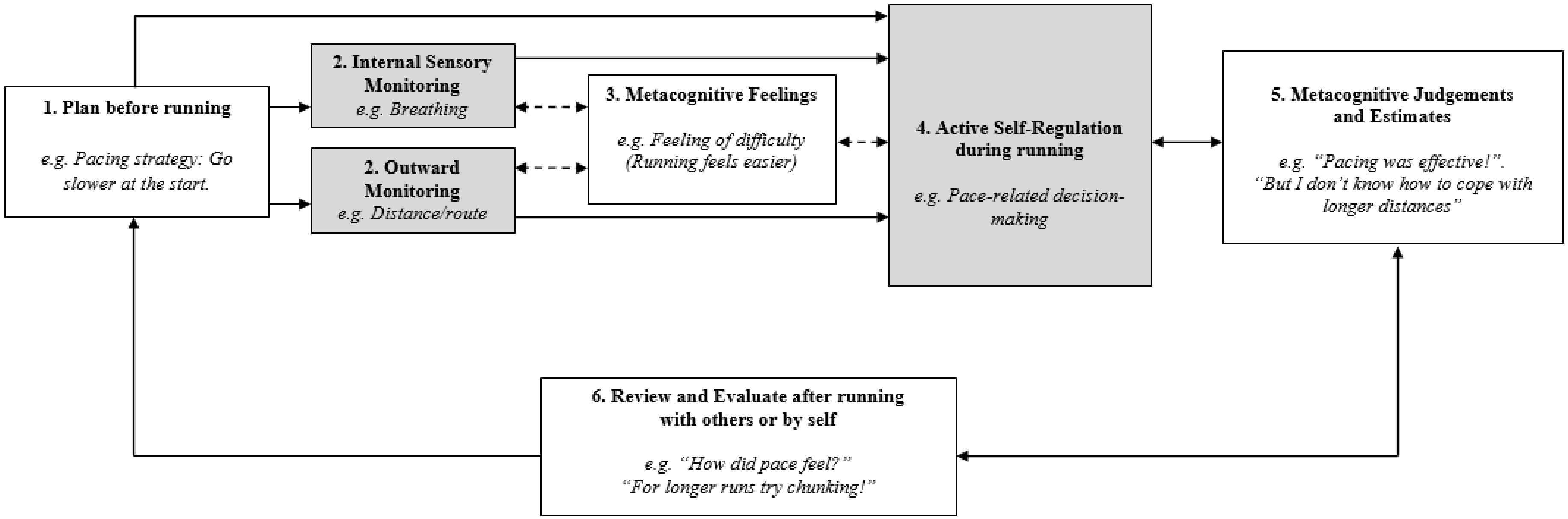
1. Plan before running
e.g. Pacing strategy: Go slower at the start.
2. Internal Sensory Monitoring
e.g. Breathing
2. Outward Monitoring
e.g. Distance/route
3. Metacognitive Feelings
e.g. Feeling of difficulty (Running feels easier)
4. Active Self-Regulation during running
e.g. Pace-related decision-making
5. Metacognitive Judgements and Estimates
e.g. "Pacing was effective!". "But I don't know how to cope with longer distances"
6. Review and Evaluate after running with others or by self
e.g. "How did pace feel?" "For longer runs try chunking!"

Figure 2b.