Teaching athletes to understand their attention is teaching them to concentrate

Oliver, Alex; McCarthy, Paul J.; Burns, Lindsey

Published in:
Journal of Sport Psychology in Action

DOI:
[10.1080/21520704.2020.1838980](https://doi.org/10.1080/21520704.2020.1838980)

Publication date:
2021

Document Version
Author accepted manuscript

[Link to publication in ResearchOnline](#)

Citation for published version (Harvard):
Oliver, A, McCarthy, PJ & Burns, L 2021, 'Teaching athletes to understand their attention is teaching them to concentrate', *Journal of Sport Psychology in Action*, vol. 12, no. 3, pp. 196-210.
<https://doi.org/10.1080/21520704.2020.1838980>

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

Take down policy

If you believe that this document breaches copyright please view our takedown policy at <https://edshare.gcu.ac.uk/id/eprint/5179> for details of how to contact us.

1 **Teaching Athletes to Understand their Attention is Teaching them to Concentrate**

3 Alex Oliver¹

4 Paul J. McCarthy¹

5 Lindsey Burns¹

7 ¹Department of Psychology, School of Health and Life Sciences, Glasgow Caledonian
8 University

11 All correspondence related to this article should be addressed to Alex Oliver by email

12 alex.oliver@gcu.ac.uk or in writing to:

13 Department of Psychology, School of Health and Life Sciences, Glasgow Caledonian
14 University, Cowcaddens Road, Glasgow, G4 0BA.

17 This is an accepted manuscript (9/10/20) of an article published by Taylor & Francis in The
18 Journal of Sport Psychology in Action. Available online at:

19 <https://doi.org/10.1080/21520704.2020.1838980>.

Abstract:

Concentration, focusing on the most relevant information for further processing, is regarded as a prerequisite for successful sporting performance. Athletes must possess awareness, knowledge, and controllability of their attention to concentrate effectively. One way to develop this awareness, knowledge, and controllability of attention is through the mechanism of meta-attention – thinking about, knowing about, and controlling attention. Meta-attention illuminates the underlying cognitive mechanisms that direct the attentional spotlight. We open with a brief background of attention and outline how concentration can be understood through a metacognitive lens. Next, we present Think Aloud Level 3 as a tool for capturing meta-attentional processes during sport performance. Finally, we discuss the applied implications of adopting a meta-attentional approach to understand concentration.

Introduction

Attention refers to selecting information for further cognitive processing consciously or unconsciously and involves the brain focusing and managing sensory inputs towards information perceived relevant to successfully complete the task at hand while inhibiting other information from further processing (Smith & Kosslyn, 2007). But attention has a limited capacity that emphasises selecting stimuli most relevant to complete the task (Chun et al., 2011). Therefore, a performer should select relevant information for further processing that facilitates performance, otherwise, performance decrements might occur as the performer becomes distracted by task irrelevant information. Concentration, or directing attention, is therefore widely acknowledged as a pre-requisite for successful sporting performance because our attention is always *somewhere*.

We best understand how attention works through metaphors. The most prominent metaphor in sport and performance psychology describes attention as a ‘spotlight’ (Posner, 1980; Moran & Toner, 2017). The attentional spotlight illuminates stimuli and what has been ‘lit-up’ is attended to – or concentrated on. The attentional spotlight can shine outwards towards external stimuli or inwards to internal stimuli. The individual must attempt to illuminate the most relevant information or face becoming distracted. Eye-tracking research (e.g., the ‘Quiet Eye’; Vickers, 1996) shows that expert athletes are better at selecting visual (i.e., external) information than their novice counterparts (Moran et al., 2018) because experts know “when, and where to look” (Mann et al., 2007: p.457). The Quiet Eye refers to the final fixation before skill movement and this fixation lasts longer in experts than in novices. The Quiet Eye phenomenon has been shown across a range of motor-skills (Vickers, 2016) and its significance in skill execution has been highlighted in meta-analyses (e.g., Rienhoff et al., 2016). Eye-tracking research, however, can only show us so much, for example, it cannot show us why or when individuals direct their attentional spotlight inwards as it only provides gaze data. Therefore, we need to get behind the ‘Quiet Eye’ if we are to understand concentration in athletes.

To direct their attentional spotlight, athletes must have knowledge and control of their attention system, something that relies on higher-order processes. First, this means that athletes need to know that they are attending to information that is most facilitative of performance at that time. By having knowledge of their attentional system, they will know the impact of their selected information on their attention. Second, athletes need to be able to implement control routines so that they can then attend to the most relevant information for performance. Therefore, knowledge and control of the attentional spotlight allows an athlete to focus and re-focus their attention during a performance. Without understanding what

athletes think about their own attention, practitioners cannot offer the most effective interventions to their athletes. This article presents an understanding about how athletes direct their attentional spotlight, outlines a methodological approach that can measure and gain insight into the control of the spotlight and provides considerations for practice. First, we explain metacognition and meta-attention and its significance to understand concentration. Next, we explain how ‘Think Aloud’ (Ericsson & Simon, 1993) can explore the meta-attentional processes of athletes. Finally, we consider applied implications of a meta-attentional approach to understand concentration.

Metacognition, meta-attention and its significance for understanding concentration.

The study of metacognition helps us to understand how athletes think about and control their cognitive processes in performance. Metacognition is an individual’s insight and control over their cognitive processes (Flavell, 1979), and it covers each cognition (e.g., meta-emotion, meta-memory, and meta-attention). This means that each cognition we experience has an associated meta-level process. Metacognition is commonly simplified to *thinking about thinking* or “knowing about knowing” (Van Overschelde, 2008, p. 47), however, metacognition is broader than its frequent simplification and can be best understood as a tripartite construct comprising: knowledge (e.g., of cognitive strategies and when to use them), control, and monitoring (Flavell, 1979; Flavell, 1987; Halpern, 2014; Tarricone, 2011). Therefore, metacognition is considered as fundamental for task performance and effective self-regulation because it allows controlling thoughts and actions to meet task demands (Dinsmore et al., 2008). Metacognition can range from a subconscious monitoring of thoughts to a more detailed reflection of the self, therefore it does not always require awareness or control (MacIntyre et al., 2014; Shea et al., 2014) and may take place in cognitive system 1 (see: Stanovich, 2011). System 2 is involved in metacognitive processes

94 where automatic processes would not be sufficient for processing the information faced, such
95 as during more complicated tasks that require reflection or decision-making (MacIntyre et al.,
96 2014). System 1 is automatic and outside of consciousness and, system 2 is conscious and is
97 engaged when an individual faces a more complicated task that relies on an effortful search
98 and control of cognitions.

99
100 The origins of metacognition and metacognitive research relate to education, with many
101 conceptualisations about metacognitive learning. For example, Flavell (1979) considered
102 metacognitive knowledge crucial for students because it enabled self-directed learning.
103 Students proficient in metacognitive knowledge possess awareness of their knowledge, what
104 they need to know and the study techniques that facilitate further knowledge, thus are more
105 effective learners than their peers who do not possess this proficiency. Much of the research
106 has built on Flavell's (1979) work and remained within an education and learning setting
107 (Hacker et al., 2008). Because intellectual skills and perceptual-motor skills rely on similar
108 mechanisms, metacognition may account for perceptual-motor skills just as they do with
109 intellectual skills (Augustyn & Rosenbaum, 2005; MacIntyre et al., 2014). Therefore,
110 metacognition is a strong theoretical concept from mainstream psychology that applies in
111 sport psychology. Taking this understanding forward, proficiency in metacognition can be
112 linked to skill development because the most successful athletes are likely to have knowledge
113 of their current skillset (i.e., perceptual-motor skills, perceptual-cognitive, technical, and
114 tactical), and the skills that require further development to achieve success (MacIntyre et al.,
115 2014; Moran et al., 2019). Further, by using 'skills' to describe metacognition it implies
116 trainability of metacognitive proficiency, that is, metacognition is not necessarily a fixed
117 trait-like characteristic so an increase in an athlete's domain-specific knowledge will increase
118 the athlete's ability to be use metacognitive strategies in performance.

119

120 Meta-attention, a component of metacognition, can provide insights into the controllability of
121 attention and concentration because it is *thinking* about, *knowing* about and, *controlling*
122 attention. Meta-attention holds great promise for better understanding concentration among
123 athletes because the study of meta-attention illuminates the underlying cognitive mechanisms
124 that direct the attentional spotlight (Moran, 1996). As we outlined earlier, an athlete's focus
125 of attention can have a significant influence on performance outcomes because an athlete
126 must select the most relevant stimuli or become distracted.

127

128 The original understanding of meta-attention is rooted in education, with research showing
129 that during a reading task younger children perceive their attention to be controlled by
130 external variables (e.g., distractions such as noise and reward), whereas older children
131 possess awareness of internal variables (e.g., interest) that can be controlled to direct
132 attention to maintain task relevant focus. In a notable study, Loper and Hallahan (1982)
133 measured meta-attention in school-age children (Kindergarten; Grade 2; Grade 5; and Grade
134 7) by using variables relevant to attention: interest, reward and noise distraction, in a forced
135 choice measure. Each variable had a positive and a negative scenario that were either aids or
136 deterrents to attention (e.g., "imagine a child who is very interested in what he is doing";
137 "imagine a child who is not very interested in what he is doing"). Cards were then paired to
138 establish forced choice items and children were asked, "which of these two children will
139 better pay attention?" Scoring was then calculated by the number of times a high value card
140 was chosen and the number of times a low value card was not (e.g., the number of times high
141 interest was chosen and the number of times low interest was not). Scoring was performed
142 for three measures: 'interest', 'reward', and 'quiet'. Each of the scenarios were paired against
143 each other, to present a variety of situations, and each card was presented five times within

144 twelve forced choices. Reading achievement was measured by using the validated measure
145 Wide Range Achievement Test (1965); a word recognition task. This test, however, was not
146 given to the youngest age group. Loper and Hallahan's (1982) findings supported their
147 hypotheses, showing that older children valued interest highest whereas younger children
148 valued reward and noise distraction. Post-hoc evaluations showed there to be significant age-
149 group differences on the interest variable. The research indicates that older children are more
150 aware of the variables required for attention and that they are able to perceive distractors too.
151 Therefore, older children are in a better position to control arising distractors, avoiding
152 disruptions to task performance (Loper & Hallahan, 1982; Miller & Bigi, 1979). Older
153 children possess awareness of their attention, therefore, know techniques that facilitate
154 concentration and those that do not. Loper and Hallahan (1982) also used Karniol and Ross
155 (1979) to help explain the differences between older and younger children's attention in the
156 reading task, outlining that it is the maturity of the reader that creates a disposition to
157 discount the value of extrinsic rewards because this may disrupt internal, intrinsic,
158 enjoyment. Therefore, changes in meta-attention are related to cognitive development.
159 Applied to sport, this means that performance related cognitions are likely to become more
160 developed with greater experience and greater knowledge. For example, an awareness of
161 standards and expectations and of cognitions that are conducive of performance. That is,
162 planning, monitoring and control of cognitions and behaviours and ensuring these are
163 consistent with the expected level. Loper and Hallahan (1982) also showed a small, but
164 significant, positive correlation between interest and reading achievement. Thus,
165 understanding meta-attention here can be related to the understanding that optimal
166 concentration requires focusing solely on actions under one's control (Moran, 2011). The
167 focus of attention may be 'lost' without an environmental distractor (i.e., external) present,
168 instead a wandering mind can direct attention towards task irrelevant thoughts (i.e., internal)

that result in lost concentration (Moran, 1996; Moran, 2011). The mechanism that realises sufficient attention is not directed to task-relevant information is a monitoring system that facilitates a re-focus to the task can and be identified as meta-attention and mapped onto the metacognitive framework. The accuracy and effectiveness of the meta-attentional mechanism is likely linked to the efficiency of an individual's cognitive processing (Moran, 1996). Because of a predicted greater metacognitive proficiency among higher-skilled athletes (MacIntyre et al., 2014), it is assumed that such athletes have a greater capacity to focus their attention, and are more aware of a wandering mind and are therefore able to implement suitable strategies to re-focus on task relevant cues allowing for successful control of attention.

Although meta-attention has only recently been examined in a sport context, some insight can be gained by looking at metacognitive research that sought to examine the role of metacognition in attentional focus. For example, Brick et al. (2015) highlighted the important role of metacognition for attentional focus in an endurance sport setting by creating a framework relevant to endurance activity, driven by interview data with elite endurance runners. Their data revealed that athletes monitor and control cognitions during running to optimise performance; specifically, athletes engaged in planning attentional strategies, monitoring task performance and, control of cognition during running. Results also indicated that athletes engaged in a review, an evaluation and refined their cognitions after running; behaviour that can be mapped to self-regulatory behaviours (e.g., Zimmerman, 2006).

Nietfeld (2003) indicated that the effectiveness of metacognitive strategy in performance is underpinned by the ability of the athlete. In a one-mile treadmill running task, Nietfeld (2003) reported a positive relationship between metacognitive strategy knowledge and the

194 ability of runners to monitor their performance. The findings here indicated that skilled
195 performers monitored largely internally and used domain-specific strategies driven by their
196 experience. Internal monitoring links to the understanding of meta-attention from an
197 educational context that searches for internal variables deemed to be important for
198 performance occurred, whereas strategies, can be linked to conscious control of attention.
199 Monitoring and information management strategies (i.e., control) were runners most frequent
200 reported attentional focus. Nietfeld's (2003) study also showed a negative correlation
201 between an external focus and metacognition, showing that metacognition is an internal
202 process. A positive correlation was reported between strategic knowledge and pace
203 monitoring; therefore, athletes should require awareness of suitable strategies and tactics to
204 most effectively monitor their performance. Overall, the findings in Nietfeld's study show
205 that skilled athletes are highly focused and strategic, processes that are seen to be optimal for
206 performance. It is suggested that their domain-specific strategies are developed through their
207 experience. Similar research using recreational runners by Brick et al. (2018) showed that
208 novice runners did not report a repertoire of metacognitive strategies, pacing and tactics were
209 reported, however, planning was not. In addition, post-race evaluations were not conducted
210 independently, rather were done with the help of more experienced runners. The results from
211 this study showed that novice runners were less strategic (i.e., planning) and were less likely
212 to plan or evaluate attentional strategies during running (i.e., monitoring). Brick et al. (2018)
213 outlined that metacognitive ability and cognitive strategies were developed through running
214 experience and this helped, runners shifting their attentional focus. Through newly gained
215 metacognitive abilities, runners were aware of sensory cues as an information source relevant
216 for their pace decision-making. By using MacIntyre et al. (2014) and Bless et al. (2009)
217 conceptualisation of metacognition, experience could be explained by expert and higher-
218 skilled athletes' possessing greater declarative knowledge (i.e., 'knowing that'; Sternberg &

219 Sternberg, 2016). Experts are then able to judge whether information is relevant, and take it
220 forward for greater processing, or if it is not relevant, to discard that information. Therefore,
221 practitioners should focus on developing declarative knowledge with their athletes because
222 this will teach them to monitor for relevant cues across situations. Thus, with declarative
223 knowledge athletes are more able to direct their attentional spotlight. Brick et al.'s (2018)
224 findings add support to the previous research that indicates the important role of task-specific
225 metacognitions that best facilitate regulation of cognitions such as attentional focus. To date,
226 the findings from studies that adopt a metacognitive framework to better understand
227 attentional processes in performance are bound by the context specificity of endurance sports.
228

229 To investigate meta-attention further Oliver et al., (2020a) used a grounded theory to
230 understand meta-attention among competitive-elite and successful-elite golfers. The resultant
231 theory showed that meta-attention operated as a bottom-up process with attentional resources
232 evaluated by golfers before using attentional control strategies; selecting an external visual
233 target, implementing a pre-shot routine and a consistent post-shot routine. In this case,
234 attentional resources can be viewed as internal variables and include, but are not limited to:
235 experience, training and confidence. Golfers experienced optimal attentional outcomes after
236 positively perceiving their attentional resources and implemented consistent attentional
237 control strategies; however, should a resource be perceived missing when required or
238 performers did not implement a control strategy, they experienced sub-optimal attentional
239 outcomes and faced internal distraction. The golfers' understanding of their own attentional
240 system drove meta-attentional processes and selection of desired attentional processes.
241 Evaluating attentional resources and implementing a control strategy uncovered in Oliver et
242 al.'s (2020a) study shows that golfers plan, monitor and control their attention regulation
243 during performance.

244

245 Building on these findings, Oliver et al. (2020b) explored meta-attention in a live setting
246 using concurrent data collection of meta-attentional processes during golf performance. By
247 using concurrent data collection, the researchers developed their previous study by exploring
248 how golfers engage in attentional thought and control during performance, capturing thoughts
249 and control strategies as they unfold. Golfers drew on different metacognitive resources (i.e.,
250 internal) at different times, however, starting control strategies were far more prevalent than
251 verbalisations of attention-based resource reflections. These findings suggest that monitoring
252 of internal resources is generally an unconscious process, however, during more challenging
253 times it may require an athlete to make a conscious search for a specific attentional resource.
254 For example, when golfers faced a tough shot or a recovery shot, they reflected on practices
255 and coaching they had received verbalising that they intended to draw on these experiences to
256 help them execute the shot they faced. Identifying unconscious monitoring allows for
257 theoretical integration with Stanovich's (2011) depiction of two cognitive systems. Golfers
258 engaged in a post-shot routine and 'switched-off', shifting their attention to a task-irrelevant
259 focus, between shots. This shifting of attention supports Davies et al. (2014) findings about a
260 golfer's attentional processes between shots and substantiates Tiger Woods' (2001) anecdotal
261 example that an evaluation should take place before an attentional shift towards the next shot
262 begins. The post-shot thoughts shared by the golfers also extend Kirschenbaum's 4-F model
263 (1997), expanding from a negative shot outcome to one for all shot outcomes.

264

265 Further meta-attentional research by Oliver et al. (under review) showed that higher skilled
266 golfers (Mean Handicap= 5.7) reported significantly more verbalisations per shot than lower
267 skilled golfers (Mean Handicap= 23), suggesting greater meta-attentional knowledge (i.e.,
268 more awareness of where their attentional beam was located). The results of Oliver et al.'s

(under review) study lend some support to MacIntyre et al.'s (2014) suggestion that expertise links with metacognition because higher skilled golfers verbalised more thoughts about their attentional cognitions. We are also cautious with this assertion because Oliver et al.'s (under review) study used two levels of club golfers, thus the extent to which the higher-skilled golfers possessed expertise could be questioned. Nevertheless, Oliver et al.'s (under review) study shone a light on golfers' attentional spotlight and concentration. Thought sequencing showed that higher skilled golfers verbalisations showed two lots of information gathering, suggesting that they spent longer gathering information on their environment, thus, could be seen to develop more informed plans to assist with successful skill execution. Sequential analysis was performed and it indicated likely thought pairings, revealing the most likely preceding thoughts, i.e., thoughts that occurred at a probability greater than chance. Thought pairings that occurred at a greater probability than chance suggest a deliberate decision to divert the attentional spotlight to information, either internally or externally, that the golfer judged most relevant.

Capturing Meta-Attentional Thoughts: Using Think Aloud.

Think Aloud (TA) is a research method outlined by Ericsson and Simon (1993) to overcome retrieval issues related to cognitive processes and experiences which are not an observable behaviour. Therefore, TA is a tool that can help us *get behind* the 'Quiet Eye' and capture conscious-level metacognitive processes involved in directing the attentional spotlight. We do, however, acknowledge that TA can only provide insight into processes occurring in cognitive system 2. Nevertheless, system 2 is where we see effortful planning, monitoring and control of physiological and psychological processes in a sport performance, something that previous research indicated expert performers do. Processes that are verbal are ideal for

TA research, thus thinking about attention and vocalising strategies deployed to control attention (i.e., meta-attention) is a prime candidate for research and applied practice.

There are three levels of TA (Ericsson & Simon, 1993), Level 1 is an effortless communication of inner speech and Level 2 refers to verbalising an internal representation that is not originally in verbal code (e.g., visual stimuli). Level 3 is at a much more detailed level than Level 1 and 2 because it requests individuals to explain their thoughts, ideas and motives. Therefore, Level 3 is closest to accessing the *meta-* level because it requires individuals to *think about their thinking* (Oliver et al., 2020b). For example, a golfer explaining why they are playing a certain shot and the factors they consider making this decision. To achieve Level 3 verbalisation, there is a requirement that the participant links between information and previously attended to thoughts. This means that Level 3 TA includes retrieval from Long Term Memory (i.e., where the explanation is housed). Because individuals consciously attend to additional information, that would otherwise be automatic, there is some concern that this focus could disrupt thought processes and performance (e.g., lead to reinvestment: Masters, 1992; Masters & Maxwell, 2008), however, research by Whitehead and colleagues (2015) allayed these fears and showed that within Level 3 TA golfers did not have their performance adversely affected by engaging in TA. Therefore, TA is a suitable tool to capture, measure and understand the cognitive processes experienced by athletes during performance with no detriment to performance. TA is also a useful tool for practitioners to better understand the cognitive processes that their athletes experience during performance.

To further highlight TA's suitability for collecting data on cognitive processes experienced by athletes during performance, is the growing popularity of the successful application of TA

across sport, including but not limited to: golf (Calmeiro & Tenenbaum, 2011; Nicholls & Polman, 2008; Oliver et al., 2020b; Oliver et al, under review; Whitehead et al., 2015; Whitehead et al., 2016), trapshooting (Calmeiro et al., 2010), tennis (McPherson & Kernodle, 2007), snooker (Walsh et al., 2018) and cycling (Whitehead et al., 2019). TA allows us to measure cognitive processes during a performance which can be mapped, and taken forward to inform interventions. Athletes should be briefed on TA and undertake practice trials that act as a warm-up and familiarisation to using TA (Eccles & Aarsal, 2017). Previous research suggests that those completing TA are handed and narrated Level 3 TA instructions outlining what is asked for them. The instructions given to participants should be sport specific for example golfers are instructed to verbalise where they directed their attention before a chip shot and why attention was to be directed there (Oliver et al., 2020b). Athletes should be given the opportunity to ask questions they have on Think Aloud. Practice trials can then provide familiarity with verbalising aloud (Eccles, 2012). Recent research outlines that practice trials may be context specific (Birch & Whitehead, 2020), however, to date much of the research has used non-task specific tasks such as calculating the number of dots on a page. The importance in familiarity and warm-up tasks shows the practitioner that athletes understand what is being asked of them when *thinking aloud*. By explaining their thoughts and actions, Level 3 TA provides an approximation to metacognitive processes because it required the golfers to think about their thinking (Oliver et al., 2020b).

Capturing meta-attentional verbalisations therefore allows practitioners to map the direction of the attentional beam, for example, when and why athletes divert it inwards at certain points during their performance. TA may also be of direct benefit to performers too as verbal reports can provide athletes insights into their own thought patterns, for example, it allows them to identify where thoughts have been helpful and unhelpful, this can then be used as part of their

own learning, development and may benefit the development of metacognition. Therefore, TA is posited as a suitable tool for understanding attentional control because it provides insights to the higher-level executive (i.e., meta- level) functions involved in orienting attention, something that can be used by athletes and practitioners.

Teaching athletes how to concentrate

Using meta-attention to understand concentration has several implications for athletes, coaches and sport psychologists. First, meta-attention shows that understanding the attentional system drives meta-attentional processes and selecting desired attentional processes. Those who are most proficient in their meta-attention can accurately direct their spotlight to the most relevant stimuli at the required time. By understanding their internal and external attentional stimuli athletes can more accurately direct their attentional spotlight and are less likely to succumb to distraction (i.e., illuminating task irrelevant stimuli). Specifically, our current understanding of meta-attention (e.g., Oliver et al., 2020a) shows an evaluation of attentional resources takes place; should an individual experience cognitive anxiety related to their attentional resources their perception of their resource can become an internal distraction. Applying this process to practice, concentration could be enhanced by teaching performers to avoid using binary evaluations of their attentional resources. Oliver et al.'s (2020a) research shows golfers evaluate their attentional resources through a positive-negative lens, they either have the attentional resource required or they do not. Using a binary evaluation on attentional resources may be the source of the problem, rather than the missing resource itself, because it is the negative perception that becomes the source of distraction. Therefore, athletes should avoid using a positive-negative evaluation of their attentional resources. To help performers avoid binary evaluations of their attentional resources, it may be worthwhile for golfers to undertake mindfulness training (e.g., Birrer et al., 2012; Birrer &

Röthlin, 2017) because being mindful takes away the binary evaluation that occurs in the monitoring stage of meta-attention. We also believe that meta-attention and mindfulness are conceptually linked because proficiency in each promote a focus on the present moment. If athletes are *mindful* they can bring their attention to the present moment, that is, they can direct their attentional spotlight to the most important information but to do so they need to know where their spotlight is shining in the first place (i.e., having meta-attentional awareness). Mindfulness-based interventions may also benefit golfers who do not have a full repertoire of the attentional resources outlined by Oliver et al.'s (2020) model because a mindful-based approach could offset negative perceptions of 'missing' resources. Practitioners could use a mindfulness-based intervention with athletes regardless of their skill level.

Another practical implication from meta-attentional research relates to controlling attentional shifts. Pre-shot routines for switching on attention is well established for self-paced sports (e.g., Cotterill et al., 2010) and is widely applied as an intervention in practical sport psychology settings. But there has been less attention in the literature that seeks to understand how golfers use the time between shots. The ways golfers make use of this time provides details on effective attention regulation, and allows for attention control and spotlight shifts to be mapped. Oliver et al.'s (2020a; 2020b; under review) findings showed that golfers took on a task irrelevant focus during periods between skill executions as a final stage in their post-shot routine. These findings offer a recommendation that those working with golfers instruct them to implement a post-shot routine to allow for feedback to take place. Then, golfers should initiate a switch-off period between shots. The downtime between shots is taken up by a task irrelevant focus. When coaches and sport psychologists are developing an attention training package post-shot routine training and switch-off should be delivered

alongside a pre-shot routine. Providing training on pre-shot and post-shot routines within the same intervention package will give golfers' greater control of their attention shifts that will occur in a round of golf. This pairing can also increase athletes' awareness and knowledge of their attention. The practical suggestion of the benefits that a post-shot routine and between-shot switch-off bring indicated by Oliver et al.'s research (2020a; 2020b; under review) is consistent with previous research in golf (Davies et al., 2014; Davies et al., 2017; Kirschenbaum, 1997). A further benefit of training post-shot routines and disassociation is that golfers preserve attentional resources required for attentional control throughout a round of golf. A post-shot routine may resemble an immediate outcome reaction (good or bad), a technical evaluation and a task irrelevant focus. Anecdotal evidence suggests that golfers "switch off" – or disassociate – between shots because it is unfeasible to be focused throughout an entire round of golf. Applied sport psychologists may wish to apply these principles to athletes from other intermittent and target sports so that their athletes optimise their concentration, and gain greater control of their attentional spotlight.

To conclude, this article has shown that meta-attention can explain distractibility in sports performers and describe ways in which an athlete focuses and re-focuses attention. Concentration depends on positive evaluations of attentional resources when they are required and implementing a suitable control strategy pre- and post- skill execution because these strategies allow performers to direct their attentional spotlight. This is a process that is underpinned by an athlete's meta-attentional proficiency. Because attention is always shining *somewhere* and metacognitive processes are on-going, TA can be used to improve spotlight accuracy because it makes performers more aware of their attentional processes. If performers are aware of where their spotlight is shining and where it should be shining they can direct it if it is misplaced. Therefore, TA would increase accuracy of their attentional

418 spotlight. We suggest that practitioners explore their athletes' understanding and knowledge
419 of attention in live performance settings, and create a bespoke training programme to
420 optimise concentration. This is achieved by showing athletes where their attention is, in turn
421 handing athletes more awareness, greater control of their attentional spotlight; teaching them
422 how to concentrate.

423

424 Word Count: 4,848 (inc. abstract).

References

- Augustyn, J. S., & Rosenbaum, D. A. (2005). Metacognitive control of action: Preparation for aiming reflects knowledge of Fitt's law. *Psychonomic Bulletin & Review*, 12(5), 911-916. <https://doi.org/10.3758/BF03196785>
- Birch, P. D., & Whitehead, A. E. (2020). Investigating the Comparative Suitability of Traditional and Task-Specific Think Aloud Training. *Perceptual and Motor Skills*, 127(1), 202-224. <https://doi.org/10.1177/0031512519882274>
- Birrer, D., & Röthlin, P. (2017). Riding the third wave: CBT and mindfulness-based interventions in sport psychology. In S. J. Zizzi & M. B. Andersen (Eds.), *Being mindful in sport and exercise psychology* (pp. 101-122). Fit.
- Birrer, D., Röthlin, P., & Morgan, G. (2012). Mindfulness to enhance athletic performance: Theoretical considerations and possible impact mechanisms. *Mindfulness*, 3(3), 235-246. <https://doi.org/10.1007/s12671-012-0109-2>
- Bless H., Keller J., Igou E. R. (2009). Metacognition. In J. Förster & F. J. Strack (Eds.). *Social Cognition, the Basis of Human Interaction* (pp. 157-178). Psychology Press.
- Brick, N. E., Campbell, M. J., Sheehan, R. B., Fitzpatrick, B. L., & MacIntyre, T. E. (2018). Metacognitive processes and attentional focus in recreational endurance runners. *International Journal of Sport and Exercise Psychology*, 16, 1-18. <https://doi.org/10.1080/1612197X.2018.1519841>
- Brick, N. E., MacIntyre, T. E., & Campbell, M. J. (2015). Metacognitive processes in the self-regulation of performance in elite endurance runners. *Psychology of Sport and Exercise*, 19, 1-9. <https://doi.org/10.1016/j.psychsport.2015.02.003>
- Calmeiro, L., & Tenenbaum, G. (2011). Concurrent verbal protocol analysis in sport: Illustration of thought processes during a golf-putting task. *Journal of Clinical Sport Psychology*, 5(3), 223-236. <https://doi.org/10.1123/jcsp.5.3.223>

450 Calmeiro, L., Tenenbaum, G., & Eccles, D. (2010). Event-sequence analysis of appraisals
 451 and coping during trapshooting performance. *Journal of Applied Sport*
 452 *Psychology*, 22(4), 392-407. <https://doi.org/10.1080/10413200.2010.495325>
 453 Chun, M. M., Golomb, J. D., & Turk-Browne, N. B. (2011). A taxonomy of external and
 454 internal attention. *The Annual Review of Psychology*, 62, 73-101.
 455 <https://doi.org/10.1146/annurev.psych.093008.100427>
 456 Cotterill, S. T., Sanders, R., & Collins, D. (2010). Developing effective pre- performance
 457 routines in golf: Why don't we ask the golfer? *Journal of Applied Sport Psychology*,
 458 22(1), 51-64. <https://doi.org/10.1080/10413200903403216>
 459 Davies, T., Collins, D., & Cruickshank, A. (2014). So what do we do with the rest of the day?
 460 going beyond the pre-shot routine in professional golf. *International Journal of Golf*
 461 *Science*, 2, 163-175. <https://doi.org/10.1123/ijgs.2014-0008>
 462 Davies, T., Collins, D., & Cruickshank, A. (2017). This is what we do with the rest of the
 463 day! exploring macro and meso levels of elite golf performance. *The Sport*
 464 *Psychologist*, 31(2), 117-128. <https://doi.org/10.1123/tsp.2016-0049>
 465 Dinsmore, D. L., Alexander, P. A., & Loughlin, S. M. (2008). Focusing the conceptual lens
 466 on metacognition, self-regulation, and self-regulated learning. *Educational*
 467 *Psychology Review*, 20(4), 391-409. <https://doi.org/10.1007/s10648-008-9083-6>
 468 Eccles, D. W. (2012). Verbal reports of cognitive processes. In G. Tenenbaum, R. C. Eklund
 469 & A. Kamata (Eds.), *Measurement in sport and exercise psychology* (pp. 103-117).
 470 Human Kinetics.
 471 Eccles, D. W., & Arsal, G. (2017). The think aloud method: What is it and how do I use it?
 472 *Qualitative Research in Sport, Exercise and Health*, 9(4), 514-531.
 473 <https://doi.org/10.1080/2159676X.2017.1331501>
 474 Ericsson, K. A., & Simon, H. A. (1993). *Protocol analysis*. The MIT Press.

475 Flavell, J. H. (1979). Metacognition and cognitive monitoring: A new area of Cognitive–
 476 Developmental inquiry. *American Psychologist*, 34(10), 906-911.
 477 <https://doi.org/10.1037/0003-066X.34.10.906>

478 Hacker, D. J., Bol, L., & Keener, M. C. (2008). Metacognition in education: A focus on
 479 calibration. In J. Dunlosky & R. A. Bjork (Eds.), *Handbook of metamemory and*
 480 *memory* (p. 429–455). Psychology Press.

481 Halpern, D. F. (2014). *Thought and knowledge: An introduction to critical thinking* (5th ed.).
 482 Psychology Press.

483 Jastak, J. F., & Jastak, J. F. (1965). The Wide Range Achievement Test. Guidance
 484 Association.

485 Karniol, R., & Ross, M. (1979). Children's use of a causal attribution schema and the
 486 inference of manipulative intentions. *Child Development*, 463-468.
 487 <https://doi.org/10.2307/1129424>

488 Kirschenbaum, D. S. (1997). Mind matters: Seven steps to smarter sport performance.
 489 Cooper.

490 Loper, A. B., & Hallahan, D. P. (1982). Meta-attention: The development of awareness of the
 491 attentional process. *The Journal of General Psychology*, 106(1), 27-33.
 492 <https://doi.org/10.1080/00221309.1982.9710970>

493 MacIntyre, T. E., Igou, E. R., Campbell, M. J., Moran, A. P., & Matthews, J. (2014).
 494 Metacognition and action: A new pathway to understanding social and cognitive
 495 aspects of expertise in sport. *Frontiers in Psychology*, 5, 1-12.
 496 <https://doi.org/10.3389/fpsyg.2014.01155>

497 Mann, D. T., Williams, A. M., Ward, P., & Janelle, C. M. (2007). Perceptual-cognitive
 498 expertise in sport: A meta-analysis. *Journal of Sport and Exercise Psychology*, 29(4),
 499 457-478. <https://doi.org/10.1123/jsep.29.4.457>

500 Masters, R. S. W. (1992). Knowledge, knerves and know-how: The role of explicit versus
 501 implicit knowledge in the breakdown of a complex motor skill under pressure. *British*
 502 *Journal of Psychology*, 83(3), 343-358. [https://doi.org/10.1111/j.2044-](https://doi.org/10.1111/j.2044-8295.1992.tb02446.x)
 503 [8295.1992.tb02446.x](https://doi.org/10.1111/j.2044-8295.1992.tb02446.x)

504 Masters, R. S. W., & Maxwell, J. (2008). The theory of reinvestment. *International Review of*
 505 *Sport and Exercise Psychology*, 1(2), 160-183.
 506 <https://doi.org/10.1080/17509840802287218>

507 McPherson, S. L., & Kernodle, M. (2007). Mapping two new points on the tennis expertise
 508 continuum: Tactical skills of adult advanced beginners and entry-level professionals
 509 during competition. *Journal of Sports Sciences*, 25(8), 945-959.
 510 <https://doi.org/10.1080/02640410600908035>

511 Miller, P. H., & Bigi, L. (1979). The development of children's understanding of attention.
 512 *Merrill-Palmer Quarterly*, 25, 235-250.

513 Moran, A. P. (1996). *The psychology of concentration in sport performers*. Psychology Press.

514 Moran, A. P., & Toner, J. (2017). *A Critical Introduction to Sport Psychology: A Critical*
 515 *Introduction*. Taylor & Francis.

516 Moran, A. P., Campbell, M. J., & Ranieri, D. (2018). Implications of eye tracking technology
 517 for applied sport psychology. *Journal of Sport Psychology in Action*, 9(4), 249-259.
 518 <https://doi.org/10.1080/21520704.2018.1511660>

519 Moran, A. P., Campbell, M. J., & Toner, J. (2019). Exploring the cognitive mechanisms of
 520 expertise in sport: Progress and prospects. *Psychology of Sport and Exercise*, 42, 8-
 521 15. <https://doi.org/10.1016/j.psychsport.2018.12.019>

522 Nicholls, A. R., & Polman, R. C. J. (2008). Think aloud: Acute stress and coping strategies
 523 during golf performances. *Anxiety, Stress & Coping*, 21(3), 283-294.
 524 <https://doi.org/10.1080/10615800701609207>

525 Nietfeld, J. L. (2003). An examination of metacognitive strategy use and monitoring skills by
 526 competitive middle distance runners. *Journal of Applied Sport Psychology*, 15, 307-
 527 320. <https://doi.org/10.1080/10413200390237942>

528 Oliver, A., McCarthy, P. J., & Burns, L. (2020a). A Grounded-Theory Study of Meta-
 529 Attention in Golfers. *The Sport Psychologist*, 34(1), 11-22.
 530 <https://doi.org/10.1123/tsp.2019-0014>

531 Oliver, A., McCarthy, P. J., & Burns, L. (2020b). Using a ‘Think Aloud’ protocol to
 532 understand meta-attention in club-level golfers, *International Journal of Sports and*
 533 *Exercise Psychology*, online. <https://doi.org/10.1080/1612197X.2020.1766536>

534 Oliver, A., McCarthy, P. J., & Burns, L. (under review). Event sequencing of the meta-
 535 attentional beam in higher and lower skilled golfers.

536 Posner, M. I. (1980). Orienting of attention. *Quarterly Journal of Experimental Psychology*,
 537 32, 3-25. <https://doi.org/10.1080/00335558008248231>

538 Rienhoff, R., Tirp, J., Strauß, B., Baker, J., & Schorer, J. (2016). The ‘quiet eye’ and motor
 539 performance: A systematic review based on Newell’s constraints-led model. *Sports*
 540 *Medicine*, 46(4), 589-603. <https://doi.org/10.1007/s40279-015-0442-4>

541 Shea, N., Boldt, A., Bang, D., Yeung, N., Heyes, C., & Frith, C. D. (2014). Supra- personal
 542 cognitive control and metacognition. *Trends in Cognitive Sciences*, 18(4), 186-193.
 543 <https://doi.org/10.1016/j.tics.2014.01.006>

544 Smith, E. E., & Kosslyn, S. M. (2007). *Cognitive psychology: Mind and brain*. Pearson.

545 Stanovich, K. E. (2011). *Rationality and the reflective mind*. Oxford: Oxford University
 546 Press. <https://doi.org/10.1093/acprof:oso/9780195341140.001.0001>

547 Sternberg, R. J., & Sternberg, K. (2016). *Cognitive psychology*. Nelson Education.

548 Van Overschelde, J. P. (2008). *Metacognition: Knowing about knowing*. In J. Dunlosky & R.
 549 A. Bjork (Eds.), *Handbook of metamemory and memory* (p. 47–71). Psychology
 550 Press.
 551 Vickers, J. N. (1996). Visual control when aiming at a far target. *Journal of Experimental*
 552 *Psychology: Human Perception and Performance*, 22(2), 342- 354.
 553 <https://doi.org/10.1037/0096-1523.22.2.342>
 554 Vickers, J. N. (2016). The quiet eye: Origins, controversies, and future
 555 directions. *Kinesiology Review*, 5(2), 119-128. <https://doi.org/10.1123/kr.2016-0005>
 556 Welsh, J. C., Dewhurst, S. A., & Perry, J. L. (2018). Thinking Aloud: An exploration of
 557 cognitions in professional snooker. *Psychology of Sport and Exercise*, 36, 197-208.
 558 <https://doi.org/10.1016/j.psychsport.2018.03.003>
 559 Whitehead, A. E., Jones, H. S., Williams, E. L., Dowling, C., Morley, D., Taylor, J. A., &
 560 Polman, R. C. (2019). Changes in cognition over a 16.1 km cycling time trial using
 561 think aloud protocol: Preliminary evidence. *International Journal of Sport and*
 562 *Exercise Psychology*, 17(3), 266-274.
 563 <https://doi.org/10.1080/1612197X.2017.1292302>
 564 Whitehead, A. E., Taylor, J. A., & Polman, R. C. J. (2015). Examination of the suitability of
 565 collecting in event cognitive processes using think aloud protocol in golf. *Frontiers in*
 566 *Psychology*, 6(1083), 1-12. <https://doi.org/10.3389/fpsyg.2015.01083>
 567 Whitehead, A. E., Taylor, J. A., & Polman, R. C. J. (2016). Evidence for skill level
 568 differences in the thought processes of golfers during high and low pressure
 569 situations. *Frontiers in Psychology*, 6(1974), 1-12.
 570 <https://doi.org/10.3389/fpsyg.2015.01974>
 571 Woods, T. (2001). *How I play golf*. Warner Books.

572 Zimmerman, B. (2006). Development and Adaptation of Expertise: The Role of Self-
573 Regulatory Processes and Beliefs. In K. Ericsson, N. Charness, P. Feltovich, & R.
574 Hoffman (Eds.), *The Cambridge Handbook of Expertise and Expert Performance* (pp.
575 705-722). Cambridge University Press.
576 <http://doi.org/10.1017/CBO9780511816796.039>