Using a “Think Aloud” protocol to understand meta-attention in club-level golfers

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At present, there is only a theoretical understanding of the role of meta-attention in golf and there is no research that studies the real-time cognitive processes that construct meta-attention. Therefore, this study sought to explore the real-time meta-attentional processes experienced by golfers within a performance as this would develop a further understanding of concentration during performance. Seven intermediate level golfers (Handicap $M = 14.43$) performed over 6 holes using Think Aloud (TA) Level 3. Players' verbalisations were recorded, transcribed verbatim, and then were subjected to verbal protocol analysis. Analysis revealed several metacognitions, control strategies and game situation thoughts during performance. Attentional metacognitions varied by the shot, however, consistent control routines were used throughout. The insights into meta-attentional processes captured lend support to the theoretical understanding of meta-attention, and show that golfers tended to externalise their attentional focus during performance, additionally golfers frequently focused their attention towards environmental information related to their game situation. The results allow for a further understanding of the higher-order processes of concentration and can be brought forward to further theoretical understanding and shape attention training given to golfers.

Keywords: meta-attention; attention-regulation; think aloud; golf; metacognition

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Introduction

Concentration is a deliberate decision to invest and direct attention towards stimuli that are most important for successful task execution. Athletes are required to actively regulate their attention to direct it towards stimuli that are most relevant for the task at hand. The ability to focus effectively is regarded as a pre-requisite of successful performance across sport settings (Moran, 2011). Nevertheless, the underlying cognitive mechanisms behind attention regulation are yet to be fully understood. For example, Posner (1980) used a 'spotlight' analogy to describe the nature of attention, however, little is known about how individuals control their spotlight and illuminate areas relevant for task performance. Furthermore, attention may be lost without an environmental distractor present and, instead a wandering mind can cause an individual to lose concentration to the detriment of performance (Moran, 1996; Moran, 2011). For example, Doug Sanders was famously a three-foot putt away from winning the 1970 Open Championship, seemingly his mind had wandered, no longer was he thinking about the putt at hand, instead he was thinking too far ahead and how he would mark the victory:

> "I made the mistake about thinking which section of the crowd I was going to bow to! I had the victory speech prepared before the battle was over" (cited in: Kremer & Moran, 2008: P105).

The cognitive mechanism that realises sufficient attention is not being directed to the task at hand becomes an area of interest because it is this mechanism that enables a performer to *re-focus* when attention is seemingly *misdirected* (Moran, 1996). Though, the effectiveness of refocusing is likely to be linked to the efficiency of a performer's cognitive processing (Moran, 1996).

Metacognition provides a possible framework to understand control and regulation of cognitions, including attention. Metacognition goes beyond cognition, is a higher-level cognitive function and is sometimes referred to as cognition about cognition (Flavell, 1979). It is defined as a tripartite construct that contains an individual's insight, control and monitoring of their cognitions (Flavell, 1979; Tarricone, 2011), and metacognition is vital for successful self-regulation (Tarricone, 2011). Stanovich (2011) outlines metacognition operates via two systems; system 1 that is automatic and unconscious and system 2 that involves an effortful search and control usually occurring under challenging circumstances. MacIntyre, Igou, Campbell, Moran and Matthews (2014) outlined metacognition as a pathway to understanding expertise amongst athletes based on the assumption that experts possess knowledge of an expected standard of performance, and an on-going metacognitive monitoring system alerts a performer to any deviation from this standard, initiating self-regulatory strategies as an attempt to return performance to expected standards. Because expert performers possess greater automation, less demand is placed on working-memory (Beilock & Carr, 2001), freeing up space for metacognitive assessment and implementing strategies to achieve goals (MacIntyre et al., 2014). Furthermore, Moran, Campbell and Toner (2019) outlined that metacognitive knowledge allows experts to be more flexible in the allocation of their attention resources to challenges faced in performance environments. Therefore, the relevance of a metacognitive framework to understanding attention regulation in performance is emphasised.

One area of metacognition that has particular relevance for performance and attention is meta-attention. Moran (1996) outlined that the study of meta-attention amongst athletes can reveal more about concentration in sport because meta-attention is an individual's knowledge and awareness of the operation and controllability of their attentional system (Miller & Bigi,

1979). Specifically, the study of meta-attention should provide insight about how an athlete can re-focus should there be a breakdown in selective attention. Selective attention is the selection and response to relevant stimuli while ignoring irrelevant stimuli (Moran, 2011). Therefore, athletes require have meta-attentional knowledge to know if they are attending to the most appropriate cues, and if not, they must implement a strategy to re-focus their attention to stimuli that are more appropriate. To date, however, meta-attention research in sport psychology has been limited. Nevertheless, endurance-based research has attempted to apply a metacognitive framework to understand attentional processes during endurance sport activity. For example Brick, Campbell and MacIntyre (2014) used interviews with elite endurance runners that revealed athletes monitor and control their cognitions during running to optimise performance. Specifically, engaging in attentional strategies to enhance performance. In another study, Nietfeld (2003) reported a positive relationship between metacognitive strategy knowledge and the ability of runners' performance monitoring. Whitehead and colleagues (2019) provided further insights into monitoring and strategy use in endurance events through a TA cycling time trial study. Whitehead et al. (2019) showed changes in cognition over the course of the event, for example towards the end of an event attention directs towards distance information which is suggested to be a possible regulatory strategy. Whitehead et al. (2019) also indicated that familiarity with a task allows them to monitor their distance against expected standards. The findings within these studies suggest that skilled performers use domain-specific strategies that are driven by their experience to inform and influence their performance. Metacognition underpins monitoring and control of performance because of its links to self-regulation (Efklides, 2008; Tarricone, 2011). Performers with greater metacognitive proficiency possess self-regulatory behaviours that allow planning, monitoring and control of an experience. This means that should a performer with metacognitive proficiency be aware their performance deviates from their expected

standard they can plan and implement a strategy to meet their goal. Cognitions alone are not enough to facilitate performance, rather an athlete must be able to manage, monitor and understand the cognitions they are experiencing. This is facilitated by their metacognitive proficiency. Though one should consider that the findings from endurance research are context specific and the extent to which the findings can be applied to a self-paced sport, like golf, are limited. The limited research on regulatory-behaviours within self-paced sport necessitates the need for further research to extend our understanding of planning, control and monitoring of cognitions during performance because such metacognitive skills are likely to be domain-specific.

Seeking to develop an understanding of attention-regulation within a self-paced sport, Oliver, McCarthy and Burns (in press) used a grounded theory methodology to explore meta-attention among eight competitive male golfers. Results from the study indicated that meta-attention is resourced-based with metacognitive reflections facilitating attentional control, and failure to locate a resource when needed can lead to internal distraction. Distraction can also occur if a golfer fails to successfully implement attentional control strategies such as a consistent pre-shot routine. Although a sound theoretical understanding of meta-attention relevant to golf was established in Oliver et al.'s (in press) study, issues surrounding retrospective recall may be a potential issue, and there is a need to better understand meta-attentional processes as they happen in performance. Oliver et al.'s research into meta-attention in golf was the first meaningful study of its type, however, further research is required to better understand concentration and its underlying mechanisms within golf performance. Because we understand concentration to underpin successful sporting performance it is important to observe the cognitive mechanisms that direct the attentional spotlight within a performance context, alongside the development of understanding golfers'

knowledge of their attentional system. That is, there is a need to better understand how golfers apply meta-attention during a performance so that we can verify the theoretical assumptions of Oliver et al. (in press) and map the attentional spotlight and the cognitive processes that direct its beam.

Due to the intermittent nature of golf frequent shifts in attention are expected, for example, Nideffer and Sagal (2006) suggested that golfers' attention should begin with a broad external focus for information gathering to inform the shot at hand, which then moves towards a narrow internal focus to execute the shot. Golfers' use of information gathering at the beginning of their thought sequences prior to skill execution has been captured in Calmeiro and Tenenbaum (2011), and Whitehead, Polman and Taylor (2016) studies that used concurrent verbalisations to capture the decision-making process during golf performance. The adoption of an external focus of attention prior to, and during, skill execution has received extensive support for athletes within skilled performance with suggestion that an internal focus of attention could lead to a breakdown in performance (Wulf, 2013). Whitehead et al. (2016) showed that under competitive pressure skilled golfers were more likely to verbalise technical instruction compared to practice conditions, particularly when performing putts. This suggests that under challenging circumstances a performers' attentional spotlight may involuntarily move inwards during a performance. Therefore, it is important that performers are aware of the movability of their attentional spotlight during a performance and they should monitor and regulate their attentional beam accordingly. Because a round of golf can last up to five hours sustained concentration is unlikely to be possible due to limited cognitive resources, therefore a golfer should be selective when they choose to initiate attentional control strategies. Hellstrom (2009) suggests that golfers should train to focus and re-focus their attention rather than being *switched on*

147 throughout a performance. By collecting data concurrently during a round of golf, calls for
148 research can be answered; in addition, by employing concurrent data collection within a live
149 golf setting data gathered can be seen to be representative of a performance environment,
150 therefore ecological validity concerns faced are addressed and real-time meta-attentional
151 processes that occur within performance can be understood.
152
153 Ericsson and Simon's (1993) 'Think Aloud' (TA) protocol analysis can be used to overcome
154 the limitations of retrospective recall, and has successfully been applied as a means to collect
155 real-time cognitions in studies across domains, including sports psychology (e.g., Nicholls &
156 Polman, 2008; Welsh, Dewhurst, & Perry, 2018; Whitehead, Taylor, & Polman, 2015;
157 Whitehead et al., 2016; Whitehead et al., 2019). Ericsson and Simon (1993) outlined three
158 levels of verbalisation, with the highest level, Level 3, requiring individuals to explain their
159 thoughts. Level 2 TA refers to verbalising an internal representation that is not originally in
160 verbal code (e.g., visual stimuli). Level 1 is an effortless communication of inner speech.
161 Level 3 can be seen as closest to accessing the meta- level because individuals have to *think*
162 *about their thinking*. Whitehead et al. (2015) used a between-groups design to examine the
163 suitability of TA in golf. Participants were assigned to Level 2 TA, Level 3 TA or no
164 verbalisation while they completed a performing a putting task and six full holes of golf. The
165 tasks were followed up by 3 retrospective interviews, the first occurred 10 minutes after
166 performance, the second 24 hours after performance and the final interview occurred 48
167 hours after performance. Whitehead et al. (2015) found that Level 3 data was richer
168 compared to Level 2 data and data recalled retrospectively. Level 3 TA enabled the golfers to
169 explain their performance and cognitive strategies to facilitate performance, thus may be
170 suitable for examining meta-attentional processes among golfers. Furthermore, it had been a
171 concern that Level 3 verbalisations would cause performance breakdowns through

reinvestment (Masters, 1992), however, Whitehead et al. (2015) showed no disruption to task performance, indicating its suitability for concurrently examining cognitive processes during a task performance. Level 3 TA is opted for over Level 2 in the current study because it can be understood to be an approximation to meta- level verbalisations and it can provide rich rata without disrupting performance.

The purpose of this study was to use 'think aloud' to develop the findings of Oliver et al. (in press) and capture real-time attentional cognitions of golfers during a practice session within a naturalistic setting. This research possesses theoretical and practical implications because it explores how golfers focus and think about their attention and then apply this to their actions during performance. Thus, following this line of enquiry provides a pathway to a better understanding of concentration in golf and one that may be used to inform psychological interventions.

Method

Participants

Four male and three female club level golfers (Handicap M = 14.43; SD = 8.78) based at golf clubs in central Scotland. Participants were required to have taken part in competitive golf within the last 12 months (e.g., club medal) and played at least once per week during the regular season. Exclusion criteria were applied to golfers who had not participated in competitive golf within the last 12 months. None of the participants had prior experience of using TA.

Materials

Each of the golfers played with their own golf clubs on six holes of their home golf course and each participant completed various types of hole (i.e., Par 3, Par 4 and, Par 5). Participant verbalisations were recorded using a digital voice recorder. Participants placed the device in a pocket which did not disrupt their swing, and a wire to a microphone was tucked inside the participant's shirt or jacket and clipped to their collar.

Procedure

The study was approved by the ethics committee of the authors' institution, golfers were then approached to participate in the present research. British Psychological Society ethical standards were followed when conducting this study and full confidentiality was guaranteed. Prior to taking part in the study, participants provided written informed consent.

Before data collection, and in alignment with Ericsson and Simon (1993), all of the participants were briefed on TA and undertook practice trials that acted as a warm-up and familiarisation to using TA (Eccles & Arsal, 2017). Participants were handed and narrated Level 3 TA instructions outlining what they were being asked to do during the study. The instructions given to participants were written with the golf context in mind, for example where they directed their attention prior to a chip shot and why attention was to be directed there. At this point, participants were given the opportunity to ask questions they had on TA. Following instruction, participants were taken through a series of non-task specific TA practice tasks (Eccles, 2012) to familiarise themselves with verbalising aloud. In accordance with Level 3 TA, participants were asked to explain how they completed each exercise. By explaining their thoughts and actions, Level 3 TA provided an approximation to metacognitive processes because it required the golfers to think about their thinking. Tasks included calculating the number of dots on a page and an arithmetic exercise. Instruction and

training took approximately 20 minutes, although participants had to demonstrate adequately completing the warm-up exercises before proceeding with the main task. Participants were asked if they were comfortable and if so participants proceeded to data collection. If participants were unsure, more TA trials were available and further instruction could be given. In all cases participants progressed straight to data collection. Data collection commenced immediately after instruction and training.

Participants completed TA over six full holes of golf, six holes was deemed appropriate based on previous research and is deemed to not be overly demanding on the golfer (Nicholls & Polman, 2008; Whitehead et al., 2015). Golfers were asked to verbalise their thoughts throughout each of the six holes (apart from during their swing) as well as providing explanations for their actions (e.g., using the tree at the back left of the green as a visual target). In line with previous TA research (e.g., Nicholls & Polman, 2008; Whitehead et al., 2015) in the event of a participant falling silent for an extended period (20s), the researcher would prompt the participant to resume thinking aloud. Throughout the data collection, the first author was present during each participant's session and stood approximately five metres away. This distance was deemed appropriate because it would allow the researcher to hear if the participant were continuing to engage in verbalisations. Recording was continuous until the golfer had completed post-shot evaluation of their sixth hole.

Data Analysis

Following data collection, each of the participant's TA verbalisations were transcribed verbatim and subject to protocol analysis (Ericsson & Simon, 1993). Verbal reports were then checked for criterion related to relevance to the given task and a second criterion related to consistency (Ericsson & Simon, 1993). Given the study aimed to explore attention regulation

(i.e., thoughts and control), task irrelevant thoughts were not removed from the dataset, instead were categorised as a task irrelevant focus because they could be regarded as an external dissociation strategy (Brick et al., 2014; Welsh et al., 2018; Whitehead et al., 2019). Line-by-line content analysis (Maykut & Morehouse, 1994) was selected to identify recurring themes in the data and was carried out by the first author. Units of information were coded and grouped in categories. Verbalisations that the first author (a PhD researcher) perceived to be attentional thoughts, or *thinking about thinking*, were coded as 'attentional metacognitions', verbalisations that involved a conscious effort to control attention and its direction (i.e., internal or external) were coded as 'attentional control' and information gathering and game-based actions were coded as 'game situation'. Content analysis drew on interplay of inductive and deductive analysis and Oliver et al. (in press.) study provided rules and verification in determining meta-attentional verbalisation coding. Following concerns about rigor in qualitative sport psychology research (Smith & McGannon, 2018), we followed MacPhail, Khoza, Abler and Ranganathan (2016) guidelines for inter-rater reliability to establish rigor in the present study. MacPhail et al.'s guidelines were selected because of their consistency with the first author's post-positivist position. Coding rules were written and this framework was used to code verbalisations. The second author (Supervisor) independently analysed a blind sample of the verbal reports and this was compared to the codes identified by the first author (PhD Researcher). An inter-rater agreement score of 0.85 was achieved and under Burla et al. (2008) guidelines this level of agreement is considered 'perfect'. Any differences in themes identified were discussed by the first and second author and in all cases agreement on a final category was established. In all cases the code identified by the first author was used. Because we sought to capture cognitions (about cognitions) as they occurred during a performance, and the lack of trustworthiness of member-checking (Smith & McGannon, 2018), we did not perform member reflections over concerns this

would artificially alter concurrent verbal reports – we specifically sought to capture cognitions as they happen. The frequency of each meta-attentional verbalisation was then calculated to provide descriptive data of the occurrence of each type of verbalisation.

Results

Participants reported 93 attentional resource reflections from 10 sources (table 1), participants engaged in attentional control strategies 736 times, from 7 strategies (5 external, 2 internal; table 2) and 397 game situation thoughts from 9 sources (table 3). The label to each theme is given with a description (inclusion criteria) and an example of the raw data. Although these themes are presented separately, overlap and interaction between each of the concepts is present. Attentional metacognitions relate to golfers' thinking about thinking, control stage relates to an appraisal of what is needed for performance and game situation are verbalisations related to thoughts related to a golfers' in-game action. The most frequent processes verbalised across the three stages of meta-attention by the participants were, *attentional metacognitions*: experience (17), acceptance (16), and the role of others (15); *control stage*: shot planning (219), outcome reaction (193), and technical instruction (113); *game situation*: Layout (115) score (56), and lie (52).

In addition to frequencies of verbalisations, a table of means and standard deviations of the occurrence of meta-attention verbalisations is presented in table 4 and table 5 presents means and standard deviations of meta-attentional verbalisations per shot.

[TABLE 1 ABOUT HERE]

[TABLE 2 ABOUT HERE]

[TABLE 3 ABOUT HERE]

[TABLE 4 ABOUT HERE]

[TABLE 5 ABOUT HERE]

Discussion

This study applied TA to investigate and understand the metacognitive processes and mechanisms experienced by golfers that underlie attentional processes during golf performance, seeking to further Oliver et al.'s (in press) grounded theory of meta-attention among golfers. Thoughts of intermediate-level golfers were analysed to identify meta-attention in a real-time setting, addressing the limitations of retrospective recall incurred in previous meta-attentional research (cf. Oliver et al., in press). Through Level 3 TA protocols, golfers provided verbal reports of: attentional metacognitions, internal attentional control, external attentional control and game situation thoughts. Overall, the results showed that golfers engaged most frequent meta-attention verbalisations related to attempts to control their attention. Verbalisations on their attentional resources (i.e., attentional metacognitions) were the least frequent reported. Furthermore, the results in the present study show that metacognitive reflections on attentional resources do not take place for every shot. This may suggest that the use of attentional metacognitions is situation dependent or that monitoring does not always occur at a conscious level of processing, the latter displays consistency with MacIntyre et al. (2014) suggestion that metacognitive monitoring can occur at an unconscious level. Nevertheless, the present study provides some support to Oliver et al. (in press) study, indicating that meta-attention processes appear to relate to 3 broad types, a reflection on attentional resources that may be required; an evaluation on their game

situation, and a conscious effort to exert control over attention. Regardless of perceptions of their attentional metacognitions or game situations faced, golfers consistently engaged in consistent strategies for attentional control and the most verbalised meta-attentional thought was shot planning.

Additionally, the results in the present study provide further context to the grounded theory amongst golfers created by Oliver et al. (in press), including when reflections on attentional resources take place. For example, a golfer may reflect on training exercises when approaching a bunker shot to feel suitably prepared to make a recovery shot. A possible explanation for the absence of reflections on attentional metacognitions is that the metacognitive monitoring system that searches for attentional resources can operate unconsciously (MacIntyre et al., 2014), and during TA only conscious thoughts are verbalised (Ericsson & Simon, 1993). Therefore, the golfer does not have conscious awareness of the hypothesised search for resources. Related to Stanovich's (2011) metacognition, it could be suggested that the search for attentional resources largely takes place in the automatic and unconscious cognitive system 1, however, when a specific resource is needed (e.g., training for bunker shots) the search takes place in system 2 where more complicated tasks that require an effortful search and control are hypothesised to take place. The results in the present study suggest that in most situations an intermediate level golfer can adequately deal with their situation through system 1 and it is only under the feeling of a challenge that a conscious search for the required attentional resource in system 2 occurs.

Although thought sequences were not evaluated in the present study, internal and external related thoughts were recorded and these can be tied to Nideffer and Sagal's (2006)

suggestion of attentional shifts between internal and external stimuli throughout skill execution in golf. Results suggest that shifts in attention take place such as the time between shots where golfers have outcome reactions (i.e., a broad external focus), engagement in technical instruction (i.e., narrow internal) and technical feedback (i.e., broad internal). Analysis of the outcome and engagement in technical evaluation of their executed skill draws similarities with Kirschenbaum's (1997) 4-F Model, however, it should be considered that the original model proposed by Kirschenbaum was related to poor shot outcomes. Nevertheless, findings in the present study indicate that an outcome reaction is followed-up by technical assessment. An additional consideration is that the use of a technical assessment following execution may also be indicative of the skill-level of the sample used in the present study or the situation faced by the golfer. Whitehead et al. (2015; 2016) showed that technical feedback more prominent among lower skilled golfers, because the sample in the present study was drawn from a non-elite sample this may account for the technical feedback verbalisations recorded.

you have demonstrated how golfers go through a process of thinking about thinking, evaluating and then applying this thinking to their in game thoughts/action. Therefore, I would recommend that you are clearer when outlining what your results demonstrate and be careful not to over reach in terms of your findings.

Further consistency in the present findings and attentional shifts, that is, switching from focused (switched on) to unfocused (task irrelevant focus) may be drawn with Hellstrom (2009) who outlined that golfers must train to focus and re-focus their attention, rather than being continually "switched on". It is likely that such training is facilitative of overall attention control and can lead to selective attention and increased concentration, however, the role of switching off in preserving attentional resources warrants further research. Golfers verbalised pre-shot routine as one of their attentional control strategies and verbalised task irrelevant thoughts. Previous research has indicated that pre-shot routines serve several functions including attentional control and preventing an internal focus towards the mechanics of an automatic skill (Boutcher, 1992). Golfers required a process of thinking

about their thinking and an evaluating shot demands so that they could implement a suitable control strategy, such as a pre-shot routine. Whitehead et al. (2016) showed consistent pre-shot routines amongst higher-skilled golfers compared to lower-skilled, the present study may add to these findings because pre-shot routines are seen as an efficacious method for attention regulation used by the golfers (Cotterill, Sanders, & Collins, 2010). Furthermore, golfers also tended to take on an external focus of attention, such findings can be paralleled to extensive internal-external research (see Wulf, 2013) that outlines skilled performers should adopt an external focus of attention to prevent a breakdown of learned automatic skills. The greater use of external focus of attention in the present study may be indicative of the performance environment, for example, Whitehead et al. (2016) showed that under elevated levels of stress, or in competitive settings, there would be an increased use of internal instructions verbalised. Because the present study used a training environment rather than a competitive environment participants would be less likely to experience elevated levels of stress, therefore verbalising an external focus of attention more frequently.

Some limitations should also be considered when interpreting the results of the present study. First, it was implied that experienced golfers would have developed a level of metacognitive proficiency (MacIntyre et al., 2014) through their playing experiences, however, this metacognitive proficiency was not explicitly measured before data collection. As the participants were drawn from an intermediate, non-elite, sample therefore it is possible that the participants in the current study were not metacognitively proficient and may not have efficiently monitored and controlled their attention to the same extent an expert performer would be expected to. Because metacognition is believed to underpin expertise (MacIntyre et al., 2014) the metacognitive processes in successful-elite and world-class elite athletes is likely to be more proficient than those within the present study. Because our participants

were drawn from a non-elite sample, it is less likely that their skill level is automated which places greater demands on working-memory (Beilock & Carr, 2001; MacIntyre et al., 2014). Greater demands on working-memory leaves less space for metacognitive assessment to take place (Moran et al., 2019), therefore it is possible that due to our non-elite sample full metacognitive assessment may not be achieved – and meta-attentional thoughts we may otherwise find in an expert or elite sample have been missed. Concerns may also be raised regarding the relatively small sample, however, the sample used in the current study is comparable to other TA studies (e.g., Nicholls & Pollman, 2008; Calmeiro & Tenenbaum, 2011). Furthermore, we believe that by gathering a range of experiences across a full range of shots over six holes of golf counters the smaller sample size used and provides a significant contribution to furthering understanding of meta-attentional processes that take place in self-paced sport, in particular golf.

Second, previous research that has used TA (e.g., Nicholls & Polman, 2008; Calmeiro & Tenenbaum, 2011; Whitehead et al., 2015; Whitehead et al., 2016; Whitehead et al., 2019), indicate that the verbalised information shared is only a proportion of what is being attended to (Ericsson & Simon, 1980). This challenge presents a couple of issues, first, it is not known for certain that the verbalisations are the golfers' actual thoughts they are experiencing at present. Second, only conscious mechanisms are verbalised, therefore insights into unconscious metacognitive mechanisms (i.e., system 1; Stanovich, 2011) are not accessed. Whitehead et al. (2015) outlined that verbalisation of concurrent thoughts can lead to golfers outlining implicit theories about their thought processes, meaning golfers report what they think they should do (e.g., an external focus point) rather than what they actually do. Similarly, Level 3 TA can cause participants to verbalise their cognitions they may not usually consciously attend to – such as processes that usually are automatic – therefore the

thought processes uncovered in the present study may not necessarily be 'natural' thoughts that usually occur at a conscious level in participants' golf performances.

Future research should first seek to address the limitations of the present study. The first limitation of the present study could be addressed by recruiting an elite-level sample such as golfers playing on professional tours. Researchers may also consider examining differences in meta-attentional processes between higher and lower skilled golfers. This line of research should provide rich insights into the development of meta-attentional proficiency among golfers. Although the present study successfully captured real-time meta-attentions it did so in a training environment, because research (e.g., Whitehead et al., 2016) suggests that a competitive environment can increase verbalisations of internal processes, it would be worthwhile to capture meta-attentional processes in a competitive setting. By following this line of enquiry, greater insights in meta-attention obtained through an ecologically valid setting would provide competitive meta-attentions and highlight any differences in a golfers' attempts to regulate their attention between training and competitive environments. Future research should also consider the role of attentional shifts, i.e., focusing and re-focusing, examining the meta-attentional processes that underlie this type of attention-regulation. By following this line of enquiry greater insights into meta-attentional control during a golf performance can be understood. Researchers may develop such an understanding in training environments, competitive environments or both.

The present study sought to build on Oliver et al.'s (in press) by using concurrent data collection to explore the occurrence of meta-attentional processes in golfers. The present study has provided detail on attention regulation during a golf task, showing meta-attention verbalisations related to attentional control, game situation, and attentional metacognitions.

Attentional control verbalisations were reported the greatest number of times, whereas attentional-metacognitions were the least frequent verbalisations. It may be suggested that the findings support the hypothesis that metacognitive monitoring may occur unconsciously and it is under times of challenge that a conscious metacognitive monitoring is initiated. By successfully mapping meta-attentional processes live in a golf performance, more can be understood about concentration in performance of self-paced intermittent sports, specifically, the present study offers insights into how golfers regulate their attention within performance by showing golfers knowledge, awareness and control of their attention through concurrent data collection. The insights shed further light on the attentional spotlight that in turn can be used to inform practice of sports psychology as coaches, athletes and psychologists can now better understand what golfers attend to during their performance, and at what point attentional resources come in to play.

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561 **Table 1. Attentional Metacognitions.**

Theme	Description	Example of raw data quote	Frequency
Acceptance	A mention of a golfer integrating a mindful-acceptance approach to thought processes and their overall game.	"if it turns over, it turns over, if it doesn't it is not a disaster" "it would be nicer to be in the middle, but [you] can't always have what you want in golf"	16
Confidence	A statement of confidence about an upcoming shot.	"I quite fancy myself to get up and down" "So I'm looking at this putt and what I'm thinking is, it's a putt that I should be able to hole"	10
Dwelling	Referring to a previous shot within the round currently being played.	"Because of my last hole I've got to really try and focus with this next putt because I really lost my concentration on my last hole, it was unforgiveable"	8
Emotions	Emotions felt by the golfer about the shot at hand.	"I am in fear of it running off the green"	13
Experience	A mention or reflection and use of knowledge about the current situation to inform the current shot.	"In fairness the wind is not normally coming in this direction, normally it would be coming across a wee bit"	17
Motivation	Any mention of motivation or motivating factors brought into attention for the shot at hand.	"what I'm thinking here is, it's the first tee so it needs to be a decent drive"	6
Organisation	A referral and	"I'm actually going to take my jacket off, too many layers!"	1

	reflection on equipment brought onto the course by the golfer.		
Psychological Resources	Any mention of psychological resources or reflection of needing psychological resources for the shot.	"It's easy to say stay in the moment, but you're out here for such a long time"	1
The role of others	Reflections on the other people who have influence on the golfer.	"I must be getting used to you now, part of golf is getting used to who you're playing with and if you don't know anyone it can take a while to"	15
Training	Any comments made by the golfer about training, adjustments made and an attempt to implement within skill execution.	"I've been working on a few things with my coach…"	6

565 **Table 2. Control Stage: Evaluation of demands**

Location	Theme	Description	Example of raw data quote	Frequency
External	Outcome Reaction	An immediate reaction and evaluation of where the ball has ended up.	"The line was great. Sneaked on. It hit it exactly where I wanted it"	193
	Shot Planning	Attention is directed towards a plan of action for the shot at hand.	"Just looking to catch the right hand side of the hill, can't afford to be short or the ball is going to run back down the slope"	219
	Pre-shot routine	A pre-shot routine action used as a means of readying self to execute the shot at hand.	"Just always follow the routine that I have. Put the marker down for the ball. Line up the ball."	34
	Task Irrelevant Thoughts	Thoughts that are not connected with execution of the task at hand that occur during the round of golf.	"One minute he's thinking about living in Glasgow, the next he's sending me details about a job in London"	48
	Visual Target Selection	The golfer makes reference to the selection of a visual point of reference when lining up a shot	"so the target is usually just inside the tree, the conifer standing there on its own"	56
Internal	Technical Feedback	A reflection on specific technical aspects of the skill execution just performed by the golfer.	"And so, I just went for it far too quickly. I still got a good approach shot. You need to slow yourself down, I was too quick there"	73
	Technical Instruction	Specified technical instruction that is based on the motor-skill and execution.	"just got to keep it simple and turn my shoulders"	113

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568 **Table 3. Game situation**

Theme	Description	Example of raw data quote	Frequency
Lie of the ball	When the golfer refers to looking at the lie of their ball	"It's thick rough, so I am conscious of the long grass might turn the head slightly"	52
Score	A mention of the score made by the golfer	"There we go, back on track, 7, 5 , 3 so we're averaging 5 which is okay"	56
Course condition	Mention of the overall condition of the golf course.	"The course is so firm the now, so everything bounces up"	30
Distance to the hole	How far the current shot is away from the pin	"I've got a range finder… it's telling me 113 yards. So that's 113 yards straight, so it's going to play like 120 yards"	32
Difficulty	A reflection on the demands and the difficulty of the hole	"It's a very, very hard hole. Even when you get up here, it's pretty wide left to right, but the depth of it isn't very long, so it's such a hard green to hit".	25
Weather Conditions	References made by the golfer to the weather conditions	"But when the elements are against you and you're fighting them, there's a bit of rain everything is cold",	13
Wind	The role of the wind in shot selection and decision making	"but with this wind, I can really get home in two", "the wind is coming over my right shoulder, so I'll maybe aim at the church spire"	35
Hole Layout	A mention of the layout of the course (e.g., lay lines or doglegs)	"The fairway slopes right to left away from you, so even if I hit it left of the marker post, I've got to be left"	115
Hazards	A thought towards hazards that may impact future shots or be detrimental to score (e.g., Out of bounds).	"You don't want to go too far left here because there's an out of bounds post on the left"	39

Table 4. Means and Standard Deviations of the number of themes verbalised among golfers over six holes

	M	*SD*
Attentional Metacognitions	13.14	5.55
Attentional Control		
Internal	26.57	10.21
External	81.85	16.73
Game Situation	56.71	22.77

Table 5. Means and Standard Deviations of meta-attention verbalisations among golfers per shot.

	M	*SD*
Attentional Metacognitions	.46	.15
Attentional Control		
Internal	.98	.46
External	2.92	.65
Game Situation	2.13	1.11