

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

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1 Using a 'Think Aloud' protocol to understand meta-attention in club-level golfers

2

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

19

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

21

22 Word Count (inc. tables and figures: 7,036)

23 Introduction

24 Concentration is a deliberate decision to invest and direct attention towards stimuli that are
25 most important for successful task execution. Athletes are required to actively regulate their
26 attention to direct it towards stimuli that are most relevant for the task at hand. The ability to
27 focus effectively is regarded as a pre-requisite of successful performance across sport settings
28 (Moran, 2011). Nevertheless, the underlying cognitive mechanisms behind attention
29 regulation are yet to be fully understood. For example, Posner (1980) used a ‘spotlight’
30 analogy to describe the nature of attention, however, little is known about how individuals
31 control their spotlight and illuminate areas relevant for task performance. Furthermore,
32 attention may be lost without an environmental distractor present and, instead a wandering
33 mind can cause an individual to lose concentration to the detriment of performance (Moran,
34 1996; Moran, 2011). For example, Doug Sanders was famously a three-foot putt away from
35 winning the 1970 Open Championship, seemingly his mind had wandered, no longer was he
36 thinking about the putt at hand, instead he was thinking too far ahead and how he would mark
37 the victory:

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

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

46

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

67

68 One area of metacognition that has particular relevance for performance and attention is
69 meta-attention. Moran (1996) outlined that the study of meta-attention amongst athletes can
70 reveal more about concentration in sport because meta-attention is an individual's knowledge
71 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

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

106

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

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

126

127 Due to the intermittent nature of golf frequent shifts in attention are expected, for example,
128 Nideffer and Sagal (2006) suggested that golfers' attention should begin with a broad
129 external focus for information gathering to inform the shot at hand, which then moves
130 towards a narrow internal focus to execute the shot. Golfers' use of information gathering at
131 the beginning of their thought sequences prior to skill execution has been captured in
132 Calmeiro and Tenenbaum (2011), and Whitehead, Polman and Taylor (2016) studies that
133 used concurrent verbalisations to capture the decision-making process during golf
134 performance. The adoption of an external focus of attention prior to, and during, skill
135 execution has received extensive support for athletes within skilled performance with
136 suggestion that an internal focus of attention could lead to a breakdown in performance
137 (Wulf, 2013). Whitehead et al. (2016) showed that under competitive pressure skilled golfers
138 were more likely to verbalise technical instruction compared to practice conditions,
139 particularly when performing putts. This suggests that under challenging circumstances a
140 performers' attentional spotlight may involuntarily move inwards during a performance.
141 Therefore, it is important that performers are aware of the movability of their attentional
142 spotlight during a performance and they should monitor and regulate their attentional beam
143 accordingly. Because a round of golf can last up to five hours sustained concentration is
144 unlikely to be possible due to limited cognitive resources, therefore a golfer should be
145 selective when they choose to initiate attentional control strategies. Hellstrom (2009) suggests
146 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

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

177

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

185

186 **Method**

187 **Participants**

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

194

195 **Materials**

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

201

202 Procedure

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

207

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

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

227

228 Participants completed TA over six full holes of golf, six holes was deemed appropriate
229 based on previous research and is deemed to not be overly demanding on the golfer (Nicholls
230 & Polman, 2008; Whitehead et al., 2015). Golfers were asked to verbalise their thoughts
231 throughout each of the six holes (apart from during their swing) as well as providing
232 explanations for their actions (e.g., using the tree at the back left of the green as a visual
233 target). In line with previous TA research (e.g., Nicholls & Polman, 2008; Whitehead et al.,
234 2015) in the event of a participant falling silent for an extended period (20s), the researcher
235 would prompt the participant to resume thinking aloud. Throughout the data collection, the
236 first author was present during each participant's session and stood approximately five metres
237 away. This distance was deemed appropriate because it would allow the researcher to hear if
238 the participant were continuing to engage in verbalisations. Recording was continuous until
239 the golfer had completed post-shot evaluation of their sixth hole.

240

241 Data Analysis

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

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

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

274

275 **Results**

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

288

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

292

293 [TABLE 1 ABOUT HERE]

294

295 [TABLE 2 ABOUT HERE]

296

297 [TABLE 3 ABOUT HERE]

298

299 [TABLE 4 ABOUT HERE]

300

301 [TABLE 5 ABOUT HERE]

302

303

Discussion

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

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

326

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

344

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

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

361 you have demonstrated how golfers go through a process of thinking about thinking, evaluating
362 and then applying this thinking to their in game thoughts/action. Therefore, I would recommend
363 that you are clearer when outlining what your results demonstrate and be careful not to over
364 reach in terms of your findings.
365 Further consistency in the present findings and attentional shifts, that is, switching from
366 focused (switched on) to unfocused (task irrelevant focus) may be drawn with Hellstrom
367 (2009) who outlined that golfers must train to focus and re-focus their attention, rather than
368 being continually "switched on". It is likely that such training is facilitative of overall
369 attention control and can lead to selective attention and increased concentration, however, the
370 role of switching off in preserving attentional resources warrants further research. Golfers
371 verbalised pre-shot routine as one of their attentional control strategies and verbalised task
372 irrelevant thoughts. Previous research has indicated that pre-shot routines serve several
373 functions including attentional control and preventing an internal focus towards the
374 mechanics of an automatic skill (Boutcher, 1992). Golfers required a process of thinking

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

389

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

400 were drawn from a non-elite sample, it is less likely that their skill level is automated which
401 places greater demands on working-memory (Beilock & Carr, 2001; MacIntyre et al., 2014).
402 Greater demands on working-memory leaves less space for metacognitive assessment to take
403 place (Moran et al., 2019), therefore it is possible that due to our non-elite sample full
404 metacognitive assessment may not be achieved – and meta-attentional thoughts we may
405 otherwise find in an expert or elite sample have been missed. Concerns may also be raised
406 regarding the relatively small sample, however, the sample used in the current study is
407 comparable to other TA studies (e.g., Nicholls & Pollman, 2008; Calmeiro & Tenenbaum,
408 2011). Furthermore, we believe that by gathering a range of experiences across a full range of
409 shots over six holes of golf counters the smaller sample size used and provides a significant
410 contribution to furthering understanding of meta-attentional processes that take place in self-
411 paced sport, in particular golf.

412

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

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

427

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

445

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

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

462

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465

466

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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

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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

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

	<i>M</i>	<i>SD</i>
Attentional Metacognitions	13.14	5.55
Attentional Control		
Internal	26.57	10.21
External	81.85	16.73
Game Situation	56.71	22.77

571

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

	<i>M</i>	<i>SD</i>
Attentional Metacognitions	.46	.15
Attentional Control		
Internal	.98	.46
External	2.92	.65
Game Situation	2.13	1.11

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