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Abstract

Objectives: Most research to date that has investigated cognitive processes in golf using the Think Aloud (TA) method has analysed data deductively and using statistical methods. Such an approach, however, can lead to potentially relevant data being overlooked and assumes that *a priori* coding schemes are valid reflections of a phenomenon. Therefore, to enable the generation of novel insights, this study sought to qualitatively explore cognitive processes in golf by inductively analysing TA data captured during competition. **Method:** Seventeen adolescent golfers (male *n* = 16; female *n* = 1, M handicap = 5.43) were asked to verbalise their thoughts while playing a 6-hole competitive round of golf. Data were analysed thematically in relation to the pre-shot and post-shot phases by each author independently, with the final findings produced collaboratively and through the use of trustworthiness procedures. **Results:** Cognitive processes during the pre-shot and post-shot phases were each captured by six themes. Some cognitive processes were consistently evident across shots, while others differed depending on the context. Before shots, the players consistently reported: monitoring; planning; and situational appraisals. Additionally, shots were followed by: monitoring; reviewing, evaluating, and planning; and situational appraisals. Before and after shots, the players also described context-specific: affective responses; distraction; and psychological skills. **Conclusions:** The study demonstrated the benefits of moving beyond deductively analysing and quantifying cognitions by using an inductive approach to analyse TA data. The findings extend current knowledge by illustrating the dynamic and often deliberative process that occurs during the decision making process in golf.

Keywords: attentional focus; self-regulation; psychology; metacognition; qualitative method.

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The study of cognition, attentional focus, and decision making in athletic performance is a continually growing area in sport psychology research, especially when considering the cognitive mechanisms underlying expertise (Moran et al., 2019; Eccles, 2020). Within this area of research, various models of decision-making, such as fast and frugal heuristics (Gigerenzer & Todd, 1999), "take the first" (Johnson & Raab, 2003), and the naturalistic decision-making framework (Klein, 1998), suggest that experts do not deliberate between options prior to making decisions, but implement the first satisfactory action. In contrast, Ericsson and Hastie (1994) suggest that expert performance involves acquired, domain-specific representations and working memory skills, which support specialized planning, reasoning, and evaluation. Whilst engaged in planning and reasoning, deliberation may occur, as a performer's thought processes may recursively shift back and forth between their long-term memory and what is present in their environment (Ericsson & Hastie, 1994). The importance of the development of domain-specific knowledge and the role of planning, reasoning, and evaluation was previously evidenced in higher-level tennis players, especially when monitoring and attending to different problems during performances (McPherson, 1999). Similar findings have been evidenced in triathlon (Baker et al., 2005) and Australian Rules Football (Elliot et al., 2020), where higher level performers demonstrated more performance-focused cognitions.

One framework that illustrates the deliberative nature of decision-making in sport is the theory of expert-cognition in orienteering (Eccles et al., 2002). Using a grounded theory approach, Eccles et al. (2002) employed interviews to understand the cognitive processes that expert orienteerers engage in when making decisions during performances. Although

the cognitive process generated was relatively sequential, the model proposed by Eccles et al. (2002) did highlight how these performers' thought processes may move 'back and forth'. For example, the sequential flow of attention between the map, environment, and travel, and how this information is processed, may vary depending on the situation. Similar findings have been further demonstrated in elite runners, where expert's cognitions were, for example, suggested to move between monitoring, metacognitive feelings, and active self-regulation when making pace-related decisions (Brick et al., 2015).

A central criticism of early cognition research was that it became 'too specialized', whereby psychologists would break down large problems and questions about the human mind into very small and isolated aspects of cognition (see Mandler, 2007 for a review). In line with this criticism, Neisser (1976) emphasised the need for researchers to make "a greater effort to understand cognition as it occurs in the ordinary environment and in the context of natural purposeful activity" (p. 7). As researchers within sport psychology have begun to study cognition as it occurs within the context of the activity, domain-specific models and theories have started to emerge. For example, McPherson (2000) used verbal reports and what were termed 'think aloud interviews' during competitive tennis, which involved players reporting their thoughts in between points. By asking a tennis player to report "what were you thinking about while playing that point?" and "what are you thinking about now?", cognitive differences were identified between experts and novices, whereby experts had more sophisticated action planning. For example, experts were more likely to explain the intent of shot and reasoning, followed by an action plan (e.g. "I was trying to angle it off wide to get to her forehand…", "so now I've got to concentrate on hitting the ball over the net", McPherson 2000, p.51), which potentially could be due to more advanced memory structures (McPherson, 2000).

More than two decade ago, McPherson (2000) outlined that studies examining thoughts during actual competition were limited, but this could still be said in the present day. Indeed, much of the literature that has captured data on cognitive processes in sport has done so retrospectively and outside of the task duration (e.g., Brick et al., 2015; Eccles et al., 2002; Oliver et al., 2020a). Furthermore, issues of memory decay and retrospective bias of accounts also pose limitations to using retrospective methods when investigating cognitions (e.g., Folkman & Moskowitz, 2004; Stone et al., 1998). More recently, researchers have started to develop the earlier work of McPherson (2000) by using the think aloud (TA) method (Ericsson & Simon, 1993) in sport to capture cognitive processes as they occur while people take part in natural, purposeful activities. Think aloud involves a participant verbalising their thoughts as they occur during a task (Ericsson & Simon, 1993). Although the nature of engaging in TA generally requires performers to engage in an additional task during performances (i.e., verbalising their thoughts), research in golf has found that TA does not adversely affect performance outcomes (Whitehead et al., 2015). Within sport, TA has been employed in a range of contexts, including (but not limited to): Australian rules football (Elliot et al., 2020); cricket (McGreary et al., 2020); cycling (Massey et al., 2020); golf (Arsal et al., 2016); snooker (Welsh et al., 2018); running (Samson et al., 2017); and tennis (Swettenham et al., 2020). Although most of these studies used TA to understand cognitive processes and/or compare more skilled to less skilled performers, some researchers have also adopted TA to explore specific psychological phenomena, such as stress and coping (Kaiseler et al., 2012; McGreary et al., 2020). Further, TA has been used in non-competitive (Welsh et al., 2018) and competitive contexts (Whitehead et al., 2017).

From a sport psychology perspective, researchers have shown the utility of TA for capturing information on cognitive processes within a range of different sporting contexts.

For example, Calmeiro et al. (2010) examined the process of positive and negative appraisals before and after shooting in trapshooters. In addition, McGreary et al., (2020) used TA to understand the cognitive processes engaged in by cricket bowlers, specifically in relation to stressors and coping responses. Previous TA studies in golf have also advanced understanding of thought sequences during lab-based golf putting in experienced and unexperienced players (Arsal et al., 2016; Eccles et al., 2017; Calmeiro & Tenenbaum, 2011). Collectively, research that has employed TA in sport has illustrated the value of TA as method for capturing real-time data on cognitive processes of performers across a wide variety of athletic domains.

The Current Study

The aim of this study was to qualitatively explore cognitive processes during competitive golf using the TA method. Golf is a self-paced sport in which competitive rounds can last up to six hours and typically involves players having long periods of time between shots. These time periods can offer players a chance to engage in cognitive processes such as reflection and planning, as well as over-thinking and distraction (Singer, 2002). Consistent with the perspective on deliberative thought processing during task performance (Ericsson & Hastie, 1994), Eccles and Arsal (2017) reported that golfers moved 'back and forth' in their thought processes during lab-based putting tasks. Specifically, golfers were found to: assess the situation; plan their response (i.e., response identification); and re-assess the situation again, before moving on to mechanical and psychological preparation thoughts (Eccles & Arsal, 2017).

By using the TA method to examine cognitive processes in golf, the current study used a similar approach to earlier studies (e.g., Calmeiro & Tenenbaum, 2011; Eccles & Arsal, 2017). There are two key differences, however, in the current study, which can help to

advance understanding of cognitive processes in this context. First, although previous studies have provided insights into the temporal dynamics of cognitive processes during lab-based golf putting (Calmeiro & Tenenbaum, 2011; Eccles & Arsal, 2017), the current study sough to examine the nature of cognitive processes in a wider range of shots (e.g., fairway shot) and in more ecologically valid settings, such as competition.

Second, the current study sought to advance understanding of cognitive processes in golf by using an inductive analysis approach. To date, most TA studies on cognitions in golf have deductively analysed and "quantitized" (Sandelowski et al., 2009) verbalised TA data for the purpose of conducting inferential statistics. For example, several studies have compared cognition frequencies between skilled and less skilled performers (e.g., McPherson, 2000, Arsal et al., 2016; Whitehead et al., 2016), while Calmeiro and Tenenbaum (2011) examined temporal patterns in cognitions during lab-based golf putts by transforming qualitative codes into numerical data and subjecting this quantitized TA data to statistical analysis. Despite its widespread use, the quantification of cognitions can have drawbacks based on the view that the frequency of qualitative themes does not always directly equate to the importance of that information (Braun & Clarke, 2006). Furthermore, by using deductive analysis approach, it is possible that valuable insights could have been omitted or unexplored because the data did not *fit* with the coding schemes that were applied. Recently, researchers have highlighted the potential utility of TA when approached from a qualitative research perspective (Eccles & Arsal, 2017). As such, by going beyond assessments of frequency and inductively exploring verbalisations during golf, this approach could have the potential to generate new insights that have yet to be fully investigated in this literature. In turn, the findings could provide novel insights into cognitive processes in golf, which could have applied implications for golfers, coaches, and applied practitioners.

Furthermore, while this study focused on a specific sport, the findings could also have broader theoretical implications for understanding of cognitions in sport.

Method

Philosophical Orientation

The current study was underpinned by a realist ontology and constructivist epistemology. Ontological realism assumes that a reality exists, but that it is independent of the conceptions the researchers have of it (Sayer, 2000), while epistemological constructivism posits that knowledge is theory-laden and fallible (Wiltshire, 2018). In accordance with our philosophical stance, we acknowledge that our knowledge can be refined, revised, or refuted (epistemological constructivism) and that cognitions reported by participants reflect real properties and events experienced by people independent of the research (ontological realism).

Participants

Participants were 17 amateur golfers (16 males and 1 female, *M* age = 17.50 years, SD = 1.65) who played off handicap ratings between zero and nine (*M* handicap = 5.43, *SD* = 2.63). Both parental consent and consent from the college that they attended at the time of data collection was provided. All participants were members of the same golf club and members of the club where the data was collected. Therefore, all participants were familiar with the course that they played during this study. Participants are referred to hereafter by numbers (e.g., P10).

Materials

All participants played with their own golf clubs and played the same six holes of the same golf course, which were all par 3 holes. An Olympus clip microphone and Dictaphone was used to capture all TA data.

Procedure

Following institutional ethical approval, all participants were approached via email through a gatekeeper of their golf college tutor. Participants were made aware that involvement in the study was completely voluntary and all participants provided written informed consent before participating. Prior to engaging in the study, all participants were trained to use TA. In line with recommendations (Birch & Whitehead, 2020), participants were provided with traditional training following guidelines by Ericsson and Simon (1980), which involved a series of TA exercises, comprising: (i) counting the number of dots on a page; (ii) an arithmetic exercise; and (iii) an anagram problem-solving task. In addition, participants were given time on a putting green to practice TA and ask the first author any questions about using TA if they felt unsure. As previously recommended by Ericsson and Simon (1993) and explained in TA studies (e.g., Swettenham et al., 2020; Whitehead et al., 2018), participants were asked to: "please think aloud and try to say out loud anything that comes into your head throughout the six holes. Do not try and explain your thoughts". This statement sought to acquire level 2 verbalisations and level 1 verbalisations. The process of directly reporting heeded information is termed level 1 verbalisation, while the information attended to during a given task that is not in a verbal mode that can be verbalised, but requires an intermediary process to record the information into a verbal code before it can be vocalised is termed level 2 verbalisation (Eccles, 2012). Participants were also asked to verbalise their thoughts as much as possible throughout their performance of the six holes. As participants were performing in a competition environment, the researchers tried to avoid interference with their performance. However, participants were told that the researchers may be walking around the course to remind them to TA. Each golfer was given one reminder during their competition.

The study involved all participants performing the same six holes in a competition. The competition was run as a stroke play event, with scores adjusted for handicap. To create a competitive, pressured scenario, participants were informed that the competition involved monetary prizes for finishing: first (£100); second (£70); and third (£30). In addition, players were told that the scores would be posted on a leaderboard and that a presentation ceremony would take place after the competition for the top three players. The participants completed their six-hole round in 50 - 67 minutes (M = 61 minutes).

Data Analysis

All of the TA audio was transcribed verbatim, with participant transcripts ranging from 647 words to 3306 words (*M* = 1378 words). All participants verbalised at least one thought per shot. A team approach, involving both authors, was employed to guide the analysis. Each author analysed the dataset independently, with the aim of promoting critical reflexivity rather than consensual agreement (Braun & Clarke, 2019; Smith & McGannon, 2018; see *Trustworthiness*). Data were analysed inductively in accordance with guidelines for thematic analysis (Braun & Clarke, 2006). Consistent with the chronological sequence of each golfer's verbalisations, the authors analysed each shot in terms of: (i) pre-shot verbalisations, and (ii) post-shot verbalisations. Although both authors agree that the cognitive process may be cyclical and we move from post-to-pre thoughts during performance, we chunked the data into pre and post cognitions based on the following. Pre shot cognitions were shots that related to the upcoming shot and happened prior to the shot being taken and post shot cognitions were related to any verbalisations after the shot was hit, up until the participant would verbalise thoughts about their next shot. Initially, the two authors read and re-read each transcript to familiarise themselves with the data through the process of 'indwelling' (Maykut & Morehouse, 2002). Next, each author

independently examined the data to generate *codes*, which reflected the most basic unit of the analysis (e.g., the quote "20 feet short of the pin" was included in the code *distance approximation*). The codes were subsequently reviewed, with similar codes combined to form *higher-order themes* (e.g., the codes *anger* and *frustration* were placed in the higher-order theme *negative emotions*). This process was then repeated to generate more expansive *themes*, which represented the broadest level of the analysis (e.g., the higher-order themes *technical planning* and *pace planning* were categorised into "shot planning"). After completing their respective analyses, the authors engaged in trustworthiness procedures (see below) to produce the final findings (see Results). Finally, the authors re-examined the data to understand how the themes fitted together temporally, prior to generating an illustrative framework of cognitive processes in golf (see Results).

Trustworthiness

The term *trustworthiness* is used by qualitative researchers to describe the steps taken to improve the quality of their work (Sparkes & Smith, 2014). Several strategies were employed to improve trustworthiness. First, data were collected in real-time as participants were performing the activity, which helps to overcome the limitations of retrospective methods (Ericsson & Simon, 1980). Second, all steps for thematic analysis were undertaken independently by two authors. The involvement of two authors in all stages of the analysis was viewed as an important process that could help to encourage critical reflexivity (Braun & Clarke, 2019). In particular, it was important that the second author was heavily involved in the data analysis to challenge the assumptions of the first author and to contribute to the generation of new or different interpretations. Finally, to facilitate such critical dialogue during the analysis, the first and second authors engaged in *peer debriefing* through formal meetings (Creswell & Miller, 2000). Specifically, the authors met once after analysing eight

transcripts to discuss and critically evaluate each other's interpretations. After analysing all 17 transcripts, the authors met multiple times to compare and critically evaluate each other's interpretations. The peer debriefing process led to some themes being re-categorised (e.g., the initial code 'breathing' was moved into the final code 'relaxation') and re-labelled (e.g., *psychological skills* replaced a previous theme 'self-regulation').

Results

This study aimed to qualitatively explore cognitive processes during competitive golf by collecting real-time data using TA. Consistent with the analytical approach, the findings are presented in two sections: (i) pre-shot cognitive processes, and (ii) post-shot processes. The final section presents an overview of the findings, which integrates themes pertaining to the pre-shot and post-shot cognitive processes into a framework, which depicts the temporal sequence of cognitive processes reported by participants. Within each section, sub-sections are used to explain each theme, with *higher-order themes* italicised in-text. Verbatim quotes are used throughout to facilitate the voice of participants.

Pre-Shot Cognitive Processes

The pre-shot cognitive processes of the participants encompassed six themes: monitoring; planning; situational appraisal; distraction; affective responses; and psychological skills (Table 1).

[INSERT TABLE 1 ABOUT HERE]

Monitoring

Pre-shot monitoring primarily consisted of *outward monitoring,* with only two players referring to *internal monitoring* of bodily sensations. During the pre-shot phase, the golfers monitored external information, such as the ball lie and location, distance to the target, and weather conditions that could impact the shot. For example, participants

articulated: “Hole is 144 [yards]. Downwind off the right. I came up short, about 105 yards short” (P10), and “not sat very well though, just about got a shot. 67 yards, from the heavy rough” (P13). Players also directed attention towards monitoring the course’s physical environment, including potential hazards (e.g., bunkers) and the terrain: “Going uphill, to the right, and it’s going to flatten out. Hopefully it's going to go quite fast downhill” (P1). Overall, information obtained through *outward monitoring* helped players with planning.

Planning

Although the players moved iteratively between monitoring and planning, in most cases players verbalised cognitions about the shot plan *after* monitoring shot-relevant stimuli. For instance, information concerning the weather was used for *determining the impact of environment conditions* on specific shots: “Wind is off the left. So I’m going to give it a bit of lift so it brings it in a little bit” (P6). By processing information generated through outward monitoring, this allowed players to engage in *shot planning.* For example, players used information about the location and/or lie of the ball and distance from the target to choose their club and plan the type of shot to play:

> Left myself 136 [yards]. Wind is currently across and slightly down, so I think it’s going to be playing about 130. I’m going to go with a 9-iron, I think this is pretty good. There's a flag in the background, which is about 5-10 foot right. I’m going to hit it straight at that and hopefully the wind should turn it over. (P10)

Furthermore, the golfers also explained how they planned the pace and line of their shots, which was most salient prior to putts: “This putt, it’s straight, just got to get the pace. [I’ve] got to hit it a little bit harder than you think” (P3). While *shot planning* typically occurred in a straightforward fashion, planning difficulties were also evident. For example: “2-tier green

and just on the bottom tier, so I'm putting up the hill. It's about 20-25 feet. Quite hard to judge the distance, it's a lot slower than you think sometimes" (P1).

Situational Appraisal

During the pre-shot phase, players assessed the situational demands and their capacity to meet these. In terms of *demand appraisals,* the performers referred to assessing the difficulty of a shot and, especially in the case of putts, appraising the likelihood of success: "Maybe slightly right to left, slightly uphill. I'm just going to go right edge quite firm. Quite a hole-able putt really" (P1). The pre-shot phase also featured competition-related cognitions, which were most salient when participants recognised the importance of a shot in the context of the competition. For instance, P12 explained: "The most important thing [is to] make your four. Come on, just make your putt, the most important putt, slightly off the right, very important putt." *Resource appraisals* encompassed feelings of confidence and, conversely, feelings of doubt. Such feelings could fluctuate quickly from shot-to-shot. For example, on the fourth-hole tee shot, P8 said he was "confident about this [because I] hit a good driver before", but reported less confidence on the next shot: "Less confident for this shot than I have been because of the shots I have played with this club today."

Distraction

In some circumstances, players attended to stimuli that were not relevant to the task, although it is important to note that these thoughts were not always deleterious to performance. For instance, players reported *distractive thoughts*, which were sometimes evident while players were *conversing* with their playing partner: "Who is it, Gary against van Gerwin? Phil versus Barnett? Oh, that'll be a good game" (P9). The golfers also experienced *ruminative thoughts,* which centred on dwelling on past - and typically poor or costly - shots: "It all went wrong on the f***ing second hole when you chipped this on eight" (P12).

Affective Responses

Verbalisations of affective responses prior to taking shots generally consisted of *negative emotions,* with *positive emotions* reported in less than 25% of players before shots. While one player reported feeling nervous, the most commonly reported emotions across the group were frustration and dissatisfaction, which were elicited in response to performance appraisals and past shots, and had the potential to impact subsequent performance: “Not too happy with my performance so far. Probably going to hit it hard because I’m angry. If I hit a bad shot, I’ll probably get more angry” (P17).

Psychological Skills

A range of strategies that primarily sought to regulate the performers’ cognitions, emotions, and behaviours were used in the pre-shot phase. For example, players used *refocussing* by making a concerted effort to shift attention away from distractive and ruminative thoughts (e.g., dwelling on a past shot), while *relaxation* techniques were used to alleviate tension. Several forms of *self-talk* were evident, with instructional and motivational self-talk often featuring in the pre-shot routine: “I just need to get through the ball. Get through the ball, come on you can hit a good shot here. Full one. Relax” (P16). On greens, several players reported *imagery* after identifying their intended target or line. For instance: “Another flat part of the green, another two foot, let it release all the way down to the flag. Just imagine my shot now” (P10). Finally, the players tended to set process goals (i.e., technique-related) and performance goals, which focused on the score players sought to obtain on their current hole (e.g., birdie, par), or in the remaining holes, with such cognitions surfacing most when players diverted attention to the competition: “I’ve got to make a birdie on here. Need a birdie-birdie finish. 1-over, need a birdie-birdie finish” (P15).

Post-Shot Cognitive Processes

Six themes were generated to represent the post-shot cognitive processes of participants: monitoring; reviewing, evaluating, and planning; situational appraisal; distraction; affective responses; and psychological skills (Table 2).

[INSERT TABLE 2 ABOUT HERE]

Monitoring

In the initial period of the post-shot phase, all players directed their attention towards the outcome of the shot through *outward monitoring.* Specifically, this involved following the line of the shot and explaining the resulting outcome. For example: “Hit the back of the bunker with a 9-iron. You only went 120-odd yards” (P12), and “right on line with the flag, just needed another few feet of run out and it would have been in” (P5).

Reviewing, Evaluating, and Planning

All higher-order themes captured by this theme were a product of outward monitoring completed after each shot. *Reviewing* referred to the players’ perceptions of the shot and, in some cases, explaining potential causes of the resulting outcome. For example: “I think the reason why it went short is because it may have just gone up a bit in the wind. The winds stalled it” (P11), and “oh dear, that was a pull, pulled it from top of the swing, no spine angle” (P13). The *evaluation* that followed each shot centred on whether the shot and outcome was judged as being positive (“struck it very well.” P1) or negative (“it’s a very poor shot. A very poor swing.” P2). After striking the shot, attention quickly turned towards the next shot, with players *planning* a specific type of shot and identifying the desired outcome: “plenty of sand in the bunker. [I’ll] try and splash it out and put it down to the pin” (P3).

Situational Appraisal

After processing information surrounding the previous shot, the players undertook a *demand appraisal*, with such thoughts mainly focusing on how the performer was beginning

to appraise the next shot: “Left [with] a nice birdie chance, but looks can be deceiving. I will see what it’s like when we get up there” (P3). During this period, the players also assessed their capabilities. The *resource appraisal* centred on general feelings of confidence, or doubt (i.e., in relation to the round), as well as confidence in approaching the next shot: “I’m confident about coming back on this hole now” (P8).

Distraction

The golfers described the return of *ruminative thoughts* about previous shots in the post-shot phase, particularly after shots with a disappointing outcome: “[I] could have made a birdie or could have gone back to 1-over. Instead I made a bogey and went to 3-over” (P8). *Distractive thoughts* included references to conversations with other players and recognition of distraction.

Affective Responses

The majority of verbalised affective responses after shots were categorised as *negative emotions.* Such emotions were most prominent after players failed to execute a shot as desired, which often led to feelings of dissatisfaction and frustration: “Got it heavy again. Why would I do that? It’s really annoying that I’ve done that” (P7). Conversely, *positive emotions*, such as satisfaction, were reported after positive outcomes.

Psychological Skills

The players explained attempts to manage their thoughts and emotions through psychological skills. All players reported *self-talk*, which differed depending on the situation and its direction. Specifically, positive and negative-self talk emerged in response to previous shots and as players evaluated themselves. For instance: “Showcasing every amount of skill you've got today, well done” (P13), and “how s**t was that? How bad is that? Completely misread everything then” (P2). Conversely, motivational self-talk was

future-oriented and directed towards the upcoming shot. Similarly, players used *goal-setting* to establish performance goals for the hole. Additionally, distinct *coping responses* were evident after players experienced setbacks during the competition, with P8 explaining how he viewed a disappointing shot more positively after concluding a hole:

> I'll take a par there. After hitting the wire, [it] got to my head a little bit. It could've been easy to make a bogey or a double there, because that's got to my head. I've hit it twice [and] made a good par putt.

Some players did, however, resort to blaming other factors, such as the course or equipment: "I've just fully fatted it [the shot] and that's not down to me, it sounds stupid, but it's down to the wedges."

Towards a Framework of Cognitive Processes during Competitive Golf

An illustration of the chronological order of all themes presented in the findings is depicted in Figure 1. Three interlinking cognitive processes were consistently evident during the pre-shot and post-shot phases, while descriptions pertaining to the remaining three themes in each phase were context-specific and, therefore, tended to differ depending on the situation faced by the performer.

During the pre-shot phase, participants consistently engaged in monitoring (M) and planning (P), while situational appraisals (S) were reported on most shots. Information generated through outward monitoring was used to plan shots and appraise the situation, but this process did not always follow this chronological order. For instance, P10 reported a series of recursive shifts between cognitions prior to a shot:

> I'm going to hit 12-yard pitching wedge shot straight at the trees (P), which are directly behind (M). Obviously same as the tee shot, I feel pretty good as before (S). Wind has picked up slightly (M), go with the 9-iron instead (P).

The emergence of distraction and affective responses was highly reliant on the context, with verbalisations pertaining to these codes tending to arise when participants were struggling during performances. Similarly, the types of, and timing, of psychological skills (PS) differed depending on the situation. Most players used strategies to manage and control their thoughts prior to striking their shots, as typified by a fairway shot played by P16:

> 113 [yards] (M). Going to hit a full wedge (P) because I know I can hit a good shot with it (S). I just need to get through the ball. Get through the ball. Come on. You can hit a good shot here. Full one. Relax. (PS)

Conversely, the players also employed psychological strategies to manage distraction and affective responses. For example, P8 outlined: “Probably a bit more nervous than I have been (AR). I might have no tee (D). Okay, try and take my time. Try and stay calm. Breathe out. Okay. Good tempo and hit this one” (PS).

The post-shot verbalisations of participants were characterised by monitoring (M), reviewing, evaluating, and planning (REP), and situational appraisals (S). Iterative shifts between these cognitions were evident in the following example:

> Hit it just to the back (M), got down a little putt. Wasn’t my best shot in the world, looked good in the air, but probably just a little bit too hard (REP). Probably got 18-20 foot coming down the hill (M), got to give it a chance, but 1-under (REP). It’s pointless ramming it five foot past, you know. Just give it a nice stroke (REP). [other player] has hit a nice shot (M), he should make that, so there’s an outside chance that I'll make that. (S)

Affective responses (AR) were elicited in response to shot outcomes, as exemplified after a fairway shot by P11: “Cannot do anything right today. Got another massive putt (REP). Disappointing. More embarrassing than anything, f*** sake” (AR). Such negative

performance evaluations could also lead to the infiltration of distractive, ruminative thoughts (i.e., dwelling on past shots). In turn, some performers reported using psychological skills to cope: “That’s a 12 (AM). Could have been worse (REP). [other player] rolled a 6-footer in for a three (AM). Right, let’s bounce back (PS)” (P9). Overall, the findings show the complexity of cognitive processes during the pre- and post-shot phases in golfers.

Discussion

The aim of this study was to qualitatively explore cognitive processes during shot-play in competitive golfers using the TA method. Previous studies that adopted TA in golf have used deductive analytical frameworks and focused on the frequency of cognitions by quantitizing qualitative TA data and undertaking statistical analyses (e.g., Arsal et al., 2016; Calmeiro & Tenenbaum, 2011; Oliver et al., 2020b; Whitehead et al., 2016). In responding to calls for the continued development of qualitative methods in sport psychology research (cf. Smith & McGannon, 2018), this exploratory qualitative investigation aimed to generate novel understanding into cognitive processes in golf by using an inductive analytical approach. Furthermore, by systematically analysing the cognitions reported by golfers before and after each shot, the current study advances knowledge by offering richer and more detailed chronological insights into cognitive processes, as depicted in Figure 1.

Findings in the current study extend understanding by providing a more comprehensive and refined insight into cognitive processes in golfers. Previous studies that used deductive analytical frameworks only analysed and reported findings using a single level of themes (e.g., Oliver et al., 2020b; Whitehead et al., 2015). While such an approach can develop understanding at a broader level, the current study provided more granular insights into cognitive processes in golf by thematically analysing and reporting findings at three thematic levels. For instance, previous studies categorised data into a theme entitled

"planning" (e.g., Oliver et al., 2020b; Whitehead et al., 2015), but the current study deepens understanding by shedding light on the intricacies of planning (and other themes), which involved assessing the environmental impact and shot planning, the latter of which also contained a range of codes. Therefore, the current study offers more precise insights into golfers' cognitions, which could be of greater value to coaches, golfers, and practitioners.

Compared to previous research that has examined the sequence of cognitions in golf (Calmeiro & Tenenbaum, 2011; Oliver et al., 2020a, 2020b), findings in the current study offer a more advanced and, in some instances, alternative perspective. Using an analytical framework generated in a previous career-based interview study (Oliver et al., 2020b), Oliver et al. (2020a) categorised TA data reported by golfers in terms of: attentional metacognitions; control stage; and game situation. Although this categorisation approach is useful for distinguishing the types of cognitions reported, it is plausible to suggest that there was a lack of clarity as regards *when* these cognitions occur. For instance, the control stage appeared to combine cognitions that occurred before a shot (e.g., pre-shot routine) and those that followed a shot (e.g., outcome reaction). Therefore, findings in the current study extend previous research by specifically explicating *when* specific cognitions were reported, whilst also providing a more detailed insight into these pre-shot and post-shot cognitions.

The findings also highlight the temporal complexities of pre-shot cognitive processes in golf and suggest that such processes do not always occur in a linear fashion, thus supporting previous work that demonstrated the deliberative nature of thought processes during sport (e.g., Eccles et al., 2002; Eccles & Arsal, 2017). Using event-sequence analysis, Calmeiro and Tenenbaum (2011) produced a quantitative output of 'transitional probabilities' to reflect the thought patterns of beginner and experienced golfers performing a golf putt. While the statistical tests undertaken by Calmeiro and Tenenbaum

(2011) suggest that thought patterns prior to a putt tend to follow a sequential process, findings in the current study suggest that cognitive processes in golf are more complex, with players often making recursive attentional shifts. For instance, golfers in the current study moved iteratively between monitoring and higher-order mental processes, such as planning and situational appraisal, before taking a shot. In turn, this highlights the limitations of delineating the sequence of cognitions based on quantitized qualitative data. Similar findings have also been evidenced outside of golf, for example, through the use of interviews, Eccles et al. (2002) provided evidence for 'nonlinear' cognitive processes that expert orienteerers engage in when making decisions during performances. Additionally, within endurance performance, Brick et al. (2015) demonstrated how expert's cognitions were suggested to move between monitoring, metacognitive feelings, and active self-regulation when making pace-related decisions (Brick et al., 2015). Further, Harris et al. (2017) demonstrated the complexities and context specific nature of decision making when under pressure within police officers during threat-of-death stress during real events. Findings within this study echo some of the processes evident within this current study, as monitoring, planning and evaluations occurred within police officers, however, it was also recognised that decision making processes differed depending on the complexity of the situation.

Furthermore, the present findings could also have implications for models of decision-making and how they can be applied to golf and other sports. Some models of decision-making, such as fast and frugal heuristics (Gigerenzer & Todd, 1999) or the naturalistic decision-making framework (Klein, 1998), suggest that experts do not deliberate between options prior to making decisions, but implement the first satisfactory action. This perspective contrasts with the current study findings, which suggested that although players

sometimes took the first choice when making decisions during the planning process (e.g., club choice), subsequent changes were often made once players obtained more information through attentional monitoring. This view of dynamic cognitive processing links to what McPherson (1999) has titled 'current event profiles', where higher level performers develop domain-specific knowledge over time, which is used in the process of planning, reasoning, and evaluation, especially when monitoring and attending to different problems during performances. Similarly, Arsal., et al. (2016) demonstrated through the use of TA, how within skilled performers, more thoughts were verbalised during more complex putts and when performing putts during higher stress situation. Again, emphasising the importance that skilled performance involves the development of more refined and higher level planning and analysis, which is situational specific (Arsal et al., 2016). It is important to note, however, that although the standard of the sample in the present study was relatively high, the sample was not elite. Thus, further research is warranted to examine whether similar patterns are evident in more elite golfers.

Finally, MacIntyre et al. (2014) have emphasized the importance of metacognitive process in the role of expertise. Higher level athletes are thought to demonstrate a more superior ability to control, monitor and self-regulate in order to meet task demands. This element of metacognition links to previous work in endurance performance (Brick et al., 2015). Although there are ostensible differences between golf and running, there are some noteworthy similarities between findings in the current study and understanding of attentional focus in endurance performance (Brick et al., 2015). Elite runners reported that information acquired through internal and external monitoring was used to form a metacognitive representation of the activity, which in turn led to the utilisation of cognitive strategies to control their cognitions (Brick et al., 2015). Similarly, golfers in the current

study used information acquired through monitoring of the external environment to facilitate planning in the pre-shot phase, and engage in the process of reviewing, evaluating, and planning in the post-shot phase. Likewise, participants also used psychological skills to manage distraction and undesired emotional responses. In turn, this offers insights into the interactions between cognitive and metacognitive processes during competitive golf. While Oliver et al. (2020a) referred to the concept of "attentional metacognitions", the current findings enhance understanding by (i) indicating *when* such cognitions occur, and (ii) illustrating the complexity of attentional focus during golf shots.

Despite the promise of these findings, further research adopting a metacognitive framework in golf and additional sports is warranted.

Strengths, Limitations, and Future Directions

The current study has a number of strengths. First, in contrast to previous golf studies that temporally examined cognitive processes in golf putting in lab-based settings (e.g., Calmeiro & Tenenbaum, 2011; Eccles & Arsal, 2017), the current study obtained data for all shots (i.e., not just putting) during six holes of competitive golf on a golf course, thus improving the ecological validity of the findings. Second, by moving away from the quantification of qualitative data and focusing on the richness of the descriptive text, the current study provides insights that might have been previously missed in TA studies in golf that adopted deductive and statistical approaches to data analysis. Finally, by providing rich and detailed TA quotations, recommended in qualitative research (see Smith, 2018), the current study could have greater potential for naturalistic generalisability than previous studies in the area that focused on inferential statistics, as the findings might resonate with other golfers (Stake, 1995). In doing so, the study takes a step towards answering calls for

the continued progression of qualitative research methods in sport and exercise psychology (Smith & McGannon, 2018).

Despite these strengths, however, a number of limitations should be noted. First, the study sampled participants of a similar performance standard in a single performance. Thus, it was not possible to determine how the golfers' cognitions compare to players who perform at different standards (e.g., elite golfers) or to other performances. Second, while the findings offer insights into *some* cognitive processes, it is acknowledged that some cognitive processes can occur outside of conscious awareness and that there are limits to the amount of information that can be obtained via TA (e.g., Eccles, 2012). As such, while participants were asked to verbalise any thoughts that entered their mind, it is possible that relevant information was not reported. Finally, although this study involved a competition, which was assumed to create a higher pressured situation in comparison to practice (Vine et al., 2011), no measure of the perceived level of pressure was obtained.

Future research adopting TA should continue to look beyond quantitizing data using deductive approaches and consider the advancements in knowledge that could be produced by employing an inductive approach, both within and beyond golf. Additionally, future TA studies could inductively explore cognitive processes in higher-level, elite performers to enable comparison with less elite golfers. Researchers should also seek to overcome the limitations of the TA method as regards the potential omission of cognitive information by combining TA with other qualitative data collection methods that seek to maximise the richness of data by reducing retrospective recall, such as event-focused interviews (cf. Author 2 et al., under review). Such research could, for example, seek to explore the reasons underlying specific cognitions and higher-order metacognitions. Finally, future TA studies in competitive scenarios could obtain measures of perceived pressure and performance.

Applied Implications

The framework of cognitive processes in golf presented in Figure 1 can be used to advance understanding amongst coaches, golfers, and sport psychology practitioners of cognitive processes during competitive golf. For instance, the findings elucidate the types of external stimuli that golfers could attend to prior to a shot and how such information could be integrated into higher-level shot planning and situational appraisals. From an applied perspective, the findings indicate that it is important for golfers to develop a range of psychological skills that can be employed before and after shots to manage context-specific distractions and emotions. Finn (2009), suggested golfers should follow the 4-F (fudge, fix, forget and focus) model (Kirschenbaum et al., 1999) post-shot to overcome negative self-self talk and cope with a potentially negative outcome. Our findings show similar examples of this model, as our participants engaged in some level of affective responses (fudge; an explanation of dissatisfaction), coping/rationalising (forget; forget about the problematic shot) and plan (focus; focusing attention on the next shot). Although we were not able to fully evidence the 'fix' element of this model, which involves a practice swing, we were able to see evidence of a proposed processes, which is used by a tour-level golfer, demonstrated by our high level participants.

Furthermore, the complexity of cognitions highlighted in the current study suggests that it is important for golfers to not only know *what* strategies are helpful for self-regulation, but also *when* these strategies should be enacted. As such, this suggests that developing metacognitive knowledge (Flavell, 1979) in relation to strategy use in the pre-shot and post-shot phases may enhance the self-regulation capabilities of golfers. Finally, it is important to note that this study offers a 'framework of cognitive processes', which could also be adopted for further research within other sports. Figure 1 provides an overarching

framework or process, which could be adopted for further research, however, table 1 provides the context specific findings within golf. Therefore, it is hoped that readers can appreciate how these findings can be used to apply to the general understanding of cognition underlying sport performance, without losing the context specific nature.

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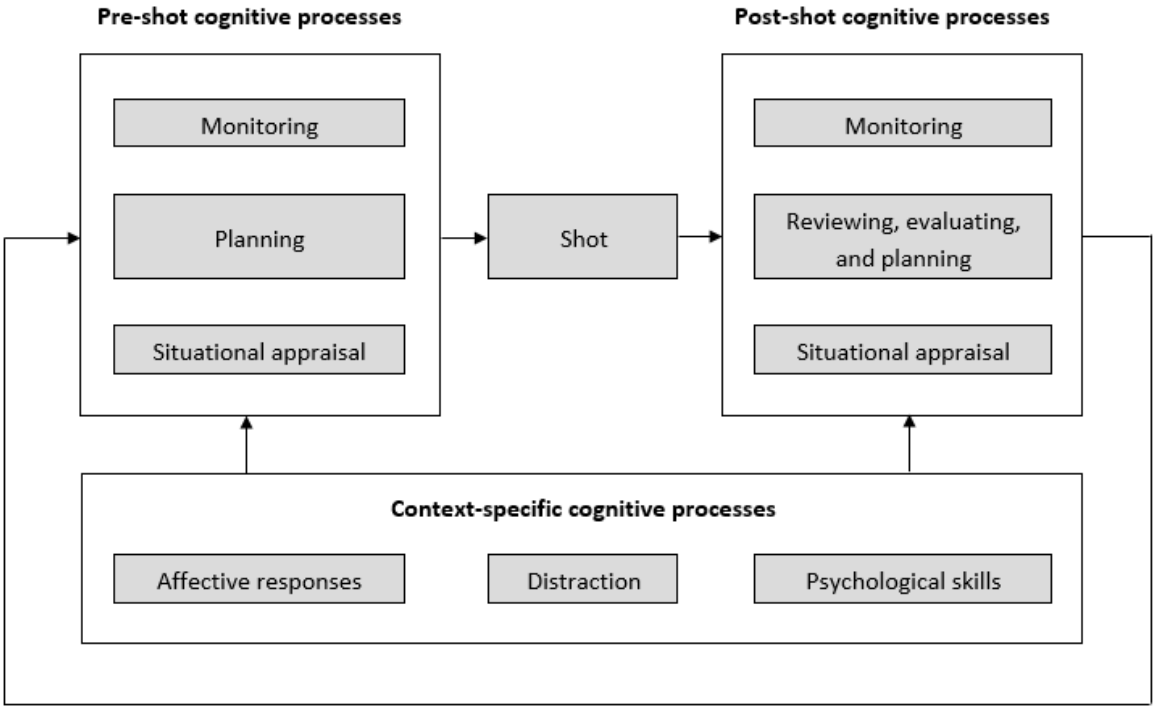
Figure 1. Framework of cognitive processing



1 Table 1: Codes, higher-order themes, and themes for pre-shot verbalisations

Example raw-data quotes	Codes	Higher-order theme	Theme
Hands really are going weird; I feel pretty good	Feeling in body	Internal monitoring	Monitoring
I'm not far off the edge of the green; I finished pin high	Ball location	Outward monitoring	
Currently got 118 to the flag; 10 feet for birdie	Distance approximation		
Not the best of lies, in the rough; sat down in the middle of the rough	Lie on the course		
He's just gone 4 over on 1 hole; 'don't 3 putt it whatever you do [name], that's be really annoying'	Other players		
This green slopes back to front, some right to left; green is very bobbly	Terrain or physical environment		
Wind is strong off that left-hand side; rains picking up a bit; the wind has just picked up again slightly	Weather		
Green is nice and wet, so should be able to get a nice bit of skid; winds slightly off the left, might be a bit of a fade, but should be fine	Determining impact of environment conditions	Assess environmental impact	Planning
It's going to be a 9-iron, not a full one; little 2 hybrid like last time	Club selection	Shot planning	
We'll go to the right and deadweight; let's try it at pace, at the right pace	Pace planning		
Not a clue which way it's breaking because it changes every day; I can't convince myself about the pace to hit	Planning difficulties		
It's an aggressive pitching wedge; it's going to land just on the green and release out	Shot type		
Commit to it, good swing; stay calm, do not accelerate; keep your spine angle nice firm	Technical planning		
Go a bit more towards the pin; try and aim at the tree this time	Visual target or line planning		
Quite a hole-able putt really; put yourself in the worst position ever, left yourself the grimmest putt	Assessment of difficulty	Demand appraisals	Situational appraisal
Very important putt; needs to go in	Awareness of importance		
3 over, knock this in, it's going to be a 7; to have any chance of the competition, I think I will have to hole this	Competition assessment		
Confident of hitting this well; this is going in, this is going in	Feeling of confidence	Resource appraisals	
Less confident for this shot than I have been; don't think this is going to go in; it's never going to go in with these greens, normally a confident player, but [not] today	Feeling of doubt		
Can't wait for my tea, I'm starving; not really concentrating; wow, my pants really are white	Task-irrelevant thoughts	Distractive thoughts	Distraction
'What did you make then? A 5?'; 'I didn't see it drop' (other player: 'did it hit the tree?') 'Yeah it did hit the trees'	Conversing		
What a random start that is, 4, 3; why did you hit a f****** 3-wood?	Dwelling on past shots	Ruminative thoughts	
Hands really are going weird; I feel pretty good	Feeling in body		
Not too happy with my performance so far; really bad shot, really not happy	Dissatisfaction	Negative emotions	Affective responses
Literally going to rage in a minute; I'm a bit pissed off	Frustration		
Feeling calm	Calmness	Positive emotions	
I do really want to win it	Outcome goal	Goal setting	Psychological skills
Most important thing is to make your 4; let's try and make a par	Performance goal		
Good connection on this will get you there; nice smooth swing	Process goal		
Judge the speed, imagining the ball going into the hole; I can visualise this going in	Imagining success	Imagery	
One practice putt behind it. Hit a ball, 1, 2, 3; walk up to it have a few practice swings and keep your head	Practice putt	Pre-shot routine	
Take it out, setting the ball; take your glove off	Preparatory behaviours		
Deep breathing; try and stay calm, relax [the] muscles, relax [the] tension	Relaxation	Relaxation	
Forget that last hole; I'm going to really concentrate on this putt now	Refocussing	Refocussing	
Be confident on this wedge shot, split the fairway take the positives; hit it this time	Instructional self-talk	Self-talk	
I will make this putt; come on you can hit a good shot here	Motivational self-talk		
I'm actually terrible at golf; absolutely diabolical	Negative self-talk		
Probably a bit more nervous than I have been; nervous of hitting bad shots because I want to do well	Nervousness		

Table 2: Codes, higher-order themes, and themes for post-shot verbalisations

Example raw-data quotes	Code	Higher-order theme	Theme
Just a tiny bit short of the pin, but it's on the green; probably landed it about 10-15 yards too short	Ball location	Outward monitoring	Monitoring
Possibly the worst shot I've ever hit;	Evaluation of shot outcome	Evaluation	Reviewing, evaluating, and planning
Moving onto the second hole 1-over, could've been a lot worse; to be honest I think this has been a poor round	Evaluation of general performance		
Plenty of sand in the bunker. Try and splash it out and put it down to the pin; left yourself 20-foot up the hill	Planning next shot	Planning	
Quite happy with the result really; should have turned but for some reason it went straight, don't know why; I didn't think it was going to make it that far	Reviewing last shot	Reviewing	
Not in the bunker, reasonable par chance; there's an outside chance that I'll make that	Assessment of next shot chance/difficulty	Demand appraisal	Situational appraisal
To be honest I really needed a hole in 1 to actually maybe get in the top 3; you're in a competition	Competition thoughts		
Birdie, birdie, birdie. Doable, I know that; more confident	Feeling of confidence	Resource appraisal	
So unconfident; can't recover from it	Feelings of doubt		
I'm really fucking pissed off because that was a shit drive; I can't believe I doubled that last shot	Dwelling on previous shot	Ruminative thoughts	Distraction
Getting so distracted by [player]	Distractive thoughts	Distractive thoughts	
What did you get on the third? 4?; (looked good in the air) yeah it did	Conversing	Negative emotions	Affective response
Really pissed off at that; it's really annoying that I've done that	Frustration		
Slightly disappointed; not so happy about that	Dissatisfaction	Positive emotions	
I'm happy with that; I'm quite happy with that	Satisfaction		
Let's take it into this next shot, make birdie, come on; right, lets bounce back	Motivational self-talk	Self-talk	Psychological skills
Good shot, nice strike; good 2 putt for par	Positive self-talk		
Crap at golf; every time I play golf I just can't make anything	Negative self-talk		
Just try make a par; try and focus in on making this putt	Performance goals	Goal setting	
Life goes on; never mind; not much you can do	Acceptance	Coping response	
always the fucking putter, every time I play golf, I just can't make anything	Blaming		
Come on, chin up. This is as bad as its going to get, come on; I'm not really taking much from my putting on these greens	Rationalising		
Take it hole by hole; just go to the next hole, keep it together	Staying in the moment		