



International

Journal of Human Sciences

ISSN:2458-9489

Volume: 18 Issue: 4 Year: 2021

The wandering mind and performance routines in golf

Paul Christianson¹

Brent Hill²

Bradford Strand³

Joe Deutsch⁴

Abstract

The past decade of research has brought about new understandings in the study of pre-shot routines, with multiple researchers advancing the field of knowledge surrounding the usage of pre-shot routines as a performance enhancement mechanism. Across golfers of novice to expert skill-levels, the results of peer-reviewed studies have clearly presented the potential benefits of incorporating pre-shot routines for all golfers in improving their play. However, with the current state of research serving as an indicator as to how far we have come in our learning of pre-shot routines in golf, researchers and practitioners in the field understand that there is still a long way to go in expanding our knowledge base on pre-shot routines and their role in the golf performance spectrum. The paper reviews the concept of the wandering mind, attentional control theory, performance routines in general, and more specifically, pre-shot routines in golf.

Keywords: Golf; pre-shot routine; golf performance.


Introduction

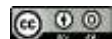
As an area of research, pre-shot routines in golf have been studied for the past 40 years by academics and practitioners. The works of research pioneers have made profound impacts on advancing the knowledge of pre-shot routines and the role they play in improving task-relevant thought in golfers. As an industry, researchers and practitioners have learned a significant amount since the first works of Kirschenbaum and Bale (1980), Rotella and Bunker (1981), and Yancey (1977) regarding the importance of pre-shot routines and the role they play in improved golf performance. Since this time, observations have been conducted on the pre-shot routines of elite golfers in competition (Crews & Boutcher, 1986a) and assessments have been made as to their applicability on behaviors in beginning golf performance (Crews & Boucher, 1986b). Researchers have introduced cognitive behavioral interventions and assessed their potential benefits on golf performance (Cohn, Rotella, & Lloyd, 1990) and groundbreaking research has been conducted on attentional control

¹ Assistant Prof., Barton College, Sports Management, pchristianson@barton.edu

² Associate Prof., North Dakota State University, Educational and Organizational Leadership, brent.hill@ndsu.edu

³ Prof., North Dakota State University, Physical Education Teacher & Coaching Education, Health, Nutrition, and Exercise Sciences, bradford.strand@ndsu.edu

⁴ Prof., North Dakota State University, Physical Education Teacher & Coaching Education, Health, Nutrition, and Exercise Sciences, joe.deutsch@ndsu.edu  Orcid ID: [0000-0003-3094-6641](https://orcid.org/0000-0003-3094-6641)



methods related to golf performance (Boutcher, 1990). A great amount has also been discovered about the focus of attention in golfers and the task-salient cues they utilize during pre-shot routines (Boutcher & Crews, 1987).

The last 30 years of research have brought upon new systems of achieving peak performance in golf (Cohn, 1991) and provided a better understanding of the attentional focus patterns that exist amongst golfers of a high level of skill (Crews & Landers, 1993). Pre-shot routine frameworks have been developed for researchers and practitioners to build upon (Moore & Stevenson, 1994) and pre-shot routines have even been integrated into a total performance management model for golf performance (Murphy, 1994). As an area of study, researchers and practitioners have been able to better understand the importance of consistency in pre-shot routines (Kingston & Hardy, 2001) and conducted studies confirming the previous findings of researchers who blazed a trail of understanding (Beauchamp, Halliwell, Fournier, & Koestner, 1996).

With the emergence and adoption of information technologies like the internet over the last 20 years, a flurry of research has been conducted with the new ease and speed of gathering information. During this emerging era, advances in a golfer's focus of attention have been discovered (Wulf, Lauterbach, & Toole, 1999) and quickly been utilized by researchers in the field (McCann, Lavallee, & Lavallee, 2001). These rapidly adopted advances in a golfer's focus of attention have produced results of mitigating levels of anxiety and arousal (Tenenbaum, 2003) and provided confirmatory evidence that an external focus of attention is superior to an internal focus of attention during the pre-shot routines of both novice and elite golf performers (Wulf & Su, 2007). These advances have asserted that a pre-shot routine is a prerequisite for superior golf performance (Jackson, 2001) and allowed researchers to propose that golfers need to remain committed to performing a pre-shot routine on every shot in order to reach elite levels of golf performance (Douglas & Fox, 2002).

The past decade of research has brought about new understandings in the study of pre-shot routines, with multiple researchers advancing the field of knowledge surrounding the usage of pre-shot routines as a performance enhancement mechanism (Cotterill, 2008; Cotterill, Sanders & Collins, 2010a; Van der Lei, 2010). Across golfers of novice to expert skill-levels, the results of peer-reviewed studies have clearly presented the potential benefits of incorporating pre-shot routines for all golfers in improving their play (Bernier, Codron, Thienot, & Fournier, 2011; Thomas, 2010). However, with all of the advances that have been made up until this point, golfers are still experiencing task-irrelevant thoughts that can be detrimental to golf performance.

The Wandering Mind

It has been suggested that the human mind spends a great deal of time in a state of stimulus-independent thought—otherwise known as *mind wandering*—as the default mode of operation (Killingsworth & Gilbert, 2010; Mason et al., 2007). Killingsworth and Gilbert (2010) found that 46.9% of people reported being aware of their minds wandering throughout the course of a day. This type of mind wandering occurs throughout a human's life based upon the tasks at hand and brain function of each human being. In modern society, mind wandering has obvious problematic implications regarding such things as a student's ability to effectively learn, an employee's productivity, and a golfer's ability to focus their attention on the task at hand to accomplish their goals.

It has been reported that a typical weekday 18-hole round of golf has remained consistent at four hours year over year, with the average weekend round increasing to four and a half hours (Last, 2014). Some competitive rounds can run even longer. With golfers found to spend roughly 14 to 20 seconds of time actually hitting a golf shot while averaging 81 shots per round, it's possible that many golfers only spend roughly 19 to 27 minutes of time focused on their actual golf shots during the course of a round of golf (Zienius, Skarbalius, Zuoza, & Pukenas, 2015). This leaves a significant amount of time for a golfer's mind to wander over the course of a golf round.

The Attentional Control Theory (ACT) suggests that mind wandering can lead to impaired attentional control and task performance (Coombes et al., 2009; Eysenck et al., 2007). In addition, ACT further contends that impaired attentional control on the task at hand can lead to deficits in task performance and feelings of anxiety (Eysenck et al., 2007). To further understand how educational practitioners may be able to limit the detrimental impacts of task-irrelevant thought, it is important to first understand that under ACT human attention is believed to be regulated by both a stimulus-driven attentional system and a goal-directed attentional system (Corbetta, Shulman, & Corbetta, 2002). Coombes et al. (2009) suggested that the stimulus-driven attentional system is sensitive to salient stimuli (such as when a teacher calls a student's name in class) and the goal-directed attentional system is responsive to a focused attention on accomplishing a specific goal (like trying to hit a golf shot over water). Anxiety inducing situations that are stimulated by task-irrelevant thought have often been found to prevent athletes in particular from focusing on the task at hand and may result in a phenomenon known as *choking* (Bernier et al., 2011).

Choking is a suboptimal performance outcome resulting from situations in which an individual is experiencing anxiety and has been found to happen in competitive situations that are directly related to a considerable desire to perform well (Hardy, Mullen, & Jones, 1996). Situations of choking can happen both in the classroom and on the golf course. Students failing large examinations due to test anxiety and golfers losing competitions as a result of thinking about prize money during competition are just two examples of where task-irrelevant thought can cause instances of choking. Emerging studies have found that anxiety demands a large allocation of cognitive resources and that pressure situations inducing anxiety prevent athletes from focusing on the task at hand (Bernier et al., 2011). As a result of this potential for choking, athletic researchers and practitioners have begun to integrate attentional focus cues (working on the stimulus-driven attentional system) into performance routines (working on the goal-directed attentional system) as a means of bringing athletes from a state of mind wandering into a state of sustained focus on the task at hand (Connor, 2010).

The primary rationale for the adoption of performance routines in the field of athletic education is to ensure that athletes have the ability to attain consistency in their performance and ensure that positive actions are being implemented to improve sporting performance (Taylor & Wilson, 2005). In a review of the performance routine literature, Cotterill (2010) found that past performance routine studies have been conducted in the sports of basketball, bowling, dance, diving, football, golf, gymnastics, rugby union, skiing, skating, tennis, volleyball, track and field athletics, water polo and wrestling. Multiple types of performance routines have also been shown to be effective in improving the performance of skilled athletes across a variety of sports (Boutcher & Crews, 1987; Cohn et al., 1990; Crews & Boutcher, 1986a; Crews & Boutcher, 1986b; Lobmeyer & Wasserman, 1986; Lonsdale & Tam, 2008; Mack, 2001; Price, Gill, Etnier, & Kornatz, 2009). In addition, some evidence even indicates that routines may benefit athletes of not only high-skill levels, but low-skill levels as well (Beauchamp et al., 1996; Boutcher & Rotella, 1987; Cohn et al., 1990). As we dig deeper into the current research that has been conducted in relation to performance routines in athletic education, it's important to first gain a better understanding of what performance routines are and how they can be utilized as an ACT informed methodology by practitioners in the field.

An Overview of Performance Routines

Routines are behaviors and thoughts that have automatically been ingrained in our daily lives and utilize a combination of physical, technical, and psychological strategies to enhance performance (Hackfort, Duda, & Lidor, 2005; Thomas, 2010). *Performance routines* (as they are commonly described in literature when related to performance outcomes) are meant to ensure that the positive influences of performance are supported and negative influences of performance are minimized (Thomas, 2010). Cotterill (2010) found that there are two common terms that are referred to in research when looking at performance routines. The previously mentioned term of performance routines has been

referred to in a multitude of studies (Cotterill, 2008; Holder, 2003; Jackson, 2001, 2003; Lonsdale & Tam, 2008; Marlow, Bull, Heath & Shambrook, 1998; McCann et al., 2001; Moran, 1996, 2004; Singer, 2002). Also commonly found in the golf literature has been the term *pre-shot routines* (Cohn et al., 1990; Crews & Boutcher, 1986b; Douglas & Fox, 2002; Gayton, Cielinski, Francis-Keniston, & Hearn, 1989; Harle & Vickers, 2001; Mack, 2001; Moore & Stevenson, 1994; Shaw, 2002).

In a further dissection of performance routines, Thomas (2010) suggested that performance routines can be broken down even further and conceptualized in three ways: pre-performance, between-performance, and post-performance routines. Pre-performance routines are described as enabling athletes to prepare for competition by consistently integrating the same strategies and by minimizing distractions. This would be akin to a golfer starting their practice routine on the driving range the same way every morning before the start of the actual competition. Between-performance routines are described as routines that can be utilized in sports with a series of period breaks (like hockey and volleyball) that enable athletes to remain consistent throughout their performance. One example of a between-performance routine would be a basketball player warming up prior to the start of the second half the same way that they warmed up prior to the start of the first half. Lastly, post-competition routines are described as those that allow for time to reflect on one's performance, evaluate performance, consider lessons learned, and plan for future training (Taylor & Wilson, 2005). An example of this type of routine would be a football quarterback watching film every Monday morning at 8:00am during the football season to enhance his on-field performance.

When describing performance routines and their usage in golf, pre-shot routines have been found to be the most frequently adopted intervention in golf literature attributed to mind wandering and are based on the assumption that a key aspect of successful task performance is the ability to attend to the task-relevant cues, processes, and behaviors during the actual process of hitting a golf shot (Wilson, 2008). In activities such as golf, the automatic nature of the skill creates ample opportunities for attention to focus on other areas such as negative thoughts and irrelevant stimuli (Niedeffler, 1976). The implementation of ACT informed methodology suggests that the integration of a pre-shot routine can assist athletes in filtering out distractions and maintaining their focus (Boutcher, 1990; Boutcher & Crews, 1987). Taylor and Wilson (2005) have also suggested that the importance of pre-shot routines is to assist athletes in the preparation of their next shot and help them refocus with Schmidt (1982) finding that a pre-shot routine may provide a way of reactivating the appropriate physiological and mental state before each shot.

In order to gain a better understanding of pre-shot routines and their usage in the field of golf education, it's important to first gain a better understanding of how past research has informed our current understanding of pre-shot routines in golf. Utilizing a chronological review of the literature, one is able to further understand how past research over certain time periods may have informed future research and knowledge construction. In adding to previous research in the field, a chronological review may also better allow future researchers to identify research trends that were taking place during different eras based upon the knowledge and beliefs at that time.

Pre-Shot Routines in Golf: A Chronological Review

Pre-shot routines have been described in golf as a sequence of task-relevant thoughts and actions that an athlete engages in systematically prior to his or her performance in a sport (Moran, 1996). Prior to the groundbreaking studies of pre-shot routines on golf performance by Crews and Boucher (1986a) and Boucher and Crews (1987), little empirical research had been undertaken on the integration of pre-shot routines on golf performance. Kirschenbaum and Bale (1980) had previously conducted research on the positive performance benefits of cognitive behavioral skills training in golf and trailblazers such as Yancey (1977) and Rotella and Bunker (1981) had published magazine articles related to pre-shot routines in golf, but no additional empirical research can be identified prior to that point.

In one of the first empirical research studies on pre-shot routines in golf, Crews and Boucher (1986a) used trained observers to record pre-shot routines in female golfers in tournament play. This study revealed that the pre-shot routines of players at this level were remarkably consistent during the course of a competitive round of golf and that the consistency of the pre-shot routines could suggest that competitive golfers playing at a higher level spend less time mind wandering and more time focused on the task at hand. From that research, Boutcher and Crews (1987) went on to add that the task facing golfers is to efficiently focus attention on the most task-relevant cues while simultaneously screening out and ignoring irrelevant information during pre-shot routines in golf. In this study, the subjects participated in a six-week putting protocol that found attentional routines effectively control mental and physiological states associated with a closed-skill performance. The findings within both Crews and Boucher (1986a) and Boutcher and Crews (1987) studies set the foundation of the empirical understanding of how pre-shot routines could be an effective method of curbing the negative impacts of mind wandering on golf performance through the utilizing of pre-shot routines.

Cohn et al. (1990) followed up the work of Crews and Boutcher (1986a) and Boutcher and Crews (1987) by introducing a cognitive behavioral intervention via the adherence of pre-shot routines in collegiate golfers. Although immediate improvements in performance did not occur as a result of the intervention, it was found via post intervention interviews that the golfers felt the implementation of a pre-shot routine had a positive effect upon performance. This finding may have suggested that a properly adhered to pre-shot routine may have a statistically significant impact on the performance of golfers if adopted over a longer period of time and provided direction for future research.

During this time frame, Crampton (1989) also conducted a study attempting to establish pre-shot routines in golf and suggested that pre-shot routines are essentially an ordered collection of thoughts and behaviors. The study of Crampton (1989) held significance in that it allowed researchers to better begin to operationalize the impactful thoughts and behaviors that provide the foundation for effective pre-shot routines in golf. In a further investigation during this time frame, Boutcher (1990) also researched the role of performance routines in sport and introduced the potential benefits of ACT informed methods on golf performance by contending that the value of performance routines was to aid athletes in maintaining focus and eliminating distractions. Furthermore, Boutcher (1990) introduced the importance of cue words (falling under ACT's stimulus-driven attentional system) and breathing as part of performance routines and suggested that they could have a stabilizing effect on performance.

In a study introducing the experience of flow states, Csikszentmihalyi (1990) addressed the importance of gaining control over one's mental processes in an effort to obtain optimal experience or a "zone-like" state of mind. In his groundbreaking study, Csikszentmihalyi (1990) found that one of the most frequently mentioned dimensions of flow experience (and potentially expert performance) was having the ability to focus one's concentration on the task at hand and eliminate the wandering mind. The importance of this study introduced the prospect that golfers may be able to attain a state of flow (or total concentration on the task at hand) via the adoption of effective pre-shot routines that allow golfers to achieve this level of performance on a consistent basis. States of "flow" can adequately be described as a state of optimal concentration and performance in which pre-shot routines seek to achieve on a consistent basis. Golfers may experience a state of flow during a specific golf shot; however, the overall objective is to attain this state of flow during the course of an entire round and fall into a "zone-like" state of total concentration on the task at hand.

As researchers embarked on the early nineties, Cohn (1991) conducted an exploratory study on the aspects of peak performance in golf and found that certain psychological qualities of peak performance in elite golfers exist. Directly related to characteristics still included in common pre-shot routines today, Cohn (1991) found that golfers were a) highly focused and immersed in the task at hand, b) performed the tasks effortlessly and automatically, c) felt physically relaxed and mentally

calm, and d) felt in control of themselves during peak performance. Additionally, the golfers had no fear of negative consequences, maintained high self-confidence, and experienced fun and enjoyment. These findings helped researchers to understand the important aspects that could be integrated into the development and activation of effective pre-shot routines in golf.

In an attempt to try and activate a state of flow, Murphy (1994) followed up with a 'performance management model' where a four-point model of 1) practice, 2) preparation, 3) performance, and 4) analysis was advocated. Murphy (1994) suggested this approach could lead to peak performance given that athletes have control over the internal environment in which the game is played, but not the external environment that can cause athletes to fall out of their flow state. An internal environment suggested that a more top-down approach (which would fall in-line with ACT's goal-directed attentional system) allows athletes to better control their thoughts based upon the goals that are set forth in the task at hand. In addition, the impact of the external environment (which would fall further in line with ACT's stimulus-driven attentional system) was also noted to have a potentially damaging impact on a golfer's performance. In that same year, Kingston and Hardy (1994) also found that the consistency of routines can be compromised in situations when the golfer over internalizes thoughts and feelings that can be brought on by salient cues. This type of breakdown would also be found to be working on a golfer's stimulus-driven attentional system.

As researchers began to build upon the work of previous studies, Beauchamp et al. (1996) later adapted the cognitive behavioral program utilized by Boutcher and Rotella (1987) and compared it to a physical skills training and control group. The results of the study supported the conclusion drawn by Whelan, Myers, Berman, Bryant, & Mellon (1988) that cognitive behavioral approaches (such as pre-shot routines in golf) are effective for performance enhancement. The results of these compiled studies further fall in-line with the suggestions of ACT in that golfers may better be able to control their behaviors on a golf course by having a goal-directed control over their cognitive thoughts. This also may support the constructs presented by cognitive behavioral theorists in that cognitive thoughts can have a major impact on controlling actions and behaviors.

As the field of research entered the late nineties, researchers such as Wulf et al. (1999) found that an external focus of attention had the ability to enhance golf shot accuracy in both beginners and experts. To gather this information, the researchers studied the pitch shot performance of 22 subjects without experience in golf. One group was told to focus their efforts internally (focusing on the arm swing) whereas the other group was instructed to focus externally on the club swing. It was found that the external-focus condition was more effective for performance during both practice and retention for novice performers. These findings were important in that they provided researchers with a better idea of exactly where to direct a golfer's attention during the pre-shot routine process.

Entering a new decade of study, Jackson (2001) began to study whether or not a pre-shot routine is a prerequisite for superior performance. In a review of the experimental evidence at the time linking routine consistency and performance, Jackson (2001) found that pre-shot routines did have functional significance and concluded that golfers may benefit from their utilization. However, Jackson (2001) did find that there was no experimental evidence to conclude that a golfer's performance will improve by simply increasing their cognitive behavioral consistency.

The findings of Jackson (2001) were followed later that year by McCann et al. (2001) as they attempted to further examine the effects of pre-shot routines on the wedge shot performance of non-golfers and golfers of low skill. Utilizing intervention strategies in both physical skill and cognitive behavioral routine programs, participant performance was measured on a pre- and post-intervention test with groups of non-golfers and golfers of low skill being grouped together. The findings suggest that non-golfers had the greatest level of performance improvements when a cognitive behavioral routine was integrated into their practice. In addition, golfers of low skill also attained performance improvements via the utilization of a cognitive behavioral routine, but the findings did not reach levels of statistical significance. Although the findings were not statistically significant, the study by

McCann et al. (2001) was important in that it was one of the first of its kind in examining the proven performance outcomes of pre-shot routines utilizing a cross sectional design.

Douglas and Fox (2002) followed up on the pre-shot routine studies that had been conducted to date and further argued that in order to reach very peak levels of performance, professional golfers must remain committed to performing a pre-shot routine on every shot, regardless of the situation. These findings further supported the construct that golfers should seek to adopt a repetitive pre-shot routine in order to build habits of mind that lead to optimal performance outcomes. Although pre-shot routines often vary slightly based upon the shot that is required, the premise is that a repetitive routine should be built that incorporates important elements to achieve a desired performance outcome.

In further support of the utilization of ACT informed methodology, Tenenbaum (2003) proposed that during golf routines, task-relevant information is systematically processed by the golfer utilizing different dimensions of attention and through a continuous interaction between working memory and long-term memory. As such, high levels of anxiety and arousal could impede the attentional aspects required to process task-relevant cues and thus compromise both the quantity and quality of information that is being processed during a pre-shot routine.

As research began to build upon itself and in a follow up study to the work of Wulf et al. (1999), Wulf and Su (2007) conducted a study assessing a golfer's external focus of attention and how it enhances golf shot accuracy in both beginners and experts. The replicated findings reiterated the performance benefits of having an external (relative to internal) focus of attention and provided converging evidence that adopting an external focus of attention enhances learning and promotes a more automatic type of movement control. The overall premise is that golfers may achieve better performance outcomes if they focus on external thoughts (such as the golf club head location in space) as opposed to internal thoughts (like the rotation of a golfer's elbow during the swing).

As the field of research entered a new decade, Thomas (2010) examined the efficacy of pre-shot routines on improving competitive youth golf putting and approach shot performance. The first focus of the study was to determine the impact of learning mental skills components related to the pre-shot routine in golf and the second focus of the study was to examine the impact of learning the pre-shot routine on competitive performance from the subjects' perspective. In an assessment of three youth high school golfers, performance improvements were observed by the investigator utilizing performance scorecards, mental skills scorecards, adherence logs, thought sampling, and interviews. The results of the study found putting and approach shot performance occurred in two of the subjects. In addition, subjects found the intervention to be helpful and agreed that their performances (ball striking, overall performance, iron, wood, and sand shots) improved. Although the design of the study presented challenges in attaining statistical significance in its results, the study presented valuable investigative tools that future researchers may be able to utilize in longitudinal studies with youth and low skill level golf performers.

In the same year, Van der Lei (2010) studied the attentional and affective states of golfers during performance. The study implemented a multi-modal assessment approach where the relationship between affective states of both performance process and performance outcome measures were determined. The researchers studied three collegiate golfers and revealed distinguishable and idiosyncratic individual affect-related performance zones associated with physiological and introspective measures for each golfer. In addition, the patterns during the pre-shot routines were found to be highly consistent (Van der Lei, 2010). As found previously by Crews and Boucher (1986a), the development of *patterns* in pre-shot routines may assist in the development of consistent pre-shot routines that can have a positive and repeatable impact on golf performance.

One year later, Bernier et al. (2011) conducted a study working on the ACT informed stimulus-driven attentional system and explored the attentional focus of expert golfers. Within the study, eight male professional golfers were filmed in both training and competitive contexts. The results of the study found that golfers adapt their attentional foci depending on the context, which

would further reiterate findings presented within ACT in relation to the potential negative ramifications of salient cues on golf performance. In addition, Bernier et al. (2011) also found that sequences of attentional foci were utilized when golfers prepared, executed, and evaluated their shots. This finding further reiterates the importance of having repeatable patterns and behaviors in developing a consistent pre-shot routine.

In that same year, Yancey, Czech, Joyner, Zwald, and Genter (2011) expanded the knowledge base of pre-shot routines in golf and conducted an existential phenomenological investigation of the experiences of professional golfers when conducting pre-shot routines. In the study, eight professional golfers were interviewed to assess the “lived experience” of golfers during their pre-shot routines. The three major themes that Yancey et al. (2011) identified were maintaining focus, the physical aspects of the routine, and shot type. Sub themes were also identified for each major theme that included focusing on the specific target at hand, internal imagery, and maintaining consistency. Where golfers stood during the routine, the amount of practice swings, consistency of use, and external visualization were also identified under important physical aspects of a routine along with differing shot types ranging from full swing shots, chipping, and putting (Yancey et al., 2011). The results of this study were important in that they allowed researchers to grasp a better understanding of what was happening inside the minds of golfers as they are progressing through a pre-shot routine process as opposed to just observing their physical behaviors.

In an attempt to “fill the gap” between the psychological skills applied in pre-tournament planning and those applied in the shorter-term pre-shot routines, Davies et al. (2014) conducted a study that examined the optimal use of the time between shots and holes. In this study, Davies et al. (2014) were able to identify an area of macro (pre-tournament) planning where professional golfers focus on things such as imagery, technical changes, refinements, and tactical plans. The researchers also introduced the concept of a meso-shot cycle that involves planning, response and clearing strategies such as what happens before the pre-shot routine (known as the pre-pre-shot preparation phase), and post-shot routine. As previously mentioned, studies (such as Thomas, 2010) have identified multiple types of performance routines that golfers may adhere to that are not directly related to hitting the shot at hand such as pre-performance, between performance, and post-performance routines. Although the construct of these themes appears to have general support in relation to the potential performance benefits of pre-shot routines, very little research has actually been conducted to validate their impact on successful golf performance outcomes.

Zienius, Skarbalius, Zuoza, and Pukenas (2015) recently assessed the total time taken and heart rate changes of youth golfers during pre-shot routines utilized on the golf course. The findings revealed that pre-shot routines for tee shots were significantly longer than those of approach shots. In addition, the findings also revealed that heart rates increased significantly from the start to end of pre-shot routines for tee and fairway shots with the number of practice swings having the strongest relationship. Although the Zienius et al. (2015) is one of the first of its kind in relation to the heart rates experienced by golfers during the pre-shot routine process, one of the most important findings was that the time differentiation that was observed across different shots. This further reiterates the proposed importance of golfers having developed pre-shot routines for different shot types to ensure their consistency.

Furthermore, and in relation to the findings related to consistency by Zienius et al. (2015), Van Der Lei, Tenenbaum, and Land (2016) sought to examine changes in routine consistency with respect to optimal and non-optimal arousal states. Studying three highly skilled golfers during competitive rounds of golf, Van Der Lei et al. (2016) found idiosyncratic differences in routine patterns both behaviorally and temporally and that the consistency of routines for each golfer varied under different arousal-related performance zones. These findings further suggest the potential importance of controlling for salient cues that can cause alterations in a golfer’s arousal and result in an activation of a golfer’s stimulus-driven attentional system.

Most recently, the Bernier et al. (2011) study on attentional focus was followed up by Diekfuss and Raisbeck (2017) where the researchers studied the attentional focus of collegiate golfers during practice and competition. The results revealed two major themes pertaining to the focus of attention adopted by collegiate golfers. Situational focus was the first theme that referred to the focus used within a specific context. One example that was presented was the differences of internal focus between golfers hitting drives and putts. In addition, reactivity focus was found as a second theme that referred to the focus golfers adopt as a result of a psychological state such as performing poorly. Within this theme, it is suggested that a golfer's internal focus may change based upon their prior performance and reactive feelings toward that performance.

Based upon the findings of this chronological literature review, it was found that very little research has been published to date that focuses specifically on the development of effective pre-shot routines for golf. As the body of research has developed over the past several decades, it is important that we understand how pre-shot routines have been developed and informed by past research. As such, the remainder of this chronological review focuses on the historical development of pre-shot routines and the similarities and disparities of what has been developed to date.

Development of Pre-Shot Routines in Golf

Crews and Boutcher (1986b) introduced a six step routine that included 1) two continuous practice swings from behind the ball followed by visualizing an imaginary line from the target to the ball 2) standing beside the ball, setting the clubface square, and glancing once at the target, 3) setting the grip, 4) setting the feet, 5) glancing at the target once more, and 6) swinging. The results of the study revealed that there was a significant improvement in golf performance when utilizing a pre-shot routine, but only in more skillful golfers and suggested that pre-shot routines may only positively affect performance when golfers reach a particular skill level. During this time frame, Crews and Boutcher (1986a) also presented a behavioral sequence that included 1) standing behind the ball, 2) moving beside the ball, 3) setting the club behind the ball with one glance at the target, 4) setting the feet, 5) a combination of three waggles with two glances towards the target, and 6) swing. Although these are some of the first known studies, the information provided primarily spoke to outward observations of the physical behaviors of golfers during their pre-shot routines and less to their inward thoughts that may have been directing these behaviors.

Additional efforts were made by Singer (1988) to further understand what was happening inside a golfer's mind during the pre-shot routine. As a result of these efforts, Singer (1988) presented a five-step approach that included steps of 1) readying, 2) imaging, 3) focusing attention, 4) executing, and 5) evaluation. This study was later backed by Cotterill (2008) who proposed that the first four steps could be utilized as a global template for routines. It was suggested that this global template would allow the flexibility for the routine to be modified regarding behaviors and timing, but still fulfill the requirements of the individual golfer (Cotterill, 2010). However, beyond its recognition in the work of Cotterill (2010) which we will discuss in further depth in this review, there still remains limited publications that have explored the application of this approach.

In an effort to help better understand the effects of a cognitive behavioral intervention on pre-shot routines, Cohn et al. (1990) developed a representative example of one subject's preliminary mental and behavioral routines at the beginning of the study. The mental routine for shots followed a pattern of 1) selecting a club, 2) picking an intermediate target, 3) drawing an imaginary line from the ball to the target, and 4) trying not to think about swing mechanics. The physical routine for shots followed a pattern of 1) getting behind the ball and picking a target, 2) taking a practice swing behind the ball, 3) approaching the ball and putting feet parallel to the target, and 4) wagging the club two times while taking two glances at the target. Separate routines were established for shots and putting. The results revealed a cognitive behavioral intervention increased adherence to a pre-shot routine

and helped researchers to better understand that there is both a cognitive (mental) and behavioral (physical) routine that golfers adhere to within pre-shot routines (Cohn et al., 1990).

During this time frame, Boutcher and Zinsser (1990) also looked at the pattern of pre-performance behaviors and found that elite golfers used their predominant pre-putt pattern on 62% of putts whereas beginners only used them on 35% of putts. The revelations of this study further promoted the idea within our current study that mid- to elite-level golf performers may be more likely to adhere to a consistent pre-shot routine. As previously described, an adherence to a consistent pattern has been proposed to have a positive impact on pre-shot routine performance (Crews and Boucher, 1986a; Van der Lei, 2010).

Further adding to the research, Moore and Stevenson (1994) developed a three-step pre-shot routine framework for improved golf performance. The first step included the phrase “Check it out” to ensure that golfers recognized the situation (lie, distance, obstacles), reviewed their game plan (club choice and flight path), and selected an intermediate target. The second step utilized the phrase “Click it in” that focused on a golfer’s swing rehearsal of gaining the correct feel, relocating the intermediate target, addressing the ball, and getting ready to clear. The third and final step in this approach was to “Let it go” where the golfer clears their breath and initiates the swing. The findings in Moore and Stevenson (1994) also presented the development of a long-term training program that included an education, training, and application phase. This comprehensive approach to golfer performance improvement features the importance of having a pre-shot routine that is easily repeatable and integrates important mental and physical aspects.

Mccann et al. (2001) later adapted the pre-shot routine presented by Crews & Boutcher (1986b) and developed a pre-shot routine to assess golf wedge shot performance in low skill novice golfers that included 13 self-developed steps. These steps were 1) address an imaginary ball next to the ball to be hit, 2) visualize an imaginary line from the target to the club face, 3) waggle the club, 4) visualize an imaginary line from the target to the club face, 5) take a deep breath, 6) perform the swing recalling the word “smooth” on the backswing and the word “swing” on the downswing, 7) visualize the ball flying from the club face with the correct trajectory and landing at the target, 8) address ball to be hit, 9) visualize an imaginary line from the target to the club face, 10) waggle the club, 11) visualize an imaginary line from the target to the club face, 12) take a deep breath, and 13) perform the swing recalling the word “smooth” on the backswing and the word “swing” on the downswing. It was found that non-golfers in both intervention groups improved performance following an acquisition phase and maintained these levels of performance in the retention test. Although performance improvements were found utilizing this pre-shot routine method, it is our position that the inclusion of 13 steps may be too many to optimize the long-term recall and repeatability of a pre-shot routine.

As we have found up until this point, and as a result of such little research being conducted related to the development of pre-shot routines in golf; Cotterill (2010) set out to explore the nature of pre-performance routines in golf and the relevant research that had been conducted up until that point. During that time, it was found that current practices relating to the development of pre-shot routines were underpinned by the implicit assumption that increasing the consistency of the routine would lead to enhanced performance (Jackson, 2003). However, this assumption had not been consistently substantiated and various rationales had been presented with the main function that a pre-shot routine fulfills. Cotterill (2010) included findings on the performer’s ability to deal with distractions (Boutcher & Crews, 1987; Gould & Udry, 1994; Maynard, 1998; Weinberg, 1988), focusing attention (Boutcher, 1992; Harle & Vickers, 2001), acting as a trigger (Boutcher & Crews, 1987; Lonsdale & Tam, 2008; Moran, 1996), enhancing ability to focus and the recall of physiological and psychological states (Foster, Weigand, & Baines, 2006; Marlow et al., 1998), and reducing the unraveling of automaticity (Beilock & Carr, 2001; Beilock, Carr, MacMahon, & Starks, 2002). Although Shaw (2002) completed a study assessing pre-shot routine development with a professional

golfer, the researcher did not focus on the process they utilized to develop the routine nor the golfer's perception of the function and composition.

As a result of the lack of research focusing on the development of pre-shot routines from a subject's perspective, Cotterill et al. (2010a) conducted a study exploring the subjects' views on the nature of the pre-shot routines that they have implemented into their game. The results of this study found nine superordinate themes that were categorized as 1) allocation of attention, 2) psychological skills, 3) shot selection, 4) routine mind set, 5) routine composition, 6) compulsive behaviors, 7) routine evolution/application, 8) top players, and 9) moderating factors. During roughly the same time as the Cotterill et al. (2010a) study, Thomas (2010) presented a pre-shot routine utilizing three phases of learning: cognitive skill building, behavioral skill building, and relaxation. As with many other previous studies that both developed and integrated a pre-shot routine in golf, the Thomas (2010) study assessed the effects of a pre-shot routine on youth (novice) golf performance without a widely adopted model to utilize in assessing the effects of pre-shot routine on golf performance.

In conducting a thorough review of the relevant literature that exists today, the findings suggest that there appears to be no widely adopted model or methodology in which to adopt when seeking to improve golf performance via the utilization of a pre-shot routine. In some of the most recent findings to date, Cotterill, Collins, and Sanders (2014) followed up their previous research with an attempt to develop a framework for developing effective pre-performance routines for golf. In this study, the researchers found that conclusions drawn, and recommendations suggested by a number of studies in golf (Boutcher & Crews, 1987; Cohn, Rotella, & Lloyd, 1990; Crampton, 1989; Douglas & Fox, 2002) did not apply to the 'real' golf situations in which shot type and preparation for different shot types appear to vary. As a result, Cotterill et al. (2014) suggested that the future direction for work exploring and developing pre-shot routines should be to focus on the role they fulfill and the key components and behaviors that need to be executed. Furthermore, the researchers suggested the need to develop a template at the psychological level that underpins the routines in golf and allows golfers to naturally develop their own pre-shot routines within these psychological constructs.

Conclusion

Although researchers such as Strand and Craw (2019) have developed compelling templates, no additional pre-shot routine models or methodologies have been located to date that have been validated in the field to effectively improve golf performance and curtail a golfer's wandering mind. It is suggested that future research be conducted on the development of a pre-shot routine template that researchers and practitioners can utilize. Additionally, it is suggested that any future pre-shot routine template be validated by researchers and practitioners in the field in direct relation to its overall usefulness and utility so that a standardized model can be adopted when conducting research on the effects of pre-shot routines in golf in the future.

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