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Professional golf coaches' perceptions of the key technical parameters in the golf swing

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Abstract

Assessing a coach's technical knowledge of a sporting technique can reveal measureable biomechanical parameters associated with successful performance. This assessment can provide new insights into technique, enhance a coach's technical knowledge or assist in optimising performance. Despite numerous golf instructional books, no scientific study has assessed a golf coach's technical knowledge of the golf swing. Therefore, the purpose of this study was to identify the key technical parameters that professional golf coaches associate with a top level golf swing; with the intention of using the results to guide future golf biomechanics research and coaching technologies. Initially, sixteen professional golf coaches were individually observed coaching a highly skilled golfer after which they participated in a semi-structured interview regarding their technical analysis of the golf swing. QSR-NVivo analysis software was used to inductively analyse the data using the grounded theory approach. Line-by-line coding was followed by comparison of 'meaning units' to form a coding hierarchy with several key technical parameters identified. A successful golf swing was defined through three elements, with "body motion" affecting "club motion" and resulting "ball flight". Several terms described these parameters including "consistent", "powerful", "accurate", "simple" and "controlled" with the most prevalent being "repeatable". "Body motion" was influenced by five intrinsically linked key technical parameters: "posture", "body rotation", "sequential movement", "hand and arm action" and "club parameters" which were further sub categorised. To conclude, the key technical parameters have been identified which will be used to support future biomechanical research in this area and to be used to direct new technologies to aid golf coaching.

1. Introduction

An important aspect of coaching involves the analysis of sporting movement in order to effect a change in performance. Coaches are required to make accurate and reliable observations of the performer's movement patterns and subsequently guide the performance towards a more optimal technique through appropriate coaching sessions. It is assumed that for coaches to improve sports skills, they have a well developed internal model of a technically correct performance. For example, golf coaches would have an internal model of a technically correct golf swing [1]. The formation of such a model is proposed to be influenced by four aspects: (i) current technical coaching knowledge, (ii) refinement of known techniques, (iii) mental picture of skill and (iv) biomechanical understanding of skill [4]. However, the content of a coach's technical knowledge which includes their biomechanical understanding of the skill are often neglected. Assessing a coach's implicit technical knowledge and the sources of such knowledge has been conducted for sports such as gymnastics and sprinting and has formed the coaching-biomechanics interface [2, 3].

The coaching-biomechanics interface aims to understand and inform a coach's knowledge regarding their technical analysis of an athlete's technique. The information gleaned from such insights, through interviews or observations, is then converted into measureable biomechanical parameters that are directly related to a successful performance. This information may provide new insights into the technique, reinforce previously accepted ideas, enhance a coach's technical understanding and assist in optimising performance [4]. Despite numerous golf instructional books, there have been few, if any, scientific studies which have investigated a golf coach's technical knowledge of a top level golf swing based on the coaching-biomechanics interface. Some studies have attempted to understand how golf coaches learn and the sources of this information [5], however this has not been related to their actual knowledge. Therefore, the purpose of this study was to identify the key parameters that golf coaches associated with a top level golf swing. The results will allow technical parameters to be defined for future biomechanical analysis, reinforce existing coaching knowledge, provide new insights to assist future skill development and direct new technologies to aid golf coaching, such as golf training aids [4].

2. Methods

2.1 Participant selection

Sixteen golf coaches were recruited that satisfied the following criteria: the coaches had gained at least a Level 3 PGA qualification (or equivalent), had coached for more than five years, were currently still coaching and had coached high level golfers (e.g. professional or tour level). The coaches that met such criteria were contacted through golf coaching specific events, golf coach and academic recommendations and directly from golf clubs. All golf coaches and golfers gave their informed consent and ethical clearance was obtained from Loughborough University Ethical Advisory Committee.

2.2 Data collection

A combination of observations and interviews were used. Despite interviews being the most popular form of qualitative data collection in sport research, a combination of data collection methods is recommended [6].

An overt observational style was adopted in a field setting where a typical technical coaching session (i.e. driver and long irons) led by the professional golf coach would take place. The golfers being coached were requested to be of the highest standard (i.e. lowest handicap) accessible to the coach. All

observations were conducted at the coach's normal coaching venue. A standard video camera (Panasonic, Japan) was used to obtain a record of the coaching session. The video camera was positioned at an appropriate distance from the coach and golfer so that the session could be audibly recorded whilst not interfering with the coaching session.

Following the observation, a semi-structured interview was conducted with the coach. This approach allows interviews to be partially guided by observational findings whilst still remaining systematic across coaches by incorporating guided questions. The interview was divided into two sections: (i) structure of the technical coaching session and (ii) technical analysis of the golf swing. Within each section an initial open-ended question was asked followed by several guide questions which were re-worded based on the interviewee's responses. The observations and interviews were conducted at the same location as the coaching session, therefore increasing the level of comfort for the coach and the probability of attaining high-quality information [7]. The interviews lasted between 30 - 45 minutes and were recorded using a dictaphone from which typed transcripts were produced for data analysis.

2.3 Data analysis

An inductive approach, based on grounded theory, to qualitative data analysis was used to identify the professional golf coaches' perceptions of key technical parameters of a golf swing. This approach has been successful in studies of similar purpose, for example, when exploring elite sprint coaches' knowledge of sprinting [2, 8]. The QSR-NVivo (QSR International, Australia) qualitative analysis software was used as it allowed all sources of data (e.g. video, audio) to be collated within a single project. The software also streamlined the coding, comparison and development of key themes from the data. Following transcription, it was important to become 'grounded' in the data in order to break data into 'meaning units' based on the content, in a process known as coding [9]. Transcripts were initially coded line-by-line which involved highlighting parts of text into meaningful units of data. Many grounded theorists believe line-by-line coding forces the researcher to think analytically and to remain immersed in the data [10]. Video files from observational sessions were watched on several occasions and excerpts of video were also attached to meaning units within QSR-NVivo. A large number of meaning units were formed which represented several themes in relation to the proposed research question. The next stage involved comparing meaning units for similar or varying themes which were subsequently grouped together into categories. This process was continued until data saturation was reached and no new information or higher order categories were observed [9]. The outcome of this analysis resulted in several higher order categories and sub-categories which represented the professional golf coaches' perceptions of the key technical parameters that were associated with a top level golf swing.

3. Results and Discussion

The purpose of this study was to identify the key technical parameters that professional golf coaches associate with a top level golf swing whilst investigating how they analyse the technical aspects of a top level golf swing. The elements of a successful golf swing and descriptors are shown in Table 1. The higher order categories, sub-categories and meaning units are shown in Table 2. For the purpose of this paper, the golf coaches description of a successful golf swing and the higher order category "Posture" are presented in further detail, however a similar process was completed for all five higher order categories.

Table 1. The elements of a successful golf swing and descriptors as identified by the golf coaches

Elements	Descriptors
Ball flight Club motion Body motion	Powerful Accurate Consistent Repeatable Controlled Simple

Table 2. Higher order categories, sub-categories and meaning units relating to the golf coaches perceptions of the key technical parameters of the golf swing

Element	Higher category	Sub-category	Meaning units
Body motion	Posture	Spine angle Postural balance Rotatory axis	- Forward bend - Lateral bend - Stable axis - Centre of gravity - Weight distribution - Centre point
	Body rotation	Thorax and abdomen rotation Pelvis rotation Arm rotation Separation of pelvis and thorax/abdomen. Additional planes of movement	- Shoulders - Torso - Core - Hips - Disassociation - Resistance - Separation - Bend/tilt/sway
	Sequential movement	Timing of movement Timing of peak speed	- Coil and Uncoil - Force-energy creation - Summation of speed
	Hand and wrist action	Grip Wrist joint Hand eye co-ordination	- Cocking and uncocking - Hinge - Lag
Club motion	Club parameters	Swing plane Shaft plane Clubface	- Shaft angle - Centered strike - Angle of attack

2.4 Successful Golf Swing

Many coaches determined a successful golf swing from initially observing "ball flight". The successful ball flight was classified as:

Generating the ball flight you want to produce...I've picked a target...I want that ball flight to be straight...and the ball [travels] up and down the target line. Many coaches acknowledged that the ball flight was a result of two other parameters, "club motion" which was affected by the golfer's "body motion".

I would be looking at a player's ball flight, how the club is moving out and entering impact, how it's exiting impact and then the things that are influencing that [such as] how the body is working within the swing

The golfer's "body motion" was the greater focus for coaches during technical analysis of the golf swing and identifying the key technical parameters of body motion was important:

In early years of coaching you would [work] a lot on where the golf club was and how it was delivered...but now you would almost look at the body first to see why the golf club is there.

Furthermore, there were several descriptive terms coaches used when discussing the elements of a successful performance which were: "repeatable", "controlled", "simple", "accurate", "powerful" and "consistent". It was important to separate these descriptive words as it added another dimension when defining the technical parameters and how they affected a coach's perception of a successful golf swing.

A top class golf swing for me...it has to have repeatability...control and it should blend power and accuracy [so] you're looking for elements that help create those four things, repeatability, control, power and accuracy.

2.5 Posture

Fourteen coaches identified "posture" as a key technical parameter of the golf swing. Three sub-categories of "posture" were also identified: "spine angle", "postural balance" and "rotatory axis". Posture was referred to at various stages throughout the swing and was regarded as both a static and dynamic parameter. The sub-category "spine angle" referred to the degree of "forward bend" or flexion of the upper body/spine to the pelvis:

[Posture]...is having the correct amount of forward bend to the pelvis and torso, keeping the lumbar and thoracic as neutral as possible so bending forward from the hips, not so much from the knees, or rounded back.

Most coaches treated the "spine angle" as one rigid segment. However, the above quote suggested that some coaches would separate the "spine angle" into different sections including the lumbar and thoracic region of the upper body. Typically, the coaches would analyse a golfers "spine angle" from a "down the line" position (i.e. right side of right handed golfer facing target), therefore, many coaches only referred to this flexion angle. Attaining the correct "spine angle" at set-up was linked to another sub-category "swing plane".

If they are set incorrectly in posture they can't work the body correctly... they're moving the wrong plane of movement and then part of the reason why their club is moving in a funny fashion is because the body is actually moving incorrectly.

An incorrect posture at set-up could have detrimental effects on the remainder of the swing and therefore it was important that golfers maintained the "spine angle" throughout the swing. Therefore, posture was also about creating a "stable axis" or "rotatory axis" which the golfer could rotate around during the golf swing. The "stable axis" or "rotatory axis" was viewed as the centre of the golf swing.

[Stable axis] I mean the centre of the golf swing...or the rotatory axis is the spine [and it] should work in a stable fashion...I would advocate a rotation around the top of the spine and that is stability.

The coach of the above quote, also stated that the "stable axis" should move "slightly laterally". This statement could be due to this coach's definition of what constitutes the "spine angle" or "rotatory axis". For example, this coach talks about rotation at "the top of the spine" (i.e. thoracic) where as other coaches have spoken about the whole upper body representing "spine angle". Maintaining a "stable axis" was pivotal to creating a powerful and efficient swing above other technical parameters such as "body rotation" .

The guys that are more efficient...powerful are the guys that maintain a good centre and rotate around it...not necessarily making massive rotations, we've seen some guys have shorter rotations [hips and shoulders] but they are staying stable...it's about maintaining those postures...to reduce injury and to allow the club to get back to the golf ball more consistently.

The notion of creating a "stable axis" was also linked to the sub category "postural balance".

Posture is being in good balance. Creating the correct spinal angle...if you're spinal angle is not right and if your balance is not right, then there are a lot of counterbalances with the golf swing to try and adjust it.

Therefore, the degree of "spine angle" was important for creating a balanced position. "Postural balance" was defined statically at set-up as positioning the "centre of gravity" correctly and repeating the position.

The reason for posture...is to develop two key balance points...the sternum and the belt buckle...and then be able to move around them.

Some coaches referred to postural balance as tracing the golfer's "weight transfer" from set-up through the golf swing. The coaches assessed a golfer's "weight transfer" by observing the lower body, in particular the golfer's feet.

[Posture is when the] body is in a balanced position that enables the club to get moving efficiently and effectively around the body... if somebody's weight gets too much on the heels it's going to be very difficult for us to get the correct pitch of the shoulders in the backswing.

From the balanced set-up position the golfer was deemed to be able to rotate better which led to improved "dynamic postural balance". One coach believed that a combination of poor "posture" (which was defined as the degree of forward bend of torso to pelvis) and poor "sequential movement" would lead to poor "dynamic postural balance" which ultimately lead to a loss of power and accuracy. Any compensatory movement or counterbalances in the golf swing were as a result of poor "postural balance" and for golf coaches one of the main aims was to simplify the movements during the golf swing.

4. Conclusion

The purpose of this study was to identify the key technical parameters that golf coaches associate with a successful golf swing. A golfer's "body motion" was highlighted by golf coaches and "posture" was identified as one of the five key technical parameters. Several interlinked sub-categories for each technical parameter were identified. These key technical parameters defined within a golf coach's context will be used to support the identification of future areas for biomechanical research on golf performance and to direct new technologies to aid golf coaching, such as golf training aids.

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