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Visual search behaviour in skilled field-hockey goalkeepers

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In several sports, effective visual information pick-up has been shown to be crucial for successful goalkeeping. However, most of the studies that used video-based techniques, presented their participants with videos captured from a stationary camera view. In this study, we examined whether visual search behaviour and performance differ when presenting the stimuli with a moving camera view compared to a stationary camera view. To this end, we invited 15 skilled goalkeepers to watch video clips (from either a stationary or a moving camera perspective) of hockey penalty corners on a large screen, and to move a joystick in response to the actions observed. Visual gaze behaviour differed across the viewing conditions. Results suggest that in the moving camera condition visually tracking the ball resulted in visually ‘overshooting’ the stopping location of the ball (i.e., gaze tracking briefly continued beyond that stopping location), thereby leading to performance decrements. In contrast, shifting gaze towards the ball-and-stick location prior to ball release was a more beneficial strategy among skilled hockey goalkeepers.

KEY WORDS: Anticipation, Expertise, Field hockey Penalties, Perception

Skilled sport performance relies not only on accurate motor execution, but also on effective visual pick-up of task-specific, relevant information (Abernethy, 1987; Huys, Canal-Bruland, Hagemann, Beek, Smeeton, & Williams, 2009; Savelsbergh, Williams, van der Kamp & Ward, 2002; Savelsbergh, van der Kamp, Williams & Ward 2005). This information is entailed in optic variables that may be provided, for example, by the kinematic information of an opponent’s movement (Abernethy, Gill, Parks &
Packer, 2001; Williams, Huys, Cañal-Bruland, Hagemann, 2009). However, not all optic variables provide equally relevant information. Hence, detecting and using the most relevant perceptual information is a crucial skill of top-level performers.

Due to the fact that skilled perception is intrinsically coupled with successful performance, researchers seek to examine the relevant optical variables in specific situations that require highly effective perception-action couplings (Savelsbergh et al., 2005; for an overview, Williams, Davids & Williams, 1999). That is, several sport situations not only require athletes to pick-up relevant information, but also to do so very quickly (i.e., most situations are highly time-constrained). For example, due to the time constraints in penalty situations, goalkeepers may need to pick up the relevant information, such as the direction as well as the height of the shot, from the body kinematics before the penalty taker hits the ball.

In penalty situations skilled goalkeepers have been shown to outperform less skilled goalkeepers, for example, in soccer (e.g., Savelsbergh et al., 2002, 2005) and handball (e.g., Cañal-Bruland & Schmidt, 2009). However, the findings are somewhat contradictory in regard to the crucial visual information that was identified (Van der Kamp, 2001). While some researchers reported that, for example, soccer players utilized the information provided by the hip, trunk and kicking leg movements prior to and at ball contact (Williams & Burwitz, 1993), others suggested that the direction of the non-kicking foot is more useful to predict shot direction (Franks & Harvey, 1997).

Research dedicated to the identification of the most useful information for predicting shot direction and height has typically used the progressive temporal occlusion approach (Abernethy, 1987). For example, goalkeepers are invited to watch video clips that present the run up of a penalty taker from the familiar goalkeeper perspective. These clips are occluded at different points in time to vary the amount of information that can be used to predict the outcome of the penalty kick (i.e., shot direction and elevation). Although this approach has been shown to successfully identify skill-related perceptual strategies (e.g., Williams & Burwitz, 1993), researchers often require participants to make indirect or artificial responses. Participants were typically asked to either respond verbally, to write down their responses or to manifest their decision by clicking pre-defined buttons (for overview see, Van der Kamp, Rivas, Van Doorn, & Savelsbergh, 2008). Only few attempts have been made to use representative motor responses (for exceptions, see Farrow & Abernethy, 2003; Savelsbergh et al., 2002, 2005; Shim, Carlton, Chow & Chae, 2005).
Savelsbergh et al. (2002), for instance, presented skilled and less skilled soccer goalkeepers with penalty kicks and asked them to indicate their keeping reactions by moving a joystick. Savelsbergh et al. (2002) reported that skilled goalkeepers saved more balls than their less skilled counterparts and were more accurate in predicting shot direction. In addition, skilled goalkeepers seemed to wait longer before they initiated their response movements. The gaze behaviour analysis revealed that skilled goalkeepers showed fewer fixations of longer duration when compared to less skilled goalkeepers. Whereas less skilled goalkeepers fixated more time on the trunk, arms and hips in order to predict kicking direction, their skilled counterparts fixated on the head and used the kicking leg, non-kicking leg and ball area when the kicking foot approached the ball.

To date most of the research on anticipatory skills and visual search behaviour of goalkeepers has studied penalty situations in soccer (e.g., Franks & Harvey, 1997; Savelsbergh et al., 2002, 2005). However, in field-hockey, penalty corners appear much more frequently than in soccer and have a larger impact on the outcome of matches. At the Hockey Champions Trophy 2007, one of the world’s most important hockey competitions, 30% of the 146 goals scored during the tournament followed penalty corners. Penalty corners are quite different from penalties in soccer, handball and ice hockey. In field-hockey penalty corners the ball is brought into play by the pusher, who is positioned on the backline (see position 1, Figure 1). Typically, the pusher plays the ball to the stopper (see position 2, Figure 1), who according to the rules, stops the ball outside the shooting circle. The drag-flicker (see position 3, Figure 1) then tries to score by shooting the still ball at the goal. While for the laboratory task applied in this experiment no additional players were presented in the video clips, in real game situations the defending team is allowed to have up to five players, including the goalkeeper, behind the back line. All other defending and attacking players must be outside the circle line.

Although not in penalty corners, previously researchers have examined eye movement behaviours and/or perceptual skills in ice and field hockey players and goalkeepers. For example, Rendell and Morgan (2005) examined gaze behaviour in 26 skilled hockey players and goalkeepers of three different age groups (i.e., U18, U 21, >21). Participants were presented with 120 sequences of three different types of shots, drag flicks, slaps and pushes respectively. These sequences were occluded at different cut off points. The results showed no differences in response accuracy either between the three age groups or between different field positions. The eye movement analysis showed that the rate of saccadic eye movements was related to the playing
experience and specific expertise. Thus, there was a difference in saccade rate between goalkeepers and field players during drag flicks, but not during the push or slap actions. Rendell and Morgan (2005) interpreted this finding as further evidence for the suggestion that the development of expertise is rather task-specific.

Williams, Ward and Chapman (2002) examined the influence of a video-based perceptual training program in 24 female hockey players using a typical pre-post-test design. The experimental group trained with video sequences of penalty flicks while neither the control nor the placebo group received this special training. Results revealed that the goalkeepers who underwent the perceptual training reduced their response times significantly, while maintaining the same accuracy level as in the pre-test. Furthermore, Williams and colleagues included a transfer test from the laboratory to the field. Results showed that the perceptual training group also reduced their response time in the field setting. Thus, Williams et al. (2002) provided evidence that perceptual skills trained with a video-based perceptual training program transfer to the field setting.

Panchuk and Vickers (2006) examined gaze and motor behaviour of expert goalkeepers when asked to react to wrist shots taken from 5 m and 10 m on ice. They showed that the ability to save the puck depended on the location, onset and duration of the final fixation prior to the saving action, referred to as the quiet eye period. Best performances where achieved when the quiet eye was directed to the puck and stick area or to the ice in front of the puck. Yet, the body of the shooter was rarely focussed during the quiet eye period.

To the best of our knowledge, and despite its importance, no researchers have looked into penalty corners in field-hockey. Additionally, in most research on penalty situations in other sports, investigators have tended to compare skilled with less skilled goalkeepers. However, even at high levels of performance some goalkeepers perform significantly better than others in penalty situations (e.g., Savelsbergh et al., 2005; Van der Kamp, 2001). Do these performance differences relate to different visual information pick-up strategies?

In order to pick up the most useful information and to stop a penalty corner, goalkeepers may use two different strategies. One strategy could be to first focus on the pusher and then follow the ball to the centre of the circle where the stopper and drag flicker prepare to shoot the ball at the goal. This is referred to as the ‘keep the eye on the ball’ strategy (Croft, Button, & Dicks, 2009; Savelsbergh & Davids, 2002; Whiting, 1969). Alternatively, goalkeepers may directly focus on the centre of the circle to monitor the behaviours of the stopper and the drag flicker. Following the ‘keep the eye on
the ball’ strategy may result in an earlier ‘tuning’ to the ball and may thus be more advantageous in the anticipation of the penalty shot when compared to the second strategy.

The aim of the present paper was to examine the relationship between different visual information pick-up strategies and performance among fifteen skilled hockey goalkeepers when facing penalty corners. To this end, we presented participants with video-clips that were captured either with a moving camera that followed the ball trajectory (i.e., from the pusher toward the stopper and the drag flicker) or with a stationary camera that was directed towards the stopper and the drag flicker. Thus, we examined visual information pick-up strategies in skilled hockey goalkeepers comparing a dynamic with a stationary camera perspective, thereby experimentally controlling and constraining the field of vision. Similar to Savelsbergh et al. (2002, 2005), participants were required to manifest their goalkeeping decisions by moving a joystick.

**Method**

**Participants**

A total of 15 skilled hockey goalkeepers (\(M = 25.9\) years; \(SD = 6.18\); 11 male, 4 female) volunteered to participate in the experiment. The mean playing experience was 13.0 years (\(SD = 6.1\)). Level of competition varied from 3rd division (regional level) to the Dutch national team. Informed consent was obtained prior to participation. Participants were treated in accordance with the local institution’s ethical guidelines.

**Apparatus and Stimulus Production**

For capturing the test videos, penalty corners performed with a drag flick were filmed from the goalkeeper’s perspective. Four skilled field hockey players who did not participate in the main experiment were invited to perform penalty corners. All four players competed at the highest national levels. They were instructed to shoot at four different targets, that is, the left and right, upper- and lower corners of the goal. Each player performed a minimum of five successful penalty corners at each target. The mean duration of the penalty corner including the push from the backline was 2.67±0.09 s. The videos were recorded with a Canon XM-1 camera, which was placed in the center of the goal 40 cm field inwards at a height of 1.77 m, and which was either directed at the stopper and drag flicker (i.e., stationary camera condition) or it was initially directed to the pusher and then moved with the ball toward the stopper and drag flicker (i.e., moving camera condition). To determine ball speed and time (i.e., from the moment the ball is visible for the first time in the video clip until the ball passed the goal line), the location and moment of ball release relative to passing the goal line were recorded with two high speed cameras at 100 Hz. The set-up is depicted in Figure 1.
In the experiment a total of 40 videos were used, including twenty clips of the stationary viewing condition and the dynamic viewing condition (i.e., moving camera) each. The video clips were occluded at 80 ms (two frames) after ball release from the drag flicker stick. We did not occlude the clips at the point of ball-stick contact as not only the period just prior to, but also shortly after, post-ball-stick contact may contain pertinent information that may impact the keeper’s performance in penalty situations (Savelsbergh et al., 2005). Besides early ball flight information also the stick movement, which does not abruptly end at the point of stick-ball contact, may provide additional information about shot direction.

During the experimental phase the videos were back-projected onto a large screen (2.29 m x 2.27 m) using a mirror (Savelsbergh et al., 2002). The penalty corners were shown from a typical goalkeeper’s perspective. The size of the projections guaranteed that (monocular) optical sizes were the same as in a real penalty corner situation. The distance between the participant and the screen was 3 meters (Figure 2). Participants made their responses by pushing a hand-held joystick to one of the four corners matching the corners of the goal. The joystick data were amplified and stored on a computer using Labview (version 5.1). Furthermore, we synchronized the joystick data and video clips (in ms) using a 5V signal of a photodiode which responded to a transition between a black and white frame preceding and following each clip.

Visual search behaviours were recorded using an eye · head integration (EHI) system that included an Applied Science Laboratories (ASL) 4000SU eye-tracker and an Ascension Technologies magnetic head tracker (model: 6DFOB). The EHI is a video based monocular system that measures eye line-of-gaze using head-mounted optics. The system works by collecting three pieces of information: displacement between the left pupil and corneal reflex (reflection of the light source from the surface of the cornea), position of the eye in the head and position and orientation of the head in space. The relative position of these features is used to compute visual point-of-gaze with respect to a pre-calibrated nine-point grid projected onto the scene plane. A simple eye calibration was performed to verify point-of-gaze.
before each participant was tested. The data were superimposed onto the scene in the form of a positional cursor to highlight point-of-gaze. This image was then stored using a video recorder for further analysis. The data were subjected to a frame-by-frame analysis using a PAL standard video recorder (Panasonic AG7330) at 25 Hz. The accuracy of the system was established as ±1° visual angle. System precision (i.e., amount of instrument noise in the eye position measure when the eye is perfectly stationary) was better than 0.5° in both the horizontal and the vertical direction.

PROCEDURE

On arrival, participants were told that they would be shown video clips of penalty corners and that they would have to imagine themselves as the goalkeepers. Furthermore, they were instructed to indicate where they thought the ball would go by pushing a hand-held joystick to one of the four corners as if they had to block the ball. After positioning and calibrating the ASL eye-tracker we presented the participants with twelve familiarization clips, which were not used in the test. In the subsequent experiment, 40 test video clips were presented five to each corner in a stationary and a dynamic viewing condition. 20 video clips were presented from each condition, and they were shown in a fully randomized order. Participants did not receive any feedback about performance or results.

DEPENDENT VARIABLES

Performance and gaze pattern data were collected and analysed. The performance data included the following two variables:

Score: the percentage of joystick responses to the correct location.

Movement initiation time: the moment at which the participant starts the joystick movement relative to the moment of ball release. For this variable the derivative of the joystick motion was determined. The movement initiation time was defined as the moment the derivative reached 10% of its maximum value.

Figure 2. A side view of the experimental settings.
For the analysis of gaze patterns, we first selected those clips that were of average difficulty. To this end, a difficulty rating was calculated for each clip by dividing the number of saves by the number of participants. For each condition, eight video clips (i.e., a total of sixteen clips) were selected nearest to the median difficulty rating for that condition. We chose to analyse clips of average difficulty because these videos are more likely to represent plays frequently encountered in real game situations. Next, a frame-by-frame analysis of the gaze pattern was performed for the selected film-clips. For each frame direction of gaze was categorized into 11 locations: ball, stick, ball-and-stick combination, stopper, upper- and lower-body of drag flicker, anticipated stopping location (i.e., area between stopper and drag flicker prior to ball arrival), area in front of the ball (i.e., when the ball was stopped), anticipated ball trajectory (i.e., fixating areas directly preceding the ball), overshoot (i.e., the gaze moves towards the stopping location, but shortly overshoots this location and, thus, requires a re-shift of gaze), and other. The latter condition was defined as all gaze directions that were not captured by the pre-defined 10 locations. The mean percentage of viewing time for each viewing location (i.e., ‘percentage viewing time’) was used as the gaze measure.

DATA ANALYSIS

First, we analysed the performance data. A paired t-test was used to compare the saving performances between the stationary viewing and the dynamic viewing conditions. In addition, Pearson correlations were performed to examine the relation between movement initiation time and saving performance.

Second, gaze data were analysed by subjecting the percentage of viewing time to a 2 (stationary vs. dynamic) by 11 (the respective viewing locations) ANOVA with repeated measures on both factors. Significant effects were further examined using t-tests as post hoc comparisons (Bonferroni-adjusted). In the case that post hoc comparisons indicated significant differences, we performed additional Pearson correlations to examine whether these differences were related to saving performance. Alpha level was set at 0.05 and effect sizes were calculated as partial eta squared values ($\eta^2_p$).

Results

The performance score did not differ between the two viewing conditions ($t(14) = .072, p > .10$). Indeed, in the stationary viewing condition (73.33 %; $SD = 22.09 \%$) the goalkeepers saved as many penalties as in the dynamic viewing condition (73.00 %; $SD = 27.44 \%$). In addition, Pearson correlations indicated that goalkeepers who initiated their response movements later (i.e., waited longer) were more accurate in their decisions both in the stationary ($r = .733, p < .01$) and in the dynamic viewing condition ($r = .816, p < .001$). There was no significant difference for movement initiation times between the stationary ($M = 179$ ms; $SD = 91$ ms) and the dynamic viewing condition ($M = 194$ ms; $SD = 78$ ms). With respect to percentage of viewing time ANOVA revealed a significant main effect for viewing location ($F(10, 120) = 80.16, p < .001, \eta^2_p = .87$). There was no main
effect for viewing condition \((F(1, 12) = .016, p > .10, \eta_p^2 = .001)\). However, the interaction of viewing condition and viewing location attained significance \((F(10, 120) = 82.77, p < .001, \eta_p^2 = .87)\).

Post hoc comparisons showed that in the dynamic viewing condition goalkeepers spent more time fixating on the ball \((t(12) = 4.96, p < .001)\) and ‘other’ location \((t(12) = 21.56, p < .001)\) than in the stationary viewing condition. Furthermore, in the dynamic viewing condition the goalkeepers spent more time viewing beyond the location the ball is stopped (i.e., visual overshooting), while in the stationary viewing condition, goalkeepers hardly looked at this location \((t(12) = 3.33, p < .01)\). In contrast, in the stationary viewing condition goalkeepers spent more time viewing at the stick \((t(12) = 2.97, p < .05)\), the ball-and-stick combination \((t(12) = 10.72, p < .001)\), and the anticipated stopping location \((t(12) = 5.75, p < .001)\).

![Figure 3. Mean viewing time for each location (in %) across the stationary and moving camera conditions. Note that the areas related to the pusher can only be presented for the moving camera condition, and were therefore included in the analysis as “other” locations.](image-url)
To further examine whether gaze behaviour differences across the two viewing conditions, as indicated by the post hoc tests, were related to performance scores, separate Pearson correlation analyses were conducted. For the stationary viewing condition, results revealed that watching the ball-and-stick combination and performance scores were positively correlated ($r = .49, p < .05$). In other words, goalkeepers who focused more time on the ball-and-stick location saved more penalties in the stationary condition. There were also correlations that showed trends approaching conventional levels of statistical significance. That is, goalkeepers that tended to look at the stopper were less successful in saving penalties ($r = -.42, p = .076$). Similar to the stationary condition, in the dynamic viewing condition watching the ball-and-stick combination was positively correlated with saving performance ($r = .43, p = .065$). Interestingly, goalkeepers who tended to visually overshoot the stopping location saved less penalties ($r = -.42, p = .067$).

**Discussion**

Previous research has focussed on dissociating visual information pick-up differences between skilled and less skilled goalkeepers in penalty situations in soccer (Savelsbergh et al., 2002, 2005). While other studies also examined visual information pick-up in ice hockey (Panchuk & Vickers, 2006; Salmela & Fiorito, 1979) and field hockey (Rendell & Morgan, 2005; Williams et al., 2002), this is the first study that examined the differences in visual information pick-up in field-hockey penalty corners within a group of experienced hockey goalkeepers. Similar to Savelsbergh and colleagues (2002, 2005), we used direct measures of visual information pick-up (i.e., gaze behaviour) and required more active responses (i.e., motor reactions with a joystick when compared to, for example, button presses). The goalkeepers were presented with video clips that were captured with either a stationary camera that was directed towards the stopper and the drag flicker or with a moving camera that followed the ball trajectory. Finally, we assessed the direct relationship between goalkeeping performance and gaze measures.

Results showed that in the dynamic viewing condition (i.e., with the moving camera), goalkeepers fixated more on the ball than in the stationary condition. Thus, when goalkeepers had the chance to get more information about the ball trajectory after the pusher had played the ball towards the stopper, they tended to search for that information. Interestingly, however, this did not seem to be a beneficial strategy. In contrast to the stationary viewing condition, the goalkeepers tended to overshoot the stopping
location in the dynamic viewing condition. It seemed that when goalkeepers are trying to visually track the ball, but the ball was stopped by the stopper, gaze tracking briefly continues beyond that stopping location\(^1\). This visual overshoot then requires a re-shift. Maybe the time needed to re-shift gaze causes a decrease in saving performance. At least, this seems to be suggested by the correlation analysis that indicated that goalkeepers who made less accurate decisions spent longer times looking beyond the stopping location. Yet, it needs to be acknowledged that the dynamic viewing condition not only allowed the goalkeepers to get more information about the ball trajectory after the pusher had brought the ball into play, but goalkeepers were also constrained to follow the path of the ball. That is to say, whether goalkeepers typically used this strategy or not, cannot be answered from the current study, and needs to be examined in future research. However, this study provides initial evidence to suggest that following the ball trajectory may have detrimental effects on saving performance.

In the stationary condition the goalkeepers spent significantly more time fixating on the stick, the ball-and-stick combination, and the anticipated stopping location compared with the dynamic viewing condition. In particular, looking at the ball-and-stick area was positively correlated with saving accuracy. In addition, also in the dynamic viewing condition the goalkeepers who spent more time fixating on the ball-and-stick combination performed better. This observation is in accordance with data of Panchuk and Vickers (2006) who showed that in successful goaltending in ice hockey, the quiet eye period was mainly related to the puck and stick area or the ice in front of the stick.

In sum, even within skilled and highly experienced hockey goalkeepers different gaze pattern led to different levels of success in saving penalty corners. The results, thus, provided initial evidence to suggest that certain strategies might be more useful than others. As revealed for both viewing conditions focusing on the ball-and-stick combination seems to provide crucial information to make accurate judgments. This observation is in accordance with previous findings suggesting that focusing on the end-effector (e.g., the kicking leg in soccer) seems to provide the most reliable and timely information about shot direction (Savelsbergh et al., 2005; Williams & Burwitz, 1993). In contrast, results seemed to further suggest that goalkeepers

\(^1\)Importantly, the end location for the moving camera was the same (i.e., the stopping point) as in the stationary camera condition, ruling out an artefact of the camera movement. Moreover, in the moving camera condition the goalkeepers fixated significantly more on the ball, supporting the conclusion that they followed the ball rather than early (i.e., while the camera is moving) making a saccade to the stopping location.
should try to avoid following the ball trajectory after the pusher brought the ball into play. Tracking the ball seems to result in visually overshooting the crucial ball-release location (i.e., ball-and-stick combination), which may cause less successful performance. Possibly, this information pick-up strategy is ineffective because the overshoot costs extra time (and goes to the expense of viewing the ball-and-stick). Moreover, the performance analyses revealed that higher levels of saving accuracy were positively related to later movement initiation times. This finding is in accordance with previous research showing that skilled goalkeepers tend to wait longer before they initiate their motor reaction (e.g., Savelsbergh et al., 2002).

To conclude, the present study revealed that in order to successfully save a penalty corner, skilled hockey goalkeepers should anticipate and focus on the ball-and-stick area rather than continuously tracking the ball after it is brought into play by the pusher. Yet, it should be noted that in contrast to real game situations in either simulation condition no other attacking or defending players than the pusher (only in the moving camera condition), the stopper, and the drag flicker were presented. It is likely that in game situations additional players may sometimes occlude the goalkeeper’s view. Therefore, in the future researchers should apply the occlusion paradigm to examine to what degree the occlusion of certain areas of interest alters the visual search behaviour in hockey goalkeepers.

Furthermore, our results showed that it is more beneficial for the goalkeeper to wait longer rather than initiating the response movements (too) early. More research is needed to provide further empirical support for these practical implications, and to develop evidence-based training scenarios, such as video-based trainings that guide visual attention towards the crucial information to be picked-up (e.g., Hagemann, Strauss, Cañal-Bruland, 2006; Savelsbergh, van Gastel & van Kampen, 2010). In the future, using a head-mounted camera to capture more representative clips or running an experiment in which hockey goalkeepers face the attacking players in real-time on the pitch (e.g., Panchuk & Vickers, 2006) would further the development of representative task designs and may thereby lead to important implications for goalkeepers, players and coaches.

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Exploring the multiple dimensions of social support among elite female adolescent swimmers

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This study concurrently explored multiple dimensions of social support of nine elite female adolescent swimmers. Data were collected and analyzed using the principles of constructivist phenomenology. Results highlighted the importance of the structural, functional, and perceptual social support dimensions on athletes’ experiences in elite swimming in relation to their coaches, parents, and peers. Coaches were an important provider of almost every aspect of social support. Parents provided social support on a more general level, with their swimming-specific informational support being the single most unappreciated aspect of social support. Teammates provided a sense of affiliation and shared experience that was described as the most positive aspect of their swimming involvement. The current qualitative findings provide new insights into the concurrent structural, functional, and perceptual dimensions of social support in female youth elite sport.

KEY WORDS: Adolescence, Elite sport, Social influences, Social support.

Structured sport is a popular leisure-time activity for North American youth (Shernoff & Vandell, 2007). Many children and adolescents report sport participation motives that generally relate to perceptions of enjoyment, social affiliation, and competence (Weiss & Williams, 2004). Despite this, sport withdrawal peaks by the ages of 13-15 years and more adolescent girls than boys drop out of sport (Weiss & Williams, 2004). Moreover, female athletes have reported lower perceptions of competence in sport and received less praise from coaches compared to males (Black & Weiss, 1992). Finally, females have generally been underrepresented in sport psychology research over the last few decades (Conroy, Kaye, & Schantz, 2008) — and a particular under-representation has been youth elite sport athletes.

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Research on elite youth sport athletes has focused a great deal on sport developmental paths (e.g., Baker, Côté, & Abernethy, 2003; Ericsson, Krampe, & Tesch-Romer, 1993) as opposed to psychosocial factors that may influence young athletes. Some of the developmental research has proposed that young athletes specialize in one sport by early adolescence (Bloom, 1985; Ericsson et al., 1993) and this elite sport specialization requires numerous physical, psychological, and social sacrifices (Gould, Dieffenbach, & Moffett, 2002; Holt & Dunn, 2004). Also, the youth elite sport context is characterized by the changing roles of parents, coaches, and peers in athlete’s lives (Bloom, 1985; Ericsson et al., 1993; Harter, Waters, & Whitesell, 1998). Research targeting the unique and interrelated roles of the coaches, parents, and peers (including teammates) on enhancing the youth elite sport experience is warranted. One approach to understanding how the multiple social influences affect young athletes and their sport experience is to better understand the social support context from the lived experiences of the athletes themselves.

Social support is a multidimensional construct consisting of structural (i.e., existence of social support networks), functional (i.e., the exchange of resources), and perceptual (i.e., appraisals of available amount and quality of social support) dimensions that are important factors in sport (Bianco & Eklund, 2001; Holt & Hoar, 2006; Rees & Hardy, 2000). To our knowledge, there are few studies that have concurrently explored these multiple social support dimensions and their outcomes in female youth elite sport. Social support is an important coping mechanism that helps athletes resist injury and psychological distress, fosters better performances, and provides motivational incentives (see Rees, 2007). For these reasons, it is important to better understand the social support context in female youth elite sport.

In youth sport, the structural dimension of social support is primarily founded on the athlete’s network of significant others including coaches, parents, teammates, and peers (Bianco & Eklund, 2001; Scanlan, Russell, Beals, & Scanlan, 2003). The coach-athlete relationship may be the most important social sport interaction (Mageau & Vallerand, 2003). According to Jowett and colleagues (Jowett & Cockerill, 2002; Jowett, Paull, & Pensgaard, 2005), the relationship is a dynamic process characterized by the coach and athlete having interrelated thoughts, feelings, and behaviors. The provision and receipt of social support may help foster this relationship. Furthermore, parents can play an additional important role in initiating, supporting, and encouraging young athletes’ sport involvement (Fredricks & Eccles, 2004). Limited findings also suggest peers (Smith, 2003; Vazou, Ntoumanis, & Duda, 2006; Weiss & Stuntz, 2004) may be important providers of sport-specific social support. Parents and peers also have distinct yet complimentary
roles in providing social support (Ullrich-French & Smith, 2006). It has recently been argued that more research attention should be directed to the coexisting multiple social relationships within youth sport contexts (Fredricks & Eccles, 2004; Ullrich-French & Smith, 2006). It is important to advance the social support literature by focusing on the structural dimension and also by understanding the meaning of support strategies (Holt & Hoar, 2006) provided by significant others in youth elite sport.

The multiple providers of social support within the structural dimension provide various support functions. The five most consistent functional social support resources include: emotional support (comfort and caring), esteem support (encouragement and praise), tangible support (instrumental and practical assistance), network support (integration in a group of similar others), and informational support (advice, suggestions and guidance) (Holt & Hoar, 2006; Rees & Hardy, 2000; Rees, Hardy, & Evans, 2007). Most of the social support evidence in sport has been garnered by quantitative studies focused on assessing one dimension or one provider of support, and has generally targeted adult athletes and non-athletes. The way in which the coaches, parents, and peers provide unique social support functions to young female elite athletes is a logical extension of existing research and can help better understand this sport context. Furthermore, most of the existing research has been from postpositivist worldviews; the ontological assumptions that accompany postpositivist work limit an understanding of the meaning of social support functions and the athletes’ experiences receiving support from multiple sources.

Finally, the perceptual dimension of social support involves the athlete’s appraisal of the amount and quality of available social interactions and behaviors (Vaux, 1985). Research has consistently shown that recipients’ (i.e., athletes) positive interpretations and perceived availability of social support are indicative of positive outcomes such as health or well-being (Sarason, Sarason, & Pierce, 1990). In a prospective study, Ullrich-French and Smith (2009) demonstrated that youth athletes’ perceptions of relationship quality provided by parents and peers was important to their continued involved in sport. Nonetheless, research has been predominantly quantitative, thus limiting the thorough understanding of implicit messages and meanings that are perceived by youth athletes. Furthermore, the relative importance of perceived support from coaches, parents, and peers has been understudied.

Quantitative postpositivist studies have examined athlete interactions with parents, peers, and coaches (e.g., Ullrich-French & Smith, 2006; Vazou et al., 2006), however, few of these were founded within a social support framework. When social support was targeted, most sport-based studies examined the functional dimension with little regard to the structural or per-
ceptual dimensions (Holt & Hoar, 2006). These approaches of studying independent dimensions in isolation limit understanding of the role of social support in fostering performance-based outcomes (Bianco & Eklund, 2001; Holt & Hoar, 2006). Qualitative studies from a constructivist worldview is needed to help inform the multiple dimensions of social support and, in particular, elite youth athletes’ experiences with receiving social support from different providers and with different functions. In this way, qualitative methods grounded in interpretative phenomenological analysis (IPA; Smith & Osborn, 2003) are particularly informative because they support the exploration and understanding of participant experiences and meanings of youth elite sport and social support. As García Bengoechea and Strean (2007) argued, more qualitative approaches could be used to better understand how significant others interact to influence athletes’ experiences in sport. This is particularly salient in female sport contexts given the lower participation rates. Therefore, the purpose of this constructivist phenomenological study was to concurrently explore the structural, functional, and perceptual social support dimensions in an elite female adolescent sport context and from the perspective of the athletes themselves.

**Method**

**Participants**

In a process of selective/purposeful sampling (Patton, 2002; Smith & Osborne, 2003), 18 elite female adolescent competitive swimmers were identified as possible participants for the study. Initial selective sampling was based on (i) location of the swimming club (convenience to conduct the interviews), (ii) female swimmers, and (iii) athletes who qualified for the high-level time standards of Swimming Natation Canada (SNC; www.swimming.ca) in their age group. The identified swimmers were provided a letter of introduction to the study and consent forms. From the original 18 swimmers, nine of them provided parental consent and assent, were in the targeted age range of 13-15 years, and had reached a top 8 Power Ranking (a Canadian National ranking and tracking system for competitive youth swimmers). These two final sampling criteria were in line with Interpretative Phenomenological Analysis (IPA; Smith & Osborne, 2003) to help identify a small homogenous group of elite sport participants. Swimming was chosen as the sport to study in this context because of the lead researcher’s experience in competitive swimming and as a swimming coach.

**Procedures**

In line with IPA, semi-structured qualitative interviews were used to better understand participants’ social support experiences and meanings within the context of competitive
swimming (Patton, 2002; Wilson & Powell, 2001). Original (45-60 minutes in length) and follow-up (30-45 minutes in length) interviews were conducted with each participant. The follow-up interviews allowed the researcher to further explore participant experiences with the multiple dimensions of social support, enabled additional collaborative inquiry, and provided the participants with a chance to add to, clarify, or challenge the researcher’s initial coding of the data. The interview guide was developed to better understand the multiple dimensions of social support for elite female athletes. In line with IPA, the interview questions were guided by empirical sources targeting social support (Bianco & Eklund, 2001; Cutrona & Russell, 1990; Holt & Hoar, 2006; Rees & Hardy, 2000) and informed by literature on interpersonal relationships and talented athlete development (e.g., Bloom, 1985; Patrick et al., 1999). Following background information on swimming (e.g., How long have you been involved in swimming? What events do you swim?) and reasons for swimming (e.g., Why do you swim?), the interview questions targeted the social network (e.g., Who supports you in your swimming? What does it mean to you to have [identified person] support you?), the functional resources provided by each of the significant others within the network (e.g., Tell me how your [coach/parents/teammates/peers] supports you in swimming), and perceptions of the availability and meaning of social support (e.g., How do you feel about [each strategy that the swimmer discussed from each of coaches/parents/teammates/peers]). During the development of the interview guide, several steps were taken to ensure the questions and interview process were age appropriate (Eder & Fingerson, 2002). First, two professionals with experience in interviewing children and adolescent athletes assessed the interview guide. Second, the lead researcher conducted pilot interviews with two elite female athletes to ensure that the questions were interpreted accurately, that what the athletes’ perceived to be the most important social support dimensions were broached in the interviews, and that the interview length was appropriate. Following the pilot interviews, there were some changes made to the wording of the questions, and several questions on motivation (which were originally included out of interest) were removed due to interview length. Finally, the first author also attended at least two of each of the swimmers’ practices prior to the data collection. This gave the researcher a better sense of the swimmers’ training environments and practice activities.

Given the purpose of this study was to explore the multiple dimensions of social support in an elite swimming context, data were collected and assessed in accordance with IPA (Smith & Osborne, 2003). IPA is an inductive, phenomenological approach that fosters a data-driven theorizing perspective to try to gain an insider’s perspective on a particular personal or social experience. IPA fostered the exploration of the multiple dimensions of social support from the participants’ perspectives, and enabled the mutual and collaborative meanings of these experiences to be identified and interpreted (Smith & Osborn, 2003). Therefore, the findings are a reflection of both the participants’ communication of their social support experiences, and the researchers’ interpretation of the young athletes’ thoughts and emotions reflected in what they said and how it was communicated.

Initially, all interviews were transcribed verbatim and stored and organized using the QSR N6 program. All transcripts were read entirely once, and the most thorough and detailed interview (Participant #2) was identified as a case document. This transcript was re-read and analyzed using open coding by identifying and subsequently labeling meaning units related to social support. Consistent with IPA, the themes were given titles using language that evoked the swimmers’ experiences, the researcher’s personal thoughts and interpretations of the participant’s meanings, and sensitizing concepts. Sensitizing concepts were predominantly the lead researcher’s experiential (i.e., ten years of provincial and national experience in competi-
tive swimming and current coaching at the provincial level) and theoretical (i.e., social support, elite sport, coaching) knowledge. A coding scheme was then developed and used to re-examine Participant #2’s transcript. This step ensured that the coding was accurately reflecting all social support dimensions discussed by this participant. Following the coding of the case document, the remaining transcripts were analyzed and new themes were labeled and added to the coding scheme as necessary. A final reading of each transcript was then completed to ensure that all meaning units were identified and coded based on the most complete coding scheme. The lead author conducted all interviews and the post-interview notes, transcription, and memo writing. All authors were involved in the coding and thematic analysis.

The process of verification was also in line with IPA principles (Morse, Barrett, Mayan, Olson, & Spiers, 2002; Sparkes, 1998). Trustworthiness was improved by having all authors intimately involved in the analysis by providing insights and interpretations. The follow-up member-checking interviews were used to ensure cooperative inquiry (i.e., participants were able to agree with, reflect upon, and challenge the researcher’s interpretations of the interview data as well as add new insight). To address method triangulation, the transcripts were compared to research field notes to ensure consistency of the data. Finally, the researcher demonstrated empathetic neutrality and personal reflexivity by focusing on understanding the young elite athletes’ experiences while avoiding judgments, and reflecting on personal experiences in competitive swimming, elite-level sport, and coaching.

Results

The results of the analysis led to the creation of five higher-order categories called **Network Support, Emotional Support, Esteem Support, Informational Support, and Tangible Support**. Each of these forms of support were influenced by coaches, parents, and peers (primarily teammates). Figure 1 provides a visual diagram of the structural and functional social support dimensions that emerged from the study. The perceptual dimension is in part illustrated in the diagram by the lines connecting the structural and functional dimensions. Non-existent lines infer that a relationship was not reported. The participants are not named in the results to maintain anonymity, but are coded from P1 to P9.

**Network Support**

All participants felt they were part of a large connected network of swimmers who shared each others’ experiences and understood and supported each others’ competitive goals. Network support had predominantly positive underpinnings within the sport context. Network support was primarily provided by teammates, and at times fostered but not directly provided by coaches. Parents were not discussed in this social support dimen-
sion but this did not bother the athletes. There were four themes in this category, including (i) acceptance, (ii) shared experiences, (iii) just being there, and (iv) ambivalence.

Swimmers felt at ease among and accepted by their teammates: “they get to see, like the whole, everything of me ‘because I’m around them so often” (P2) and “we’re all just ourselves around each other” (P6). Girls also felt that they shared the same challenges associated with committing to elite competitive swimming, training difficulties, and lifestyle habits with their team-
mates. Generally, they felt their teammates were there and could be counted on to support them in any way. This type of support from teammates was tremendously important to them.

In spite of the shared experiences and understanding with their teammates, athletes felt a lack of support and understanding (i.e., ambivalence) by non-sport peers. Swimmers discussed how school peers could not identify with their training, level of athletic commitment, and competition. This lack of support was quite frustrating to most of the athletes because they didn’t feel that they fit in with any peer groups; yet they also liked being known as elite athletes. Many of the girls ($n=7$) also reported that they had no social lives outside of swimming, as illustrated by the following quote:

I don’t have a social life. Swimming is my life…I just started high school and meeting new people but not being able to meet them outside or get to know them. When I walk to school and walk down the hall, I kind of feel like, ‘I don’t know you as well as I should.’ Or like, ‘I don’t relate to you as much.’ So I kind of feel alone there (P2).

In spite of this lack of support from school peers, the swimmers felt understood and cared for by teammates and gained a drive for continued sport participation through simply associating with and comparing themselves to other swimmers within their network. It also meant a lot to the girls’ sense of self to be known around school as a swimmer/athlete, however they felt generally disconnected from peers at school and perceptions of isolation were frequently discussed. Nonetheless, the athletes felt that the availability of network support was effective for their athletic accomplishments.

**Emotional Support**

Coaches, teammates, and parents were perceived as providers of emotional support. Emotional support provided by parents was unconditional, whereas support by teammates and coaches was contingent on the context. The three themes in this category included (i) care and concern, (ii) understanding and empathy, and (iii) avoidance as necessary.

Coaches showed explicit concern by listening and talking things over either during a practice or after a competition and also left swimmers alone after bad performances. Swimmers believed that their coaches understood hardships associated with competitive swimming, however, they also felt that their coaches demonstrated a lack of tolerance or appreciation pertaining to issues outside of sport. Therefore, coaches generally offered emotional support primarily for swimming-related issues.
Contrarily, the direct comfort and concern provided by parents was perceived to be unlimited and unconditional in both the swimming and general life contexts. In spite of the fact that swimmers felt their parents were not completely understanding of what they were doing or how hard it was for them to train and compete, they appreciated that their parents were always there when they needed them: “…she does everything and she’ll always be there, ’cause my friends might not and my coach might not, but my mom will always be there no matter what” (P9). Several swimmers also indicated that parents showed them acceptance and love whether or not they swam and that was encouraging to them.

Like parents and coaches, the girls indicated that their teammates were understanding and showed care and comfort in many ways. Teammates knew when to leave the swimmers alone, and the participants themselves tried to avoid others if they knew their negative mood might interfere with their teammates’ swimming. Teammates would also give them non-verbal encouragement (pats on the back, hugs, smiles, etc.) and indirect forms of understanding such as distractions. The swimmers appreciated the distraction strategies that their teammates offered in difficult environments and the ability to diffuse focus. Some distraction tactics included avoiding the topic, changing the emphasis to something unrelated to swimming, and humor.

The swimmers perceived the more rational, logical, and specific emotional support strategies from coaches as effective for their continued motivation in swimming. Many of the girls (n=6) also reported wanting their coaches to recognize and validate their efforts in swimming as well as their performances. Many swimmers (n=8) also felt that their coaches did not understand issues that they had to deal with outside of swimming, such as schoolwork, employment, and social interactions. These perceptions allude to the limited contextual nature of coaches’ provision of emotional support. Nonetheless, parents were perceived as providing emotional support unconditionally, which appeared to comfort the swimmers and indirectly enhance their sport participation. Finally, all girls expressed a gratitude for their teammate’s indirect provision of emotional support.

ESTEEM SUPPORT

Coaches and teammates were the most salient providers of esteem support because of their knowledge and participation in the swimming context. Parents provided minimal, more distal esteem support. There were two
themes for esteem support: (i) tough love and challenge, and (ii) comparative feedback and praise.

Coaches always demanded 100% effort from swimmers in practice sets and challenged them to push their limits by appealing to their emotions (i.e., making them angry or upset) or directly challenging their skill and ability. The athletes were at times frustrated by these approaches but eight of the nine participants described an appraisal process wherein they eventually perceived the merit in this tough love approach. The swimmers also emphasized the positive verbal and physical challenge of teammates who swam against each other in practices. For instance, P7 said that when she did not finish part of a set in practice her teammates challenged her by making her realize that she could have finished the set in her sleep and therefore “rubbed it in so much that the next round I did it”. Indirectly, the athletes also felt pressure to succeed to impress their teammates. Participants (n=6) also described a self-imposed upward comparison challenge to keep pace with faster swimmers across Canada by using published race results as motivation.

Directly appeasing forms of esteem support from coaches included encouragement and appreciation of swimmers’ efforts, abilities, and achievements. Some of the girls (n=5) were motivated when their coach differentiated between athletes on the team. Coaches made explicit comparisons about the swimmer’s superior work ethic or provided them with more detailed attention and feedback about errors and improvements. Swimmers also gained motivation directly through teammate recognition of their efforts, abilities, and achievement in swimming. Teammates showed confidence in swimmers’ by letting them lead certain practice sets, by emphasizing their vital role on the team, and by verbally acknowledging each other’s achievements and abilities. Parents also provided esteem support in more indirect ways, such as recognizing their daughters’ achievements in swimming by searching the internet sites, comparing results to other swimmers, showing excitement over results, and by bragging to others about their daughters’ swimming achievements. This made swimmers feel proud of their accomplishments.

Generally, swimmers felt that their coaches really valued their abilities and cared about them, and the girls learned how to handle the tough-love approach by their coaches. Esteem support provided by teammates was embraced because many of the swimmers (n=6) felt re-energized, motivated, and competent when they heard or saw their teammates cheering for them at swim meets. They also enjoyed the overt and direct performance challenges provided by teammates, however swimmers (n=5) felt that within-team challenges were not frequent enough. Finally, parental esteem support was more
distal but welcomed by all swimmers. None of the swimmers mentioned peers outside of swimming as providers of esteem support within their network. Nonetheless, two girls highlighted their enhanced motivation for swimming when peers at school recognized their accomplishments.

**INFORMATIONAL SUPPORT**

There were four themes in this category, including (i) trust and knowledge, (ii) guidance, (iii) structure and control, and (iv) unwelcomed support. Generally, coaches, parents, and teammates provided distinct advice and instruction to athletes on swimming-related issues, and also let athletes have some personal control over their training.

All athletes explicitly mentioned that they trusted their coaches and felt that they were knowledgeable and effective in coaching by providing specific technical directions and feedback specific to technique. Nonetheless, five swimmers reported that they maintained most of the responsibility of their swimming experiences that ranged from independence to shared mutual decision making. The four other swimmers reported instances when they felt that their improvements were unnoticed or their opinions were ignored, and they wanted more control over their swimming experience: “I know [my coach] is supposed to tell me what to do. But she’s one of those people where it’s like either her way or like, it’s wrong...and that bothers me, ‘cause then I can’t have my own opinion on what I want to do about my race” (P3).

In contrast to trusting the information and feedback provided by coaches, girls negatively construed specific informational feedback from parents whom they deemed unknowledgeable in swimming. Seven athletes’ parents tried to correct errors by offering technical advice, comparing the athletes to other swimmers, and focusing on winning; and all of these strategies were described as being ineffective supportive tactics. The girls were generally frustrated by their parents’ attempts at providing technical feedback because parents were not viewed as a credible source of technique- or race-specific information such as coaches or teammates: “My mom is always trying to help me to become better...but I feel like she doesn’t know ‘cause she doesn’t know how to swim” (P9). Furthermore, the girls perceived that parents were not knowledgeable enough in competitive swimming to criticize and offer race-specific advice. For instance, “...they don’t understand what you have to do to go faster. It’s easy to just say it, but to actually do it, it’s a lot harder” (P3). Swimmers explicitly showed an aversion to, and lack of appreciation for, this type of information from parents. Teammates provided very
little information support in the form of feedback and instruction. Two participants felt that they gave advice to teammates but did not receive reciprocal feedback on technique, strategy, or skill improvement.

Whereas eight of the swimmers reported that they were not given many choices from coaches on what or how they swam in practice, this coaching behavior was primarily interpreted positively because the girls trusted their coach’s instruction and respected their high standards. The biggest issue was that the girls really wanted to feel that their opinions and suggestions were taken into consideration by their coaches.

Distinctions between mothers and fathers were only evident or discussed around issues of information support. Many of the girls \((n=6)\) indicated that fathers mostly reacted negatively and made performance-based comments such as: ‘why didn’t you get the gold?’ \((P9)\) and ‘you should have gone faster…’ \((P4)\). Also, fathers tended to provide more social comparative feedback compared to mothers, who tended to provide more specific (yet unwanted) technical information:

I think my dad sometimes gets carried away ‘cause he wasn’t a swimmer so I don’t think he realizes what it takes. So when I come out and he’s like, ‘why didn’t you beat so and so,’ or ‘oh you didn’t do that well,’ it’s kind of like, ‘just shut-up dad, don’t talk to me about that.’ … I’m like, stop comparing me kind of thing.’ \((P2)\)

My mom doesn’t really pressure me but she’s always trying to help me to become better. She’s like, ‘OK fix your stroke, don’t forget to do this, don’t forget to do that.’ \((P9)\)

Based on this perspective, the informative advice was not necessarily wanted but the reasons underlying the provision of support were understood and perceived as a positive aspect of both parents trying to help.

None of the swimmers received informational feedback from teammates, and many of them \((n=5)\) felt this aspect was not missing from their overall social support process. While a couple of swimmers discussed the enjoyment of providing informational support to their teammates, many of them also relayed how taking guidance from swimmers who were not as skilled or advanced as they were would be unwarranted and not welcomed.

**Tangible Support**

Two themes were identified for tangible support, including: (i) practical assistance, and (ii) financial provisions. Parents constituted the most important source of general assistance and financial support. Swimmers appreci-
ated that their parents drove them to practice everyday, paid for all costs associated with swimming (e.g., coaches, competitions, equipment, and travel), supported healthy lifestyles (e.g., healthy eating and sleeping habits), and were involved with the club (e.g., team management, chaperoning). Swimming became all-consuming for the girls and parents, and the athletes recognized the financial and time sacrifices that their families made to support their passion: “I swim right after school and my dad works downtown and I think my mom has taken a half time job so she can drive me to swimming all the time. So, swimming is her life too” (P2). Coaches and teammates provided very little tangible support. The girls also mentioned the school administration as providing practical assistance in the form of modified class schedules to accommodate their training. Teammates’ parents at times provided practical assistance by driving the girls to practices.

Girls felt loved and valued by their parents because of how much of their resources they were putting into their sport. All of the athletes mentioned appreciation for the money and time that their parents provided, and felt that these tangible means of support influenced their motivation as well as their perceptions of competence. However, at times, all but P3 felt guilty about the demands that were placed on their families and these emotions presented a quandary since they needed this support but also felt substantial personal pressure as a result of it. The following quote illustrates the perceived pressures that many of the girls expressed:

“…[Swimming] costs a lot. And I know there are so many other things that she could be spending that money on. She sacrifices a lot, and it’s hard for me like, keeping me in swimming cause I know the money issues, driving, and time away from the rest of the family. I know it’s hard on my mom and I don’t like putting all that extra stress with money and stuff on her. So that sometimes makes me like, ‘oh if I wasn’t swimming’ it’d be so much easier on everybody. But she reassures me that she doesn’t think that way…” (P8)

Discussion

This study highlighted the importance of the structural, functional, and perceptual social support dimensions (see Holt & Hoar, 2006) on female athletes’ experiences in elite swimming. In particular, it concurrently examined the athletes’ perceptions in relation to their coaches, parents, teammates/peers. Qualitative methods founded within a constructivist epistemology enabled the generation of informative data about the multiple dimensions of social support within a natural, yet understudied, elite female sport context. These data show the unique and informative ways that the dimen-
sions of social support were internalized by the participants and interpreted within their sport setting.

Parents were deemed important providers of unconditional support. While the swimmers did not necessarily appraise any unique functions of parental support, it was evident that all swimmers felt a sense of self-worth (Harter et al., 1998) as a result of their parents’ provision of general esteem and emotional support. Consistent with previous qualitative findings (e.g., Wolfenden & Holt, 2005), parents made significant social and financial sacrifices to support their daughters in swimming, which were viewed both positively and negatively by the athletes. The swimmers felt their parents supported them through tangible means (assistance support) because of their belief in their abilities and potential. However, the results revealed that eight girls may have interpreted and internalized negative meanings associated with their support by reporting worry and guilt for the financial support and time dedication from their parents. Furthermore, most swimmers reported receiving undesirable feedback and advice from their parents. Wolfenden and Holt suggested that the meaning and importance of parental sport-specific informational support depends on athletes’ perceptions of their parents’ experience and knowledge. Parental feedback and advice is appraised more positively when they have participated in the same high-level sport as their children (Holt & Dunn, 2004). None of the participants’ parents had ever coached or reached the National level in competitive sport or swimming, and the interpretations from swimmers demonstrated that they did not feel understood by or connected to their parents in swimming contexts. To date, research has found that competitive youth sport athletes get upset when their parents try and provide information on their sport when the parents themselves are lacking the background, knowledge, and experience to do so (Holt, Tamminen, Black, Sehn, & Wall, 2008).

Coaches’ provisions of esteem and information support were highly valued by the swimmers. Consistent with sport research on feedback, coaches were described as providing an effective approach of reinforcement, encouragement, and technical advice (i.e., Smoll, Smith, Barnett, & Everett, 1993). At times, however, the athletes discussed wanting more control over various aspects of their sport, including practices. Furthermore, and somewhat inconsistent with previous studies (e.g., Garcia Bengoechea & Strean, 2007; Holt & Dunn, 2004; Wolfenden & Holt, 2005), coaches provided emotional support in the form of concern, comfort, understanding, and perceptions of shared experiences and perspectives. Coaches in the current study were generally perceived to be valuable sources of emotional support because their expertise was highly respected and they understood the environment and the
needs of the swimmers. More research is necessary to better understand the coach’s role in providing (and the athletes’ interpretations of) emotional support.

Coaches also challenged the girls’ thoughts, attitudes, and behaviors in ways that were initially deemed unhelpful but, following some cogitation, were appraised as positive supportive tactics. This ‘tough love’ approach, which included the coaches’ sarcastic, harsh, or even nonverbal feedback, is consistent with both a task and emotional challenge social support dimension (Rees et al., 2007; Richman, Rosenfeld, & Hardy, 1993). There is debate in the literature about whether challenging forms of support can be interpreted as positive, and thus operationalized as support (Rees et al., 2007). The current qualitative findings suggest challenging elite athletes’ skills and motives may be appraised initially as negative; yet these strategies were effective because they created an environment that let the swimmers realize their own athletic strengths and limitations. As such, the current study enabled a qualitative look at the ways in which coaches interacted with their elite-level athletes, and the complex process that the athletes used to interpret coaching behaviors. Nonetheless, these approaches may not be perceived as positive or supportive by less competitive athletes or those at younger developmental stages than the girls in the current study. Given the importance of athlete perceptions and interpretations of coaching behaviors (Horn, 2002), the finding of rumination that takes place following coach support tactics is not well researched and highlights the importance of understanding mechanisms involved in fostering motivation in elite sport.

The coach-athlete relationship has been defined using terms such as inequality, power, and control (Burke, 2001; Tomlinson, 1997). This relationship has also been defined as a utility interaction based on the coach and athlete getting what they want and need (Drewe, 2002). Also, coach-athlete interactions have been described as a caring and nurturing experience that is much like that of a parent-child relationship (Neale & Tutko, 1975). The current findings speak to a combination of these perspectives – one that supports Jowett’s (2005) work defining this relationship as providing athletic excellence and personal growth using a range of social support functions. Taken together, elite athletes should be encouraged to harness the social support that they need from coaches.

Teammates predominantly provided network support by being part of a group who had similar sport lifestyles, goals, and struggles. While few studies have focused on network support, it was clearly a specific social support function that was important to the elite athletes in our study, although there were limits to this support. The participants reported feeling a lack of net-
work support from peers at school and outside of their athletic context. In fact, the athletes described feelings of isolation, discomfort, and negative affect among others who were not involved in swimming. There is research support suggesting that talented athletes struggle with social relationships and lack of understanding from others beyond their sport context (Patrick et al., 1999). Taken together, the findings from this study support previous research and highlight the need to explore possible strategies that can help talented athletes feel connected to additional social networks outside of their sport. Finally, teammates provided very little in the form of informational support. This finding is not surprising given the participants were all the best swimmers on relatively small teams. Several swimmers saw themselves in modeling roles and providers of support to younger or less talented athletes, rather than receiving informational support from teammates. More research is necessary to elucidate if and how athletes in coactive team sports share sport related information and if the size and composition of the team bears any influence.

While the current study enabled an understanding of unique social influences and strategies provided by coaches, parents, and teammates/peers, there are some limitations that need to be discussed. First, the sample consisted of self-selected elite athletes. Second, there may be differences in the support provided by fathers and mothers that could not be adequately understood in the current study. Whereas there was some evidence that fathers provided social comparative and ego-oriented feedback, and mothers focused on performance-based and technical advice, this line of inquiry was not probed in detail with each athlete. In much the same way, differences in the support strategies provided by male and female coaches are possible. Despite this, the overarching positive atmosphere described in the current study, with the exception of unwanted parental information support, lack of autonomy from coaches, and missing social support from peers at school, may be a result of the line of questioning during the interviews. Also, athletes may have perceived the interviews on social support to be an opportunity to recount their more positive experiences. Finally, the positive appraisals of support may be a result of the elite athlete status of the girls, their level of cognitive maturity, and/or development stage. Researchers should attempt to understand the more negative aspects of social support in future studies.

In summary, the coaches were an important provider of almost every aspect of social support. Athletes felt that the esteem, informational, and emotional support provided by coaches was important to their swimming. Sport psychology consultants working with coaches are encouraged to help
them realize their potential in providing the range of social support functions. While parents provided mostly global support that was clearly linked to their daughter’s sense of self, swimming-specific feedback from parents was the single most unappreciated aspect of social support. Sport psychology practitioners may want to help young athletes reflect on the positive support provided by their parents. Finally, all participants reported that the most positive aspect of their swimming involvement was affiliation with teammates. Affiliation and network support can likely be fostered by sport psychology skills such as team cohesion and group dynamics exercises. Given the importance of this social support function, efforts should be directed at enhancing network support in elite sport. Given the unique social support domains that emerged from each provider, current findings encourage researchers to diversify their approach to the study of social support in sport by including young participants’ meanings and interpretations of various social influences. Furthermore, future research may be best directed using social support theoretical perspectives to guide an understanding of how social support operates, and provide further insight into the outcomes (see Lakey & Cohen, 2000). These perspectives would further advance the current qualitative findings that elucidated the multiple dimensions of social support in female elite-level sport.

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Applied sport psychology consultant perceptions of the usefulness and impacts of performance profiling

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Despite the apparent widespread use of Butler and Hardy’s (1992) performance profiling procedure (Doyle & Parfitt, 1999), there is limited research detailing the benefits that can accrue from its use. Hence, the present investigation sought to provide an evaluation of sport psychologists’ perceptions of the usefulness and impacts of performance profiling. Fifty-six British Association of Sport and Exercise Sciences accredited sport psychologists completed a closed survey detailing their perceptions of the usefulness and benefits associated with the production of an individual athlete performance profile within a group setting. Descriptive analysis revealed that consultants believed profiling to be useful in providing a basis for goal setting, identifying strengths and weaknesses, raising athlete awareness, evaluating and monitoring athlete performance, and in facilitating discussion, communication and interaction within teams. This brief report argues that further research is needed to empirically evaluate the usefulness of profiling in order that its frequent use can be fully justified.

KEY WORDS: Initial assessment, Performance profile, Psychologist opinions, Survey.

Several methods of sport psychological assessment have been identified in the literature including questionnaires (O’Connor, 2004), interviews (Lloyd & Trudel, 1999), and behavioral observation (Tkachuk, Leslie-Toogood, & Martin, 2003). Another frequently employed sport psychological assessment strategy is the performance profile (Butler, 1989; Butler & Hardy, 1992; see figure 1 for an example profile). Drawing upon selected principles of Personal Construct Theory (PCT; Kelly, 1955), Butler and Hardy developed a client-centred, idiographic performance analysis tool which asked athletes to identify the attributes essential to their performance (e.g., technical, physical, psychological qualities) and then rate themselves on those

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Fig. 1. An example completed performance profile for a football midfielder player.
attributes. It was proposed that this procedure would help athletes to become more involved in the evaluation of their performance capabilities, help them to identify their perceived strengths and weaknesses and thus facilitate greater engagement and adherence to future training interventions (Jones, 1993).

A number of impacts, uses and benefits have been suggested to accrue from the use of the performance profile with athletes (Hardy & Jones, 1994). These include providing a basis for goal setting (Butler, 1997; Butler, Smith, & Irwin, 1993), raising athlete self awareness (Butler, 1989; Butler & Hardy, 1992), helping to motivate athletes (Butler & Hardy; D’Urso, Petrosso, & Robazza, 2002; Jones, 1993), building/protection athlete confidence (Butler et al.), facilitating communication within teams (Dale & Wrisberg, 1996), evaluating and monitoring performance (Butler, 1997; Butler & Hardy; Doyle & Parfitt, 1997), and as an aid to help structure training interventions (Butler & Hardy; Dale & Wrisberg; Jones).

Despite early suggestions of the widespread use of performance profiling (Butler & Hardy, 1992; Doyle & Parfitt, 1999), very few articles have been published relating to the application of the technique, with only five articles (Doyle & Parfitt; D’Urso et al., 2002; Gucciardi & Gordon, 2009; Mellalieu & Juniper, 2006; Robazza, Bortoli, & Hanin, 2004) published in the last ten years. Some of the profiling literature has attempted to experimentally test specific uses of the procedure (e.g., Doyle & Parfitt, 1996; 1997), however the majority of articles are either, dated case study accounts of a small number of consultant profiling experiences (e.g., Butler et al., 1993; Dale & Wrisberg, 1996; Jones, 1993) or more recently, alternative applications of the profiling procedure (e.g., Gucciardi & Gordon; Mellalieu & Juniper). Whilst the development and extension of the profiling approach is welcome, research that systematically examines the usefulness of Butler and Hardy’s original procedure is yet to be conducted despite it being in existence for over 17 years. Hence, the present survey aimed to investigate the perceptions of a broad range of applied sport psychologists as to the usefulness of performance profiling, in addition to the benefits that can accrue from its use.

Whilst some alternative types of profiles (e.g., athlete, team and coach profiles) and approaches to profiling (e.g., individually or as part of a group) have been suggested, the present study focused on examining the efficacy of producing an individual athlete performance profile within a group setting (see Butler & Hardy, 1992 for specific details of this procedure). Specifying one common method of profiling within the survey ensured that all consultants were rating the usefulness of the strategy against the same delivery style
rather than across a range of alternative profiling delivery approaches thereby enhancing the validity of the responses produced. As descriptive research has been suggested as a useful basis from which to stimulate further research and theory development (Gould, Greenleaf, Chung, & Guinan, 2002), the final aim of this brief report was to stimulate new ideas for future research examining the efficacy of this popular technique.

Method

Participants

All 93 British Association of Sport and Exercise Sciences (BASES) accredited sport psychologists at the time of testing were written to and invited to participate in the study. The 56 (37 males & 19 females) who returned the survey, had been BASES accredited sport psychologists for an average of 4.91 years (SD = 5.07; range 1-20 years).

Instrument

Since the aim of the present study focused only on the impacts of producing an athlete performance profile in a group setting, the following brief summary of Butler and Hardy's (1992) group profiling procedure was provided to familiarize the participants with the relevant procedure:

- The team/squad is split into groups to brainstorm qualities for their sport/position.
- Each group feeds back to the whole team the qualities that they have generated.
- Each individual athlete then chooses the qualities that he/she perceives are important for their sport/position in relation to their style of play. Once the qualities have been chosen the athletes rate themselves in relation to their perceived ability on each of the qualities at that moment in time to give the athlete their own individually specific performance profile.

Consultants were then asked two questions relating to this procedure. Firstly, consultants were asked how useful they perceived it would be to produce an athlete performance profile within the group setting. Secondly, consultants were asked to rate how effective they believed the production of an athlete performance profile within a group setting to be in relation to 24 potential impacts (e.g., ‘help to encourage responsibility’; see table 1). On both questions consultants were given a 5-point Likert scale from 1 (not at all) to 5 (very), with 3 providing a ‘moderate’ score.

Triangular consensus of three researchers determined the impact items from a review of performance profiling literature and content analysis of pilot interviews with six BASES accredited sport psychologists experienced in using performance profiling. Lasting approximately 1 hour, the individual semi-structured interviews were conducted by the first author experienced in such methodology. The interviews sought to identify key benefits, impacts or uses that the consultants believed would result from the production of an individual athlete performance profile within a group setting. Following inductive content analysis procedures (Patton, 2002), all three investigators read and reread 50 pages of single spaced interview tran-
scriptions, independently identifying raw data themes for the impacts/benefits of producing athlete performance profiles. Twenty impact themes were established via the triangular consensus from 54 raw data themes. A review of the profiling literature revealed 15 performance profiling impacts. Following an examination of the interview and literature review profiling impact themes, three researchers agreed upon the 24 items to be included within the questionnaire. Combining literature review and interview analysis procedures to develop items for a questionnaire in this way, is in line with approaches adopted elsewhere in the literature (Weinberg, Burton, Yukelson, & Weigand, 2000; Yoo, 2000). Survey impact items displayed good internal reliability ($\alpha=.94$).

**DATA ANALYSIS**

Descriptive statistics were taken to determine the mean (& standard deviation) responses regarding the usefulness and benefits of profiling within a group setting.

**Results**

Descriptive statistics indicated that consultants found performance profiling to be useful ($M = 4.27$, $SD = 0.79$). Table 1 outlines the descriptive results for the consultant perceived impacts of performance profiling. Multivariate analysis of variance revealed no significant gender differences for the impact items ($\text{Wilks’ } \lambda = .654$, $F(24,17) = .375$, $p=.986$, $\eta^2 = .35$, $\beta = .16$).

**Discussion**

The present findings indicate that BASES accredited sport psychology consultants strongly believed performance profiling to be useful, thus confirming previous research (Butler & Hardy, 1992; Dale & Wrisberg, 1996; D’Urso et al., 2002). In particular, the consultants believed profiling to be most useful in helping provide a basis for goal setting, identifying the athlete’s strengths and weaknesses, raising athlete self awareness, facilitating discussion within the team, and helping the athlete focus on what’s important. The least important impacts of profiling in a group, rated moderately by the consultants, related to the technique’s ability to encourage independent thought and make athletes more accountable.

Butler and Hardy (1992), in introducing the profiling procedure, suggested that the process of raising the athlete’s awareness regarding the qualities essential for elite performance and the athlete’s ability in relation to those qualities, would help provide a useful basis to set goals. Goal setting in sport
Table I

<table>
<thead>
<tr>
<th>Impact of Performance Profiling in a Group Setting</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Help provide a basis for goal setting</td>
<td>4.46</td>
<td>0.76</td>
</tr>
<tr>
<td>Help identify the athlete's strengths and weaknesses</td>
<td>4.43</td>
<td>0.79</td>
</tr>
<tr>
<td>Help to raise the self awareness of athlete</td>
<td>4.37</td>
<td>0.82</td>
</tr>
<tr>
<td>Help facilitate discussion within the team</td>
<td>4.21</td>
<td>0.87</td>
</tr>
<tr>
<td>Help the athlete focus on what's important</td>
<td>4.16</td>
<td>0.78</td>
</tr>
<tr>
<td>Help the athlete to assess themselves</td>
<td>4.11</td>
<td>0.90</td>
</tr>
<tr>
<td>Help the athlete to evaluate how they're performing</td>
<td>4.10</td>
<td>0.77</td>
</tr>
<tr>
<td>Help to structure an athlete's training programme</td>
<td>4.06</td>
<td>0.94</td>
</tr>
<tr>
<td>Help to enhance communication within the team</td>
<td>4.04</td>
<td>0.86</td>
</tr>
<tr>
<td>Help facilitate interaction within the team</td>
<td>4.00</td>
<td>0.90</td>
</tr>
<tr>
<td>Help monitor the athlete's progress</td>
<td>3.97</td>
<td>1.02</td>
</tr>
<tr>
<td>Help promote task involvement in the athlete</td>
<td>3.67</td>
<td>1.00</td>
</tr>
<tr>
<td>Help the athletes understand the demands of other positions</td>
<td>3.66</td>
<td>0.99</td>
</tr>
<tr>
<td>Help to improve team dynamics</td>
<td>3.62</td>
<td>1.08</td>
</tr>
<tr>
<td>Help enhance the intrinsic motivation of the athlete</td>
<td>3.61</td>
<td>1.06</td>
</tr>
<tr>
<td>Help to identify roles within the team</td>
<td>3.55</td>
<td>1.10</td>
</tr>
<tr>
<td>Help increase the commitment of the athlete</td>
<td>3.54</td>
<td>0.86</td>
</tr>
<tr>
<td>Help to enhance the athlete's confidence in themselves</td>
<td>3.52</td>
<td>0.93</td>
</tr>
<tr>
<td>Help to encourage responsibility</td>
<td>3.47</td>
<td>0.94</td>
</tr>
<tr>
<td>Help enhance the self determination of the athlete</td>
<td>3.41</td>
<td>0.98</td>
</tr>
<tr>
<td>Help enhance the athlete's adherence to an intervention</td>
<td>3.40</td>
<td>1.14</td>
</tr>
<tr>
<td>Help the athlete to gain control over their performance</td>
<td>3.36</td>
<td>1.05</td>
</tr>
<tr>
<td>Help to encourage independent thought</td>
<td>3.35</td>
<td>0.95</td>
</tr>
<tr>
<td>Help to make the athletes more accountable</td>
<td>3.28</td>
<td>1.19</td>
</tr>
</tbody>
</table>

has been shown to facilitate performance improvements when athletes participate in setting goals for themselves (Kyllo & Landers, 1995). Indeed, athletes not only prefer to set their own goals (Weinberg, Burton, Yukelson, & Weigand, 1993), but they are also likely to do so irrespective of the goals set by their coaches (Weinberg & Weigand, 1993). Hence, the initial use of performance profiling should provide consultants with a useful basis from which to introduce and deliver effective athlete-centred goal setting practices. However, the choice of goals set by athletes may not always result in the most appropriate goals being set (Butler, 1997). Hence, practitioners should attempt to steer athletes towards choosing more appropriate goals when necessary. Furthermore, given that profiling encourages athletes to focus on self-referent performance development and skill mastery, the procedure may help to develop greater task involvement in athletes, an impact moderately supported by the present consultants.

Drawing upon Deci and Ryan’s (1985) Cognitive Evaluation Theory (CET), Butler and Hardy (1992) proposed that the client centered profiling procedure would help to facilitate greater athlete intrinsic motivation to train and perform. CET proposes that social factors which facilitate key motivational mediators (i.e., perceived autonomy, competence and relatedness)
would result in greater intrinsic motivation and thus more positive cognitive, affective and behavioral outcomes. Examination of the present consultant opinions of the profiling procedure suggest that they believe profiling could be useful in facilitating these motivational mediators (e.g., enhancing athlete confidence, providing more athlete control and facilitating interaction within the team) in addition to having a positive impact upon athlete intrinsic motivation and self-determination. Given the present findings and strong theoretical rationale for the influence of profiling on athlete intrinsic motivation, further experimental research is required to investigate whether single, or repeated, profiling interventions are able to significantly improve athlete intrinsic motivation. Furthermore, it would be useful to see whether any changes in athlete intrinsic motivation as a result of a profiling intervention are mirrored by changes in motivational mediators and consequences as proposed by Deci and Ryan’s CET.

The team related benefits of performance profiling in a group setting found in the present survey included helping to identify roles, understanding various positional demands in the team, improving team dynamics and facilitating communication, discussion and interaction within teams. These findings support and extend those of Dale and Wrisberg (1996) and suggest that sport psychology practitioners believe that the profiling procedure has a number of beneficial team related impacts when conducted in a group setting. Given that the present study was confined to examining the perceptions of the sport psychology deliverers of the profiling procedure, research is needed to investigate whether the athlete and coach consumers of the strategy believe there to be similar benefits from the technique. Furthermore, experimental research is needed to investigate the characteristics of profiling interventions (e.g., length, duration, frequency, type of profiles, etc.) which can help to maximise team productivity and cohesion.

The present findings support descriptive research which suggests profiling to be useful in helping athletes to assess, evaluate and monitor their progress (Butler & Hardy, 1992; Butler et al., 1993; Jones, 1993). Doyle and Parfitt (1997) in their experimental investigation into the construct validity of the technique, suggest that profiling may only be useful in monitoring progress over periods where large improvements in performance are likely. Indeed, lack of improvement or decrements in ratings over time could have a negative impact upon athlete confidence (Butler et al.). Hence, caution should be taken when employing the technique to monitor athlete progress in order to avoid the potential negative implications that may result from non-improvement on quality ratings. In relation to the performance evaluation benefits of profiling identified by the present consultant population,
more research is needed to examine how this use of the profile impacts upon
the attributions an athlete gives for their performances. Weiner’s (1986)
model of achievement attributions suggests that evaluating one’s perfor-
mance via personally controllable, unstable and internal attributes, as con-
tained within an athlete’s profile, would result in more functional attribu-
tions being given for performance in addition to encouraging more positive
thoughts and behaviors. Given the present findings and strong theoretical
rationale for the profile’s usefulness in a performance evaluation capacity,
future research should examine whether profiling is able to help athletes
assume more functional attributions and what subsequent impact those attri-
butions have upon athlete cognitive and behavioral responses.

In summary, the present survey confirms and extends the findings of the
previous literature and has suggested a number of future research avenues.
Principally, more research is required to experimentally examine the efficacy
of profiling on various psychological parameters and team based impacts.
Furthermore, given the client centred approach to profiling, it is essential
that future research evaluates athlete perceptions as to the usefulness,
strengths and limitations associated with profiling on single or multiple occa-
sions throughout the season and across group and one to one delivery
approaches.

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Coping with social physique anxiety among adolescent female athletes

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This study explored how adolescent female athletes cope with social physique anxiety (SPA). Participants, 73 female athletes age 13-19 years, reported their state SPA, coping strategies, coping function, and perceived coping effectiveness for a self-identified situation within sport in which they experienced SPA. Trait SPA was also assessed. Participants reported 129 coping strategies (1-4 strategies per participant). Strategies were coded into 13 categories based on Kowalski and colleagues’ (2006) taxonomy of coping with body-related issues. Social support, behavioral avoidance, short-term appearance management, humor, cognitive avoidance, and acceptance were the most commonly reported strategies. Number of coping strategies was associated with state SPA ($r = .34$, $p < .05$). Trait SPA was related to avoidance coping function ($r = .21$, $p < .05$). Results demonstrated that coping strategies were used for multiple functions, and coping functions had distinct associations with short-term, long-term, and health-related effectiveness.

KEY WORDS: Body image, Coping function, Coping effectiveness, Social anxiety, SPA, Social Physique Anxiety Scale, stress.

Adolescence can be a relatively stressful time, as youth encounter numerous social, psychological, and physical changes. During adolescence, youth experience a changing body, learn new social roles, and are often faced with increased social ridicule and criticism (Leary & Kowalski, 1995). Adolescents also tend to become more preoccupied with how they are viewed by other people (Harter, 1999). This social influence, combined with the natural process of increased body fat during puberty, societal ideals of a thin physique (Levine & Smolak, 2002), and the strong link between perceptions of appearance and self-esteem (Harter, 1999) contribute to adolescents’ feelings of uncertainty, insecurity, and anxiety about their bodies.
Body issues are especially salient when adolescents are concerned that their body might not meet others’ expectations (Leary & Kowalski, 1995). When adolescents are unsure whether their desired impressions can be achieved in settings where social evaluation is salient, they can experience social anxiety. Social physique anxiety (SPA) is a specific type of social anxiety where the anxiety experienced by an individual is in response to perceptions of others’ evaluation of his/her physique (Hart, Leary, & Rejeski, 1989). SPA was originally conceptualized as a trait characteristic (Hart et al., 1989), and it is correlated with physical factors such as body fat, weight, and height (Cox, Lantz, & Mayhew, 1997; Crocker et al., 2000; Hart et al., 1989). But SPA is increasingly being examined at the state level (e.g., Kowalski Mack, Crocker, Niefer, & Fleming, 2006; Mack, Strong, Kowalski, & Crocker, 2007), suggesting it may also be conceptualized as an emotional state. Furthermore, trait and state SPA have been found to be moderately correlated (r = .44; Kowalski et al., 2006) in a sample of adolescents, suggesting that they are distinct, but related constructs.

The sport environment is a public context that has an inherent focus on physicality, and therefore is an important domain in which to study SPA. Simply stated, sport places the physical body on center stage (Greenleaf, 2002), and often leads to the body being objectified as an instrument of performance and physical attractiveness (Cox & Thompson, 2000). Furthermore, female athletes have to negotiate the discourse surrounding gender and heterosexuality that often clash in sport as a result of a desire to be seen both as physically strong and feminine (Cox & Thompson, 2000). Training often leads to a more muscular physique that is necessary for high performance, but it can draw the body further away from feminine ideals and increase concerns of being viewed as masculine or abnormally strong (Mosewich, Vangool, Kowalski, & McHugh, 2009). This conflict may resonate both inside and outside the sport context.

Within sport, individuals may pursue activities that will take them closer to their ideals, even if it will harm their athletic performance (e.g., restrictive eating behavior, overtraining, skipping strength programs). Outside of the sport context, this conflict may arise in situations where the inability to meet the cultural ideal is amplified (e.g., an athlete may become distressed when trying on clothes if she finds that most are not designed to fit her muscular body). This conflict, and experiences of SPA in general, are not confined to particular types of sports such as aesthetically judged sports (e.g., gymnastics) or sports in which more revealing attire is worn (e.g., swimming). SPA
has been identified among athletes in a wide variety of sports, and no relationship has been found between trait SPA and type of sport (Crocker et al., 2000) or type of athletic attire (Krane, Stiles-Shipley, Waldron, & Michalenok, 2001). Because of the potential for concerns over body evaluation both within and outside the sport context, the concept of SPA seems to be a relevant concern for adolescent female athletes across many sporting contexts.

The objective of this study was to explore how adolescent female athletes cope with SPA within the context of sport. Although there are a number of studies that have looked at SPA in sport (e.g., Crocker et al., 2000; Hausenblas & Mack, 1999; Martin & Mack, 1996) and coping with SPA in non-sport populations (e.g., Kowalski et al., 2006; Sabiston, Sedgwick, Crocker, Kowalski, & Mack, 2007), to date little is known about the complex process of coping with SPA in the sport environment. Coping includes cognitive and behavioral efforts aimed at managing stressful situations (Lazarus & Folkman, 1984). Coping can be examined from the perspective of the strategies used, the intended function of those strategies, and the effectiveness of coping efforts. Each of these elements provides unique and important information, and examining all three together provides a more comprehensive understanding of the coping process.

In any single stressful encounter individuals usually use a number of coping strategies available to them (Folkman & Lazarus, 1980), and exploring the specific coping strategies can provide information about the cognitions and behaviors female adolescent athletes employ when coping with SPA. Although not specific to the sport context, two recent studies have directly explored the specific strategies female adolescents use to cope with SPA (Kowalski et al., 2006; Sabiston et al., 2007). Kowalski et al. (2006) coded coping strategies used to deal with a specific instance of SPA reported by 398 adolescent females. The most commonly reported coping strategies were behavioral avoidance, appearance management, social support, cognitive avoidance, and acceptance. However, a wide variety of other coping strategies including physical activity, communication with the evaluator, leisure activity, diet, cognitive problem-solving, emotional expression, and humor were also reported by many of the participants. They also found that state SPA significantly related to both trait SPA ($r = .44$) and the number of strategies reported ($r = .21$). In another study, Sabiston and colleagues (2007) used focus group methodology to explore the coping strategies reported by 31 adolescent females. They found strategies could be coded into 10 sub-themes: behavioral avoidance, cognitive avoidance, appearance management, diet, social support, physical activity, reappraisal, cognitive deflection
and comparison to others, seeking sexual attention, and substance use. While these studies provide important insight into the coping process associated with SPA, strategies used by adolescent athletes coping with SPA within sport remain largely unexplored.

In addition to identifying the specific strategies female adolescents are using to cope with SPA in sport, it is important to know the intended function(s), or goal(s), of the strategies they are employing. A key distinction at the functional level is among problem-focused coping, emotion-focused coping, and avoidance coping. Problem-focused coping are efforts that help an individual to change the actual situation. Emotion-focused coping are attempts to change an individual’s affective response to the situation. Avoidance coping occurs when athletes attempt to remove themselves from the stressful situation (e.g., Amirkhan, 1990, Endler & Parker, 1994, Kowalski & Crocker, 2001). The perceptions of the individual play an important role in defining the function of the strategy. An individual can employ a particular strategy for problem-focused, emotion-focused, or avoidance reasons, and often for a combination of these functions simultaneously (Folkman & Lazarus, 1985). Therefore, it cannot be assumed that a given coping strategy is employed to fulfill a particular function. Rather, it is imperative to assess both coping strategies and participants’ intended coping functions. Directly relevant to the present study, Hart and colleagues (1989) indicated that those individuals with high trait SPA are more likely to avoid situations in which their physique will be scrutinized. However, little is known about the function of specific coping strategies to manage SPA or their associations with level of SPA.

An examination of the effectiveness of coping strategies is also warranted, as coping is an important factor in the relationship between stressful events and adaptational outcomes (Folkman, Lazarus, Dunkel-Schetter, DeLongis, & Gruen, 1986). The research on coping effectiveness in sport is minimal, despite the concern that knowing what strategies are used by athletes provides little insight into the effectiveness of those strategies (Kowalski, 2007). One of the problems in this line of research is that coping effectiveness is difficult to define, and has been operationalized in a number of ways including performance outcome and satisfaction (e.g., Haney & Long, 1995), affective outcomes (e.g., Ntoumanis & Biddle, 1998), and perceived effectiveness (e.g., Nicholls, Polman, Levy, Taylor, & Colby, 2007). Research by Kim and Duda (2003) on the perceived effectiveness of coping strategies used by 318 U.S.A. athletes and 404 Korean athletes to deal with competitive stress also highlighted the need to look at both short-term and long term-effectiveness of coping. They found that problem-focused, emotion-focused,
and avoidance coping were associated with perceived short-term effectiveness, while only problem-focused coping was related to perceived long-term effectiveness. In the case of SPA, it is useful to examine an individual’s perception of coping effectiveness because it can provide insight into which strategies alleviate their appraisals of stress related to SPA, as well as whether or not she expects those strategies to be effective over the short- and/or long-term. In addition, when dealing with concerns related to the body, the coping strategy choices might have dramatic effects on health (Hart et al., 1989). Consequently, it may be important to also identify the perceived health consequences to gain a more complete understanding of strategy effectiveness.

The purpose of this study was to explore coping strategies utilized by adolescent female athletes to manage specific experiences of SPA in sport. Specifically, we examined (1) what strategies athletes report using to cope with state SPA, and the functions and perceived effectiveness of each strategy; (2) the relationship between trait SPA and state SPA; (3) whether the number of strategies and coping function reported by athletes are associated with state SPA; and (4) the relationship between coping functions and long-term, short-term, and health-related coping effectiveness. We hypothesized that (1) the athletes would report similar coping strategies to those found in Kowalski and colleagues’ (2006) research with adolescent females; (2) trait and state SPA would be significantly and positively correlated; (3) athletes who have higher levels of state SPA would report using a larger number of coping strategies. Given the lack of theoretical suggestions or empirical evidence about the associations between coping function and state SPA and coping effectiveness, no hypotheses were forwarded concerning these questions and the investigation of these relationships was considered exploratory.

**Method**

**PARTICIPANTS**

79 females ranging in age from 13 to 19 years ($M = 15.5, SD = 1.7$) who were part of a sport program and trained a minimum of two times per week during their competitive season were recruited for this study. Athletes participated in 25 different sports (alpine skiing, badminton, basketball, cheerleading, curling, cycling, dance, diving, fastball, fencing, gymnastics, hockey, judo, kayaking, racquetball, ringette, soccer, softball, speed skating, swimming, synchronized swimming, track and field, triathlon, volleyball, and wrestling). They were currently participating in 1-4 sports, with an average of 2.1 sports ($SD = 1.0$) per participant. In terms of sport level, 35.5% were competing at the club level, 27.7% were at the provincial level, 31.6% were at the national level, and 5.2% were at the international level. The self-reported average height of the athletes was 165.08 cm ($SD = 7.38$), and their average weight was 56.91 kg ($SD = 9.54$).
PROCEDURES

Following approval from the university behavioral research ethics board, a list of provincial sport organizations in Saskatchewan was obtained from the Sask Sport website (www.sasksport.sk.ca) and all were contacted. Upon the approval from each sport organization and coaching staff, the first author or a research assistant attended a practice session to explain the purposes and procedures of the study. Consent and assent forms were distributed and taken home to be completed by both the athletes and their parent or guardian. Forms were returned, generally within a week, to the coaching staff. A member of the research team then returned to administer the questionnaire and was present to answer questions. Participants first completed demographic questions. They then completed an open-ended section in which they were asked to describe situations that made them uncomfortable or nervous, any overall body concerns, and how they dealt with those concerns. The purpose of this section was to act as a cue to facilitate thinking about issues relevant to the study, and was not used in the analyses. The remaining measures were then completed in the following order: state SPA, coping, and trait SPA. Responses were anonymous, and questionnaires took 15-45 minutes to complete.

MEASURES

Demographics. Participants were asked to indicate gender, age, height, weight, sport involvement, and corresponding team/club names and level (club, provincial, national, and/or international).

State SPA. The state SPA measure was adapted from Kowalski et al. (2006) who developed the measure for use with an adolescent female non-sport sample. Athletes first described a situation in sport where they felt uncomfortable or nervous because their body was seen or evaluated by other people. Specifically, they were asked to "Please describe the situation that made you feel the most uncomfortable in the past year." Second, they described why the situation made them feel uncomfortable or nervous. Third, they rated their level of state SPA on a visual analogue scale in reference to how uncomfortable or nervous they were in the situation, ranging from 0 (not uncomfortable or nervous) to 100 (extremely uncomfortable or nervous). Convergent validity was supported by Kowalski and colleagues (2006) via a significant relationship with trait SPA ($r = .44, p < .05$). All situations reported by the adolescents were double-checked and confirmed as body evaluation scenarios.

Coping strategies, functions, and effectiveness. Open-ended questions were utilized to gather information on the coping strategies athletes used to cope with the experience of SPA in the self-identified situation described in the state SPA measure. Participants were provided with the following instructions, "Now we are interested in the specific ways to deal with the situation that you described". They were provided instructions to fill in only as many strategies as they tried, regardless of whether or not the strategy was successful. On each page, if applicable, they completed their response to the follow item stem, "To manage the uncomfortable or nervous situation, I: ________". To assess function, participants indicated (yes/no) whether each strategy was (1) an attempt to change the situation (problem-focused); (2) whether it helped them to manage or control their feelings (emotion-focused); and (3) whether it was an attempt to physically or mentally avoid the situation (avoidance). They then
rated the long-term, short-term, and health-related effectiveness of each strategy on a 5-point Likert scale ranging from 1 (not at all) to 5 (very much), a format adapted from Kim and Duda (2003). Participants rated the degree to which each strategy (1) reduced anxiety during the specific situation (short-term effectiveness); (2) prevented anxiety from reoccurring (long-term effectiveness), and (3) allowed them to deal with the anxiety in a healthy way (health-related effectiveness).

The coping strategies were coded using a taxonomy of coping in the body domain (see Kowalski et al., 2006). The taxonomy consists of 24 strategies, including 16 behavioral strategies, four cognitive strategies, three social support strategies, and one "other" category. Previous research using the taxonomy, to code strategies reported by female adolescents coping with SPA, has demonstrated acceptable reliability (Kappa = .86; Kowalski et al., 2006).

Trait SPA. The nine-item unidimensional version of the Social Physique Anxiety Scale (SPAS) was used to measure trait SPA (Hart et al., 1989; Martin, Rejeski, Leary, McAuley, & Bane, 1997; Motl & Conroy, 2000). Participants indicated the degree to which each item was characteristic of them on a 5-point Likert scale (not at all, slightly, moderately, very, and extremely characteristic). Items were then averaged to produce a trait SPA score ranging from 1 to 5. Adequate internal consistency has been demonstrated in a number of studies including research with adolescent females (e.g., Kowalski et al., 2006). Evidence for the factorial validity, factorial invariance, construct validity, and reliability of the SPAS has been found in studies with adolescents and adults (Martin et al., 1997; Motl & Conroy, 2000). Construct validity of the SPAS has been supported by positive correlations with measures of social anxiety, public self-consciousness, weight and body shape satisfaction, and BMI; and negative correlations with body cathexis and self-esteem (Hart et al., 1989; Petrie, Diehl, Rogers, & Johnson, 1996). Discriminant validity is supported by evidence that individuals who report high and low SPAS scores differ on levels of discomfort, negative thoughts, and stress during physique evaluation (Hart et al., 1989). The SPAS has a low correlation (r = .07) with the Social Desirability Scale (Hart et al., 1989).

DATA ANALYSIS

Open-ended coping strategies were coded by two independent coders, and strategies on the open-ended questionnaire were reviewed to ensure that only one coping strategy was reported per section. There was only one occurrence of a participant identifying two strategies in a single section. The decision was made to separate the two strategies and provide the same corresponding function and effectiveness for each strategy. Proportion of agreement after correcting for chance among the two independent coders was high (Kappa = .96). Discrepancies between coders’ results were resolved through discussion following coding of all responses. The distributions of all quantitative variables were examined for normality, and descriptive statistics were computed. Descriptive statistics included: (1) total number of each type of strategy; (2) number of people reporting each type of strategy; (3) proportion (%) of the total number of strategies that were used for each coping function; and (4) mean and standard deviation of the effectiveness ratings for each type of strategy and of state and trait SPA. The remaining research questions were explored using Pearson correlations.
Results

DESCRIPTIVE STATISTICS AND SCALE RELIABILITIES

Of the initial 79 athletes who completed the questionnaire, six were excluded from the analyses because they were either outside of the target age range (n = 4), not involved in organized sport (n = 1), or missing data on the majority of the questionnaire (n = 1). All variables were normally distributed (i.e., skew and kurtosis values less than three times their standard error). Descriptive scores for state SPA (M = 51.52, SD = 23.00, scale range = 0-100) and trait SPA (M = 2.85, SD = .82, scale range = 1-5) were calculated. Reliability of trait SPA was acceptable, α = .88. Descriptive statistics for the coping strategies and associated coping functions and effectiveness are presented in Table 1.

Strategies used to cope with SPA. Participants reported using a total of 129 coping strategies to manage their self-identified SPA-provoking situation. Number of coping strategies used by each person ranged from 1-4 (M = 1.77). In partial support of the first hypothesis, 13 of the 24 types of coping strategies from the taxonomy developed by Kowalski and colleagues (2006) were reported by athletes in this study. Social support (e.g., "Talked to a friend"), behavioral avoidance (e.g., "I left the shower, in a hurry"), humor (e.g., "Laughed it off"), short-term appearance management (e.g., "Wore shorts with my bathing suit"), cognitive avoidance (e.g., "Ignored it while on the court"), and acceptance (e.g., "Accepted it") were the most commonly reported coping strategies (see Table 1). No other coping strategy was reported by more than 5 athletes.

Coping function. The proportion of times a particular coping strategy was used for a problem-focused, emotion-focused, or avoidance function is presented in Table 1. While some strategies were more frequently used to serve a particular function (e.g., social support was used for an emotion-focused function in 92% of cases, 28% for problem-focused, and 36% for avoidance), all of the coping strategies were used for multiple functions. For all of the strategies, there were instances where the same strategy was used for multiple functions simultaneously, as evidenced by all three of the coping function proportions totaling more than 100%.

Coping effectiveness. For coping strategies reported by more than one person, mean effectiveness scores tended to be moderate. The highest mean scores for short-term, long-term, and health-related effectiveness were for humor, increased effort, and seeking professional help. Short-term, long-term, and health-related effectiveness ratings varied within most strategies, suggesting they represented distinct effectiveness outcomes. For example,
seeking professional support had a mean health-related effectiveness score of 4.8, but a long-term score of only 2.0; and behavioural avoidance had a score of 3.2 in the short-term, and 2.2 in the long-term.

Associations among SPA, Coping Function, and Coping Effectiveness. Contrary to our second hypothesis, trait and state SPA were not significantly correlated, \( r = .19, p > .05 \). Consistent with our third hypothesis, the number of coping strategies reported was significantly associated with state SPA (\( r = .34, p < .05 \)), with athletes who experienced higher levels of state SPA employing more coping strategies. The exploratory examination of associations between SPA and coping function demonstrated that trait SPA was significantly related to avoidance coping (\( r = .21, p < .05 \)), and state SPA was significantly related to emotion-focused coping (\( r = .24, p < .01 \)).
Problem-focused coping was the only function significantly associated with short-term effectiveness \( (r = .19, p < .05) \), with athletes reporting the use of more problem-focused coping perceiving higher levels of short-term effectiveness. Coping function was not, however, associated with long-term effectiveness. Both emotion-focused coping \( (r = .19, p < .05) \) and avoidance \( (r = - .26, p < .05) \) were correlated with health-related effectiveness, with athletes who used more emotion-focused coping and less avoidance reporting higher perceptions of health-related coping effectiveness.

Discussion

This research explored how adolescent female athletes cope with SPA. This study built on previous work by Kowalski and colleagues (2006) who employed a similar design to gain an understanding of the coping strategies and functions female adolescents utilize to deal with self-identified SPA experiences. This study extended that work to female athletes’ coping strategies, and explored the functions and effectiveness of those strategies when dealing with instances of SPA. The strategies used by female athletes to cope with SPA were similar to those identified in prior work, but also exhibited distinctions such as the emphasis on humor and the absence of some strategies documented in the general population (Kowalski et al., 2006; Sabiston et al., 2007). Results of the coping function and effectiveness analyses supported the contention that strategies are used for multiple functions, and that the coping functions have distinct associations with short-term, long-term, and health-related effectiveness. Furthermore, the lack of an association between trait and state SPA suggests that coping with SPA may have unique parameters for adolescent female athletes.

Similar to prior research with a general population of adolescent females (Kowalski et al., 2006), multiple strategies were used to cope with SPA. Social support, behavioral avoidance, short-term appearance management, cognitive avoidance, and acceptance were among the most commonly used strategies. The most frequently reported strategy, social support, has been highlighted in previous research as an important coping strategy, particularly for females (Tamres, Janicki, & Helgeson, 2002). SPA research has shown adolescent females utilize friends and family as an important support structure as a way of coping with SPA and developing coping options (Sabiston et al., 2007). Social support is commonly emphasized in the stress and coping literature because it can be used for both instrumental and emotional reasons (Holt & Hoar, 2006). The emergence of behavioral and cognitive avoidance is
consistent with Lazarus’ (1991) identification of avoidance as a key action tendency of anxiety. Specifically, Hart and colleagues (1989) stated that individuals high in SPA will attempt to avoid situations in which their bodies are on display or being scrutinized. The emphasis on appearance management is consistent with Sabiston and colleagues’ (2007) finding that most young women in their study, with a general population of adolescents, reported using appearance management strategies, primarily as indirect means to change the way they look. Similarly, Cox and Thompson (2000) suggested appearance management strategies, such as covering the body with towels while walking to and from the dressing room, limit exposure of the body from others’ view. Thus, appearance management might serve an important function in the experience of SPA as a way of limiting exposure of the body for social evaluation or presenting desired impressions to others. Acceptance is similar to the “journey towards self-acceptance” theme documented in prior research examining muscularity among female track athletes (Mosewich et al., 2009). In that study, acceptance was described as a process, and sometimes a struggle, for female athletes to reconcile their desires to adhere to cultural norms and to have a body that performs optimally. Similarly, the theme of “resignation” that emerged in a qualitative study with adolescent females has conceptual overlap with acceptance in that it suggests that girls may resign themselves to negative body-related emotions if they believe they will never be completely satisfied with their appearance (McHugh et al., 2008).

A unique finding was the emergence of humor as a common coping strategy. Humor is not included in most coping frameworks (see Skinner, Edge, Altman, & Sherwood, 2003 and Tamres et al., 2002 for reviews of coping dimensions that appear across a wide range of coping scales). One scale that humor does appear on is the MCOPE, which was developed specifically to assess coping in sport (Crocker & Graham, 1995). However, previous research has found that humor is not a commonly used coping strategy when coping with a stressful performance situation in sport (Crocker & Graham, 1995) or among adolescent females coping with SPA (Kowalski et al., 2006). A review or research on humor and coping suggests that humor, and particularly self-deprecating forms of humor, may allow people to distance themselves from stressful circumstances that are personally meaningful, while still allowing them to remain emotionally involved with their situation and preserve a positive sense of self (Lefcourt, 2001). Preserving self-image and maintaining positive engagement could be particularly pertinent in the sport environment where performance and evaluation are forefront. Taken together these findings suggest humor might be important to include in research on coping and SPA in sport.

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In contrast with research in the general population of adolescent females (Kowalski et al., 2006; Sabiston et al., 2007), aggressive activities, leisure activity, physical activity, self-handicapping, spitting/vomiting, substance use, surgery, tension reduction/relaxation, wishful thinking, spiritual support, and seeking sexual attention did not emerge as strategies for coping with SPA in the present study with adolescent female athletes. It is possible that the sample size of the current study limited our ability to reach saturation and document all of the relevant coping strategies in this population. However, some of the most concerning strategies from a health perspective found in prior work with the general population of adolescent females (Kowalski et al., 2006; Sabiston et al., 2007) study did not emerge. This finding suggests an alternate explanation that the additional emphasis on physical performance and possibly staying healthy in sport could be protective for these athletes compared to the general population. For example, prior research has suggested that higher levels of SPA are associated with avoidance of physical activity (Crawford & Eklund, 1994). In the sport context, however, that coping strategy may not emerge because it is inconsistent with achieving athletic goals that are also highly valued. Future research is needed to further explore the validity of these differences and their potential mechanisms, but they are consistent with research demonstrating links between sport participation and health-related behavior such as lower rates of smoking (Kaczynski, Mannell, & Manske, 2008) and risky sexual behavior (Miller, Sabo, Farrell, Barnes, & Merrill, 1999).

Contradictory to Kowalski and colleagues’ (2006) study, there was no significant relationship between state and trait SPA. Although the sample size may have limited our power to detect an association, this lack of a relationship could result from unique aspects of the sport environment. Sport is physical and places athletes bodies on display; however, it is also an environment where participants often have similar physiques, priorities, and perspectives (Greenleaf, 2002). Thus, athletes’ SPA experiences may be different within and outside sport. For example, an athlete may be comfortable with a highly muscular body in sport, a context where a powerful female body is rewarded, and less comfortable in a social setting where she may feel too muscular or masculine (Greenleaf, 2002; Mosewich et al., 2009). Also, sport may be an environment where athletes can demonstrate physical competence and experience desirable appearance changes associated with regular participation (Crocker et al., 2000). Alternatively, aspects of the sport environment could highlight physical attributes that can be hidden in general culture, such as when having team showers or wearing revealing team uniforms (Cox & Thompson, 2000), potentially exacerbating SPA in sport.
Because of these factors, athletes' trait SPA and state SPA in sport may vary considerably. Support for this discrepancy is shown in the mean values on state SPA and trait SPA. In this study, SPA values were as follows: trait SPA, $M = 2.85, SD = .82$; state SPA, $M = 51.52, SD = 23.00$; whereas Kowalski et al. (2006) reported the following: trait SPA, $M = 3.21, SD = .93$; state SPA, $M = 52.20, SD = 24.83$. A one-sample t-test comparing the means on state and trait SPA in both studies showed there was a significant difference on trait SPA, $t (72) = 3.71, p < .05$, but not state SPA, $t (72) = 0.23, p > .05$. Prior studies have not directly compared SPA levels of athletes and non-athletes. Hausenblas and Mack (1999) found that divers had lower trait SPA levels than both athletes in other sports and nonathletes. The focus on diving in that study, however, makes it difficult to compare their results with those of the current study. Krane and colleagues (2001) reported mean levels of trait SPA for college-age female exercisers (34.99) and athletes (32.25). They did not find the groups to be different on SPA, but they were only compared within an analysis that broke the athletes down by uniform type; so the athlete-non-athlete question was not directly addressed. Future research comparing athletes and non-athletes’ SPA experiences is needed before conclusions can be drawn about the relative differences in SPA between athletes and non-athletes. While athletes might experience relatively less trait SPA compared to non-sport populations, they might still experience similar levels of state SPA to the general population of adolescent females because of the evaluative nature of sport.

The relationships between state SPA and number of coping strategies reported is consistent with prior work (Kowalski et al., 2006). Tamres et al.’s (2002) meta-analysis showed that the severity of the stressor plays an important role in amount of coping utilized. Thus, it is not surprising that as state SPA increases athletes implement more strategies to manage it. The links between SPA and coping function also partially supported previous findings. The significant relationship between trait SPA and avoidance was expected because avoidance is the action tendency of anxiety (Lazarus, 1991). Previous studies have shown that individuals who are highly anxious with regard to how others view their physiques are likely to try to avoid SPA-provoking situations (Hart et al., 1989). The lack of a relationship between SPA and problem-focused coping may seem counter-intuitive because problem-focused behaviors such as physical activity and diet can change the physique and alleviate the perceived problem (Hart et al., 1989). For athletes, however, physical activity may be perceived as redundant to achieving a reduction of anxiety because they are already highly active and still experiencing SPA, and elements of their activity context may actually be contributing to
SPA (e.g., Cox & Thompson, 2000). Emotion-focused coping was the only coping function associated with level of state SPA. This is consistent with prior research on coping in sport showing that level of stress is associated with emotion-focused coping, but not problem-focused coping or avoidance coping among adolescent female athletes (Kowalski, Crocker, Hoar, & Niefer, 2005).

The associations between coping function and effectiveness were exploratory, but there are some interesting links that could be further examined in future research. Problem-focused coping was the only function associated with short-term effectiveness, having a positive relationship. This suggests that athletes perceive that they are most effective at alleviating their current feelings of SPA if they can actively do something to change the SPA-provoking context. With the exception of short-term appearance management, all strategies cited more than once were used more frequently as emotion-focused or avoidance strategies than as problem-focused strategies. This suggests that while the participants feel that problem-focused coping is more effective in the short-term, they either do not have many strategies that they think can help them change the situation, or they choose to use those strategies less frequently. In contrast, coping function was not associated with long-term effectiveness. It may be difficult for adolescent athletes to assess how their present actions will affect them in the future, as compared to short-term effectiveness where they have the feedback about how the situation and their emotions evolved and changed over the course of the stressful encounter. Alternatively, examining links between long-term effectiveness and coping function may be influenced by problems with assessing perceptions of long-term effectiveness in a cross-sectional study. Furthermore, it is important to note that perceived effectiveness was assessed in this study rather than objective indicators of coping effectiveness. The use of more objective assessments of effectiveness may be a useful pursuit in future research, particularly in the area of health-related effectiveness where objective health markers may be established and assessed.

Other limitations of this work include excluding athletes who have dropped out of sport, and recall issues when using measures that ask participants to recall an experience of SPA and coping. Sport drop-out is a potential limitation because if athletes use dropping out as a coping strategy they would be excluded from this research. Research on exercisers has shown that women with high SPA prefer settings that de-emphasize the physique and are more likely to drop out of structured exercise than women with lower SPA (Crawford & Eklund, 1994). If dropping out is also used as a coping strategy in sport, information about the function and effectiveness of this strategy and
its relationship with SPA cannot be explored in research that targets current sport participants. Many researchers have recognized that assessment of coping is reliant on participant’s recollection and interpretation to give an accurate, reliable, and detailed account of the situation and their responses, and may limit research findings. Lazarus (1999) acknowledged these limitations, but identified the need to use self-report methodologies in coping research as individuals’ appraisals and perceptions are fundamental to the stress and coping process.

This study builds upon the Kowalski et al. (2006) study to extend coping with SPA in adolescence to the sport context. Together, the results suggest that the ways in which athletes cope with SPA in the sport setting may be unique and require dedicated investigation and is consistent with the idea that contexts are important in understanding the way adolescent female athletes appraise and cope with SPA. Future research should tease out specific contextual factors that may influence the relationships between SPA and choices of coping strategy, function, and perceived effectiveness. For example, research linking perceptions of conditioning and competence to physical activity and SPA suggest there is a need to more specifically examine the role of competence-based interventions, such as skill development and feedback approaches as ways to manage the effects of SPA and promote motivation in sport and activity contexts (Crocker et al., 2003; Brunet & Sabiston, 2009). Another extension of this work is to explore the role of significant others such as peers, coaches, parents, and the media in the development of body perceptions (Crocker et al., 2003), and in assisting with effective management of female adolescents athletes' experiences with SPA. The athletes in this study frequently looked to significant others to provide social support, and future research could explore the approaches these social partners take and their impact on coping.

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Demographic dissimilarity and affective reactions to physical activity classes: The moderating effects of diversity beliefs

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The purpose of this study was to examine the influence of pro-diversity beliefs on college students’ reactions to physical activity classes. Data were collected from 157 students at a large public university in the Southwest United States. Structural equation modeling indicated that pro-diversity beliefs moderated the relationship between perceived race dissimilarity and satisfaction with others in the class. The effects were particularly strong among those who perceived themselves to be racially similar to the rest of their classmates. Satisfaction with classmates then held a positive association with satisfaction affective reactions to the class. The findings contribute to the diversity literature and have implications for class instruction.

KEY WORDS: Affective reactions, Dissimilarity, Physical activity.

Diversity represents one of the most important issues within sport and physical activity today. While many gains have been made in some areas (e.g., increased participation among women), people who differ from the typical majority continue to face prejudice and discrimination (for an overview, see Cunningham, 2007b; Cunningham & Fink, 2006). For instance, women and racial minorities are under-represented in coaching and leadership positions (Acosta & Carpenter, 2008; Lapchick, 2009), sexual minorities face physical abuse from other players (Anderson, 2002) and discrimination in the workplace (Sartore & Cunningham, 2009), and persons with disabilities encounter barriers both in terms of inclusion and accessibility (DePauw & Gavron, 2005). These effects are also observed in physical activity patterns. Women (Carron, Hausenblas, & Eastebrooks, 2003), racial minorities (Grieser et al.,

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The elderly (Sheppard et al., 2003), and persons with disabilities (DePauw & Gavron, 2005) all participate less frequently in exercise and leisure activities than do their counterparts. The differential participation patterns have been attributed to a number of factors, including institutionalized prejudice, socioeconomic status, and cultural norms (Cunningham, 2007b; Mays, Cochran, & Barnes, 2007).

In examining these issues, diversity and social justice researchers have most frequently compared the sport experiences of one group of people (e.g., women) to another (e.g., men), or what Tsui and Gutek (1999) refer to as a categorical approach to diversity research. While such studies provide considerable insights, they are also limited in that they do not consider potential within-group differences or contextual influences. As an alternative, Tsui and Gutek (1999; see also Riordan, 2000) argued for a relational demography approach to the study of diversity. The underlying premise here is that one’s demographic characteristics, relative to the characteristics of others in that social group, will impact that person’s subsequent attitudes, behaviors, and performance. Thus, the relational demography approach moves beyond comparing members of various social categories to consider the individual in relation to the group. The primacy of a relational demography perspective is heightened in sport and physical activity, being that a number of people exercise or are physical activity in group settings (Carron et al., 2003).

The few researchers to adopt this perspective within the sport setting have found that people who differ from others in a group have poorer experiences than do their counterparts (Cunningham, 2006, 2007c; Fink, Pastore, & Riemer, 2001). Cunningham’s (2006) study of physical activity class students is particularly relevant to the current investigation. He observed that people who differed from others in the class by gender, race, and age also had low affective reactions to the class—that is, they did not express the enjoyment, fun, or involvement as those who were demographically similar to their classmates. These relationships were mediated by perceptions of such demographic differences and by perceived deep-level dissimilarity, or the degree to which people differ based on unseen attributes, such as values, personality, and attitudes. That dissimilarity from others resulted in lower affect to the class is especially disconcerting when considering the link between affect and continued participation in both physical activity classes and the activity itself (Cunningham, 2007a).

Collectively, this literature paints a dim picture: despite the many positive effects of regular physical activity (Haskell, 1994; Biddle & Mutrie, 2001), people who are dissimilar from others in the physical activity context
are likely to express lower levels of liking and enjoyment, which in turn, negatively affects their subsequent activity levels. Efforts are needed, therefore, to address these trends and to ameliorate the negative effects of demographic dissimilarity from others. The purpose of this study is to examine the efficacy of one such strategy. Specifically, in drawing from the social categorization framework (Tajfel & Turner, 1979; Turner, Hogg, Oaks, Reicher, & Wetherell, 1987) and the recent work concerning diversity mindsets (van Knippenberg & Schippers, 2007), I argue that the negative effects of dissimilarity on subsequent affect are likely to be attenuated when the class is characterized by pro-diversity beliefs. These effects are examined for age, race, and gender diversity. In the following space, I provide an overview of the study’s theoretical underpinnings and present specific hypotheses.

Theoretical Framework

Social Categorization

The social categorization framework provides the theoretical foundations for relational demography. This framework, which collectively draws for social identity theory (Tajfel & Turner, 1979) and self-categorization theory (Turner et al., 1987), suggests that people classify themselves and others into groups. This classification process can be based on a myriad of factors, including demographics (e.g., race, age), values and attitudes (e.g., liberal, conservative), or other identities (e.g., Protestant, Catholic). Thus, people define themselves in terms of a social identity (Tajfel & Turner, 1979). In doing so, persons who are perceived as similar to the self are considered in-group members, while those who differ from the self are considered out-group members. When the positive distinctiveness of the in-group is challenged or threatened, the social categorizations will result in intergroup bias, whereby people hold more positive attitudes and engage in more helping behaviors toward in-group members than they do toward out-group members (Tajfel & Turner, 1979; see also Hogg & Abrams, 1988). This process creates an intergroup bias and the subsequent “us” and “them” distinctions.

The social categorization process is seen as fundamental to understanding the potential negative effects of being different from others in a group. Mannix and Neale (2005), for instance, suggested that social categorization and the accompanying stereotypes are likely to result in “biased behavior directed toward out-group members and favoritism and preference directed toward in-group members” (p. 41). In a similar way, Tsui, Egan, and O’Reilly
(1992) suggested that the social categorization process was fundamental to understanding people’s preference for working in groups of people demographically similar to the self. The social categorization framework is likewise applicable in the current study and helps explain why demographic dissimilarity from others in an physical activity group is associated with poor outcomes (Cunningham, 2006).

**Diversity mindsets**

Researchers have increasingly sought to target the social categorization process as a way to reduce intergroup bias (see Brewer & Miller, 1984; Gaertner & Dovidio, 2000; Brown & Hewstone, 2005). The underlying assumption here is that if intergroup evaluations can change such that perceptions of the in-group correspond with those of the out-group, then the negative effects of dissimilarity would dissipate. One such strategy for achieving this end is to target people’s diversity mindsets, also referred to as diversity beliefs. According to van Knippenberg and Schippers (2007), whose research was set in the organizational context, the effects of increased diversity “should be more positive in contexts where individuals, groups, and organizations have more favorable beliefs about and attitudes toward diversity, are more focused on harvesting the benefits of diversity, and have a better understanding of how to realize these benefits” (p. 531). When diversity is seen in a positive light and perceived as beneficial to the physical activity class context, those who are different from the typical majority might also be valued, as opposed to being marginalized. After all, it is the presence of differences that positively contributes to the class and the learning that takes place in it; thus, demographically different others might be perceived as the individuals who make the class diverse in the first place. This reasoning suggests that, in contexts where diversity is valued, demographically different persons might be more satisfied with their experience than if they were in a class where differences were not viewed so positively.

While the research is just emerging, there is some work to support this rationale. Ely and Thomas (2001), in their qualitative study of multiple firms, found that employees who worked in companies that valued diversity and fully integrated it into the organizational system were likely to (a) feel valued and respected, (b) openly discuss and integrate diversity topics and issues, and (c) perceived their diversity as “a potential source of insight and skill” (p. 257). In a laboratory study, Homan, van Knippenberg, Van Kleef, and De Dreu (2007) found that diverse groups performed better when the group was
characterized by pro-diversity attitudes rather than pro-similarity beliefs. Homogeneous groups in their study were unaffected by diversity beliefs. In both their experimental and field-based studies, van Knippenberg, Haslam, and Platow (2007) found that people more closely identified with diverse groups when they believed that diversity added to the value of that group. Finally, in two separate studies, Cunningham (2008, 2009) found that athletic departments that coupled pro-diversity beliefs with high employee diversity realized greater employee satisfaction, creativity, and objective measures of performance than did their peers.

**Current research**

In drawing from this literature, the purpose of the current study was to examine the potential effects of pro-diversity beliefs on the relationship between perceived demographic dissimilarity and affective reactions to the class. As previously articulated, the emphasis on perceived dissimilarity is based on the growing literature showing that perceptions of being different mediate the relationship between actual differences and subsequent outcomes (Cunningham, 2006, 2007c; Harrison, Price, Gavin, & Florey, 2002; for an excellent review, see Riordan, 2000). In drawing from the diversity mindset research (Ely & Thomas, 2001; van Knippenberg & Schippers, 2007), it was expected that pro-diversity beliefs would influence the relationship between perceived dissimilarity and the interactions with others in the class. From one perspective, it is being different from dissimilar others that is thought to negatively influence affective reactions to the class (Cunningham, 2006); thus, if differences are viewed in a positive light, then this might most directly affect students’ interactions with and reactions toward the other students. From a different perspective, pro-diversity beliefs might also influence the attitudes of those who are similar. That is, for persons in the majority, pro-diversity attitudes might result in them holding more positive attitudes toward those who might have traditionally been viewed as different (van Knippenberg et al., 2007). By way of example, a White male who holds pro-diversity attitudes might have more positive attitudes toward dissimilar others, relative to another White male who does not. If this is the case, then satisfaction with one’s classmates would be higher for the White male with pro-diversity attitudes than it would for his counterpart who does not hold such beliefs.

Based on this rationale, I first hypothesized that pro-diversity beliefs would moderate the relationship between perceived demographic dissimila-
rity and satisfaction with students in the class. Corresponding hypotheses are presented for the different diversity forms: perceived age dissimilarity (hypothesis 1a), perceived sex dissimilarity (hypothesis 1b), and perceived race dissimilarity (hypothesis 1c). These hypotheses are based on the premise that being different from others in the class impacts one’s affective reactions to others in the class. If this is the case, then satisfaction with classmates ought to also impact one’s overall affective reactions to the class. Indeed, others have also noted the influence of others in the class on shaping one’s affective reactions (Cunningham, 2007a; Leenders, Sherman, & Ward, 2003). As such, I also hypothesized that satisfaction with classmates would be positively related to affective reactions to the class (hypothesis 2). The specific methods and data analysis employed to test these hypotheses are presented in the following sections.

Method

Participants

Students (N = 157) who were enrolled in physical activity classes (i.e., basketball and soccer) at a large university in the southern United States participated in the study. All participants provided consent to take part in the study. The sample included 86 men (54.8%) and 71 women (45.1%); it was mostly White (n = 116, 73.9%), followed by Hispanic (n = 21, 13.4%), Asian (n = 8, 5.1%), African American (n = 7, 4.5%), and persons who chose the “other” category (n = 4, 2.5%). The mean age of the participants was 19.94 years (SD = 1.52), with a range from 18 to 25 years. The college classification of the participants was relatively evenly distributed: 48 freshmen (30.6%), 37 sophomores (23.6%), 37 juniors (23.6%), and 35 seniors (22.3%).

Measures

Participants received a questionnaire which requested them to provide their demographic information, as outlined in the preceding section, and to respond to items pertaining to their perceived dissimilarity, diversity beliefs, satisfaction with classmates, and affective reactions to the class.

Perceived demographic dissimilarity. Three items adapted from Harrison and colleagues’ work (Harrison, Price, & Bell, 1998; Harrison, Price, Gavin, & Florey, 2002) were used to measure perceived demographic dissimilarity from others in the class. Students read the following phrase: “Think about yourself in relation to others in the class. How similar to others in the class are you with respect to:”. Participants then rated their similarity based on “age”, “sex”, and “race” using a 7-point Likert-type scale ranging from 1 (very dissimilar) to 7 (very similar). Responses were reverse scored such that higher scores were reflective of greater perceived dissimilarity. A number of studies have provided content and predictive validity evidence for this scale (Cunningham, 2006, 2007c; Harrison et al., 1998, 2002).
Diversity beliefs. In drawing from van Knippenberg and Schippers (2007) and Ely and Thomas (2001), two items were used to measure diversity beliefs ($\alpha = .67$): “differences among students positively influence the class” and “differences among people make the class a success.” The items were measured using a 7-point Likert-type scale from 1 (strongly disagree) to 7 (strongly agree).

Satisfaction with classmates. Satisfaction with classmates ($\alpha = .90$) was measured with three items modified from Bishop and Scott (2000). The items were preceded by the phrase, “how satisfied are you with...”. A sample item is “how you get along with others in the class.” Participants responded to the items using a 7-point Likert-type scale from 1 (not at all satisfied) to 7 (very satisfied).

Affective reactions to the class. Affective reactions to the class were measured with three items from the Satisfaction/Interest in Sport Scale (Duda & Nicholls, 1992). The items were adapted to fit the context of the physical activity class setting (see Treasure & Roberts, 2001, for a similar approach): “I usually enjoy myself,” “I usually get really involved in the class,” and “I usually have fun” ($\alpha = .71$). The items were preceded by the phrase “when participating in this physical activity class:” and were anchored by a Likert-type scale from 1 (not true) to 7 (very true). Various studies, across a variety of settings, have demonstrated the sound psychometric properties (e.g., validity evidence, high reliability) of the scale, across a variety of settings (Duda & Nicholls, 1992; Nicholls, Cobb, Wood, Yackel, & Patashnick, 1990; Treasure & Roberts, 2001).

PROCEDURES

After I received approval for the study from the university’s human subjects board and the course instructors, I asked students enrolled in basketball and soccer classes to participate in the study. These specific classes were chosen because the students participate in an interdependent manner with one another, and the outcomes (both positive and negative) associated with diversity are most likely to be detected under such conditions (Doherty & Chelladurai, 1999; Jehn, Northcraft, & Neale, 1999). These classes met twice a week over a 15-week semester. The questionnaire distribution took place during the twelfth week of the semester, thereby allowing participants to have the time form their perceptions of the class. Participation in the study was voluntary, and approximately 10 minutes were required to complete each questionnaire. Questionnaires were distributed at the end of the class periods, thereby allowing those not wishing to participate to leave. Participants were debriefed as to the purpose of the study after completing the questionnaire. All the questionnaires were collected during the same week for each data collection time.

Data analysis

The data analysis was a multi-step process (Anderson & Gerbing, 1988). Prior to conducting the primary analyses, a confirmatory factor analysis, using AMOS 7.0 (Arbuckle, 2006), was used to examine validity evidence of the multi-item measures (i.e., diversity beliefs, satisfaction with classmates, affective reactions to the class) based on internal
structure. An oblique model was tested, thereby allowing the latent factors to correlate with one another, and errors were left independent (see Arbuckle, 2006). Means, standard deviations, and bivariate correlations were then computed for all variables. Finally, structural equation modeling was then used to examine the study hypotheses. Marsh, Wen, and Hau’s (2004) guidelines were used to test the moderating effects of pro-diversity beliefs on the relationship between perceived demographic dissimilarity and satisfaction with classmates. Note that the perceived demographic dissimilarity variables were measured with the single item; thus, in efforts to not duplicate material in creating interaction terms (Marsh et al., 2004), diversity beliefs were treated as an observed variable in the analysis. The root mean square error of approximation (RMSEA) and comparative fit index (CFI) were both used to assess model fit. Following Williams, Vandenberg, and Edwards (2009), RMSEA values of .08 or less and CFI values of .95 or greater were considered indicative of close fit.

Results

CONFIRMATORY FACTOR ANALYSIS

Results of the confirmatory factor analysis indicated that the hypothesized three-factor model (i.e., where diversity beliefs, satisfaction with classmates, and affective reactions are distinct factors) was a good fit to the data: $\chi^2 (n = 157, df = 17) = 25.29, p = .09; \chi^2 / df = 1.49; \text{RMSEA (90\% confidence interval: .00, .10) = .06; CFI = .98.}$ This model was tested against an alternative, two-factor model, where the satisfaction items all loaded on a single factor and the diversity belief items loaded on another. This model was a poor fit to the data: $\chi^2 (n = 157, df = 19) = 71.86, p < .001; \chi^2 / df = 3.78; \text{RMSEA (90\% confidence interval: .10, .17) = .13; CFI = .89.}$ The chi-square difference test indicated that the hypothesized model was a statistically better fit to the data than was the alternative model: $\Delta \chi^2 (\Delta df = 2) = 46.57, p < .001.$ Collectively, these results point to the sound psychometric properties of the measures used in the study.

DESCRIPTIVE STATISTICS

Descriptive statistics are presented in Table 1. Perceived age dissimilarity was negatively related to satisfaction with students, while perceived sex and race dissimilarity were not. Pro-diversity beliefs were positively related to satisfaction with classmates and affective reactions to the class as a whole, and the latter two variables also held significant, positive associations with one another.
Results from the structural equation model indicated that the model was a good fit to the data: $\chi^2 (n = 157, df = 43) = 57.70, p = .06; \chi^2 / df = 1.34; \text{RMSEA} (90\% \text{ confidence interval:} \ .00, .08) = .05; \text{CFI} = .97$. A test of the partially mediated model indicated that the data were also a close fit to the model: $\chi^2 (n = 157, df = 36) = 46.93, p = .11; \chi^2 / df = 1.30; \text{RMSEA} (90\% \text{ confidence interval:} \ .00, .08) = .04; \text{CFI} = .98$. However, the chi-square difference test indicated that the two models did not significantly differ from one another: $\Delta \chi^2 (\Delta df = 7) = 10.77, p > .05$. Thus, the more parsimonious model was accepted and interpreted when testing the hypotheses. The model explained 24% of the variance in satisfaction with classmates and 35% of the variance in satisfaction with the class. An illustrative summary of the findings is presented in Figure 1.

Hypothesis 1a-1c predicted that pro-diversity beliefs would moderate the relationship between perceived age dissimilarity, perceived sex dissimilarity, and perceived race dissimilarity, respectively, and satisfaction with classmates. As seen in Figure 1, Hypotheses 1a and 1b were not supported. However, in support of Hypothesis 1c, the perceived racial dissimilarity × pro-diversity beliefs interaction term was significant ($\beta = -.18, p < .05$), and the interaction is depicted in Figure 2. For both persons who perceived themselves to be similar and those who perceived themselves to be different from others, pro-diversity beliefs were associated with greater satisfaction with classmates; however, the effects were stronger for persons who perceived themselves to be racially similar to the class than it was for their counterparts.

Hypothesis 2 was supported. Satisfaction with classmates was positively associated with affective reactions to the class ($\beta = -.31, p < .001$).
Fig. 1. - Illustrative summary of structural equation model. 
**p < .01. ***p < .001.

Fig. 2. - Moderating effects of pro-diversity beliefs on the relationship between racial dissimilarity and perceived deep-level dissimilarity.
Discussion

People who differ from others in a group setting are likely to have less positive experiences in that setting than are their counterparts (Riordan, 2000; van Knippenberg & Schippers, 2007). This trend is particularly relevant to the sport and physical activity context given (a) the high number of people who exercise in groups, and (b) that demographic dissimilarity from others in an exercise setting has been shown to negatively influence people’s affective reactions (Cunningham, 2006). The purpose of this study was to examine the potential of pro-diversity mindsets in reducing these negative effects. In pointing to the efficacy of this approach, results indicate that such beliefs were positively associated with both satisfaction with others in the class and affective reactions to the class (see Table 1). These findings are consistent with research in other contexts (Ely & Thomas, 2001; Fink, Pastore, & Riemer, 2001) showing that people who perceive their group to hold positive attitudes toward diversity are also more likely to have pleasant experiences in that entity.

In addition, pro-diversity beliefs moderated the relationship between perceived racial dissimilarity and satisfaction with classmates, with the effects being stronger for persons who were racially similar. These results suggest that when racially similar persons, which in this context predominantly means White students, had positive attitudes toward the value diversity brought to the class, they were more likely to have positive affective reactions to all of their peers in the class. From a social categorization perspective (Tajfel & Turner, 1979; Turner et al., 1987), *ceteris paribus*, people are likely to hold positive attitudes toward racially similar others, which in this case, would mean Whites being satisfied with other Whites. It is possible that the pro-diversity attitudes also increased the evaluations among Whites of racially dissimilar others. If this is the case, then the satisfaction with all students—those racially similar and those who are racially different—would be higher than if such pro-diversity beliefs did not exist. Such a rationale is consistent with related findings from van Knippenberg et al. (2007), who observed that people more closely identify with a diverse group when they believe that diversity adds to the functioning of the group.

Interestingly, the moderating effects of pro-diversity beliefs were not present for perceived age and sex dissimilarity. From a multivariate perspective (see Figure 1), neither of these variables had independent effects. It is possible that the restricted age range (18-25 years) influenced these results. Indeed, as seen in Table 1, perceived age dissimilarity had the lowest mean score and smallest standard deviation, thereby suggesting little variability in
the students’ perceptions. The lack of effects for sex is more puzzling, as previous research in this context (Cunningham, 2006) has found that perceived sex diversity does influence subsequent outcomes. Cunningham’s study focused on the influence of sex diversity on subsequent perceptions of deep-level differences, however, and not satisfaction with other students. It is possible that since men and women are equally represented on the college campus where the research took place and in many of the activity classes, such differences do not have a considerable impact on subsequent satisfaction with other students.

Finally, the results point to the importance of satisfaction with others in influencing students’ positive affective reactions to the class as a whole. These findings are consistent with previous research in the leisure, recreation, and athletics domains, which has shown that many people derive their satisfaction with those endeavors based on their satisfaction with others in the group (Beard & Ragheb, 1980; Chelladurai & Riemer, 1997; Rossman, 1995). Within the physical activity setting, then, fostering amicable relations among students appears to be key in influencing students’ satisfaction with the class as a whole.

**Contributions, Limitations, and Future Directions**

This study makes several contributions to the extant literature. First, previous research has pointed to the negative effects of being different from others in a group, as such differences negatively influence people attitudes toward and behaviors in the group (Cunningham, 2006, 2007c; Randel & Jaussi, 2003; Tsui et al., 1992). Being different from others, however, is increasingly becoming a reality, whether in educational settings or within organizations. Thus, seeking ways to improve the interactions among people in diverse groups is paramount. This study identified one such mechanism: the diversity mind-set. These findings are encouraging, as research suggests that people’s attitudes toward diversity are not set in stone, but can be influenced through education (Cunningham & Fitzgerald, 2006; Rynes & Rosen, 1995). Consequently, instructors might be able to change people’s diversity mindsets, and their resultant affect toward the class, through diversity-related instruction.

In a related way, activity class instructors can model the value in diversity in their classroom. This could be accomplished by illustrating the benefits of taking into account different perspectives and opinions, discussing research findings showing the positive effects of differences among group members
(see Homan et al., 2007), or strategically assigning dissimilar classmates to work with one another under cooperative conditions (see Pettigrew, 1998).

Despite these contributions, there are limitations. Some may point to the single data collection as a limitation, as method variance becomes a concern. An important point to consider, however, is that such concerns are unfounded with respect to the moderation effects, as common method bias cannot account for interactions, and, if anything, actually makes them harder to detect (McClelland & Judd, 1993). Second, the data were collected at a single university in the Southwest United States; thus, caution should be used when generalizing these results to other contexts.

Based on the study’s findings, there are several avenues for future research. First, future researchers should continue to explore how to ameliorate the potential negative effects of differences within groups, and specifically physical activity classes. In drawing from a social categorization perspective (Tajfel & Turner, 1979; Turner et al., 1987), efforts aimed at targeting how people shape their perceptions of (dis)similarity from others might prove fruitful. For instance, research among collegiate coaches has shown that the presence of a common in-group identity on the coaching staff increased the satisfaction of coaches who racially differed from their colleagues (Cunningham, 2005). Similar approaches could be considered in the physical activity class setting. Second, the data were collected at one point in the semester. Some researchers have found, however, that the saliency of social categories potentially changes over time (Harrison et al., 1998, 2002). In drawing from this understanding, researchers should investigate the influence of pro-diversity beliefs on group functioning over time. Third, additional research adopting a qualitative approach might yield unique insights. Finally, additional research is needed to understand other factors that influence students’ satisfaction with physical activity classes, especially when considering the benefits those classes have in shaping the students’ health behaviors (Cunningham, 2007a; Leenders et al., 2003; Sparling, 2003). Indeed, any efforts aimed at increasing the positive affective reactions college students have toward physical activity and healthy living would prove to be a useful endeavor.

REFERENCES


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Representative experimental design issues in observing golfer pre-performance routine behaviour.

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The representative experimental design of many previous studies exploring the nature of pre-performance routine usage in golf has been limited by flaws in research design. The purpose of this study was to ascertain whether the use of a full-swing golf simulator could provide an ecologically valid alternative to lab-based experimental designs.

Participants were six elite male golfers (mean age = 22.5yrs, s = 3.3 years; mean handicap = +1, s = 1; mean years playing = 8.63, s = 5.21) who were required to play in three conditions: simulated; practice; and competition.

A one-way, within-participant MANOVA was conducted investigating whether significant differences existed in the temporal characteristics of the behavioural categories (head, club, posture, still) within the routines across the three conditions. Four dependent variables relating to category of behaviour were used: head, club, posture and still. The independent variable was the condition. No significant differences were identified (participant one F_3,144 = 0.74, P = 0.66; participant two F_3,144 = 1.52, P = 0.16; participant three F_3,144 = 1.54, P = 0.16; participant four F_3,144 = 0.74, P = 0.66; participant five F_3,144 = 0.88, P = 0.54; participant six F_3,144 = 1.72, P = 0.10) for any of the dependent variables, within participant, across conditions.

The results suggest that the use of environmental simulators in golf could offer the opportunity to maximise the ecological validity of experimental designs, allowing the researcher to understand more fully the strategies used by the golfer in the competitive environment.

KEY WORDS: Golf, Pre-performance routines, Representative experimental design, Simulator.

Introduction

Representative design in the research environment is crucial if comparisons are to be drawn with the real competitive environment. Araújo,
Davids, and Passos (2007) suggested that the term representative design refers to “the arrangement of conditions of an experiment so that they represent the behavioural setting to which the results are intended to apply” (p.71). Indeed, Araújo et al. (2007) suggested that a lack of representative design could lead to the results of specific experiments not being representative of functional behaviour in participants’ environments.

Much research has been conducted exploring the nature and use of pre-performance routines in golf, particularly focusing on the impact they have on the execution of successful performance. Pre-performance routines (PPRs) have been defined by Moran (1996) as a “sequence of task-relevant thoughts and actions which an athlete engages in systematically prior to his or her performance of a specific sports skill” (p.176). However, the positive relationship between routine usage and successful performance appears to be based upon shaky foundations. Studies exploring the nature of PPRs (Boutcher & Crews, 1987; Cohn, Rotella & Lloyd, 1990; Douglas & Fox, 2002; Harle & Vickers, 2001; Marlow, Bull, Heath, & Shambrook, 1998; McCann, Lavallee & Lavallee, 2001; Southard & Amos, 1996) appear to have encountered difficulties in replicating the competitive environment and task demands accurately. In particular, concerns relating to the ecological validity of the research environment; including the tasks performed, environment type, participants’ visual perception perspective and task difficulty, and resulting impacts on behaviors and underlying psychological processes need to be addressed. Douglas and Fox (2002) required their participants to complete 18 putts to three different targets, with six consecutive putts at each hole. Boutcher and Crews (1987) used a similar 18 putts, at three holes approach, while McCann, Lavallee and Lavallee (2001) required their participants to play the same shot into a 10m radius target from two distances (40m and 60m). Each of these studies have designed tasks which due to their repetitive nature are representative of the real golfing environment. Little work to date has explored the impact of task constraints (Newell, 1986), which are performance and environmentally related aspects of the task, on PPRs or the dynamic nature of golf in which the same shot or type of shot is very rarely played consecutively. Starkes and Lindley (1994) suggested that the fidelity of the environment is a crucial factor in determining the effectiveness and ecological validity. They defined fidelity as the ‘extent to check the simulation mimics the real-world task’ (p.221). Lintern, Sheppard, Parker, Yates, and Nolan (1989) further proposed three distinctly different components of fidelity. Physical fidelity refers to the look of the task. Functional equivalence refers to
whether the simulated task feels like the real task, and psychological fidelity refers to how much the performer perceives the simulated environment to be realistic.

It could be argued that the functional equivalence in previous studies has been at best a poor imitation of the real task. When participants are required to repeat the same aspect of their game (e.g., putts, Boutcher & Crews, 1987; Douglas & Fox, 2002) they are not completing a task with the same dynamic demands that exist in competition. The physical and psychological fidelity of the tasks have also changed, players do not play the same shot continually in the competitive environment. If the fidelity of the experimental tasks has changed when compared to the real environment it cannot be assumed that there is not a subsequent change in pre-performance behaviour.

Specific requirements for an experimental paradigm exploring sports performance behaviour were outlined by Paull, Case and Grove (1997) who suggested that by adhering to specific recommendations representative design could be maximised. These recommendations include: Environments reproducing the perceptual information cues available in the usual performance situation; dynamic displays of the action typical of the skill domain; realistic motor response actions that have, through practice, become coupled in a performer’s memory to his/her perceptual system; the ability to manipulate perceptual and probabilistic cues in the display; the recording of control, timing, and response data without interfering with subjects’ execution of their usual actions for the skill.

The potential difference between experimental and competitive environments has been highlighted by Jackson and Baker (2001) who adopted a case study approach to exploring PPRs focusing on an individual elite rugby goal kicker. Jackson and Baker reported that the participant’s concentration times (time from the end of physical preparation to the point when the run-up was initiated) tended to be shorter for kicks taken in the competitive environment when compared to the controlled experimental environment. The results also indicated significant differences in the mean physical preparation time (time from removal of hand from the ball to the end of physical preparation time) between the experimental conditions and the competitive conditions. The fact that both the concentration time and physical preparation times were different suggests that the preparation strategies could also be different.

Visual perception could differ between research and real environments (Bruce, Green & Georgeson, 1996). The various forms of energy flowing through the environment such as light rays, sound waves, and neural activation over space and time are used by the performer to support the goal-
directed actions (Williams, Davids, & Williams, 1999). Thus, changes in the nature of the environment could directly influence the behaviour of the performer.

The effective replication of the competitive environment is key to maximizing the ecological validity of pre-performance behaviour research. Simulators are used increasingly in different domains for training and research (Diechmann, 2000). Environmental simulators have been used extensively to facilitate training and real experiences in a number of professions including the medical professions (Gaba, Howard, Fish, Smith & Sowb, 2001); engineering (Kamath, 2005); the military (Childs, 1997); the aviation industry (Lee, 2005); to simulate on-road vehicle driving conditions (Schultheis & Mourant, 2001) and in cycling (Plumert, Kearney, & Cremer, 2004). Paull et al. (1997) also suggested that the use of full-sized images of actual dimensions is necessary to the virtual research paradigm.

In the last few years, real play computer-based simulators have proliferated in golf. These simulators offer golfers the opportunity to play a realistic simulated golf course of their choice, using their own clubs and golf balls. Golf simulators such as the one marketed by SmartGolf UK appear to have a number of distinct advantages over other methods of observing golf performance outside of competition. First, they visually recreate an accurate view of the shot facing the player on the course. Thus the task demands are similar to those in a real competition. Second, players are able to play with their own clubs, consistent with the real environment. Third, due to the nature of the simulator, participants are required to undertake similar thought processes as in real competition situations e.g. club selection, round construction, competition against other players. All of these reinforce the ecological validity of the psychological and task-related factors impacting on the players, making the routines and behaviours observed as realistic as possible within the simulated environment.

The purpose of this study was to ascertain whether significant differences existed between the behavioural pre-performance routines utilised by golfers when comparing three different environmental conditions – the full-swing golf simulator, real competitive environment (on the golf course), and a practice condition (putting green). Based upon the suggested differences between real and artificial performance environments it was hypothesized that there would be significant differences between the routines within subject when comparing the competitive and practice environments, and between the simulated and practice environments, but not between the competitive and simulated environments.
Method

PARTICIPANTS

The participants in this study were six elite male golfers (mean age = 22.5yrs, s = 3.3 years; mean handicap = +1, s = 1; mean years playing = 8.63, s = 5.21). These golfers were recruited through personal contact, and were required to play golf in three distinct environments.

Golf simulator. The simulated environmental condition was created using a full swing golf simulator marketed and supplied by Smart Golf Europe [TM]. This type of simulator allows the golfer to execute a full swing and to hit the ball at a screen that displays a projected picture of a golf course hole including the tee, fairway, hazards, and green with a pin and flag. The participants had no experience of playing in a full-swing simulator prior to participation in this study.

The simulator itself is housed in a box with a 3.05m x 3.66m screen at one end and an overall depth of 5.49m. As the player strikes the ball it passes across the simulator’s dual tracking system, which scans more than two million infrared beams per second. The launch conditions (ball speed, launch angle, and spin) are measured and then used to predict its trajectory and range (carry and roll) (see Figure 1). Once the data are processed a virtual ball is created in the virtual screen environment with these calculated characteristics. The shot then continues in the virtual environment until its conclusion. Travel of the original ball is halted on contact with the free hanging screen, which absorbs the impact. The simulator also provides different texture surfaces for the player to attempt their shot depending on the surface on the course. The range of surfaces includes the fairway, green, rough, long grass and sand. All of these features are available to both left and right-handed players.

Fig. 1. Plan layout of the simulator including infrared sensors and playing surfaces.
Procedure. Previous studies of pre-performance routines in golf have focused on measuring the frequency, duration, and consistency of the participants’ behaviours prior to, during, and after, ball strike (Crews & Boutcher, 1986; Boutcher & Zin esser, 1990; Douglas & Fox, 2002). Previous studies have adopted this approach due to the highlighted importance of monitoring behaviour in understanding underlying processes impacting upon performance. A similar robust approach to measuring pre-performance behaviour was adopted for this study. First, the duration of the PPRs was recorded. This was identified as the period of time between the player grounding the club behind the ball for the first time, and the time that the ball was struck. Then, during the same period of time all discrete behavioural actions (glances at the hole / target, changes in foot position, swaying, limb movement, practice swings, raising the club) were recorded. These were classified into four distinct behavioural categories — ‘head’, ‘posture’, ‘club’, or ‘still’, all of which has further behaviour classifications as shown in Table 1.

A Sony DCR TRV950 digital video camera, with a digital zoom of 150x, a maximum shutter speed 1/10000s, 3.6mm – 43.2mm zoom lens, 246,000 pixel display format, and a IEEE 1394 Firewire / i.LINK connection was used to record each participant’s PPRs for each shot in each of the three environmental conditions. This facilitated analysis of both the temporal and behavioural components of the routines using Dart Trainer ProSuite behaviour analysis software.

A sampling rate of 50 video fields per second allowed a precision of ± 0.02s. The dart trainer software allowed a frame-by-frame analysis of the routines with a frame-counter and marker option to identify the start and finish of the routines and behavioural components of the routines. The mean temporal duration of each behavioural component was then calculated and used as the basis for analysis.

The participants were required to tee-off in three different conditions: practice (driving range), in a simulated environment (golf simulator) and during competition (on the golf course). Each subject completed 30 shots with their driver of varying difficulty on the local Open Golf driving range. Participants were further required to play four rounds on a golf simulator (SmartGolf) using a simulation of the Brabazon course at the Belfry (Birmingham, UK).

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Behaviour</th>
<th>Description</th>
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<tbody>
<tr>
<td>Head</td>
<td>Glance</td>
<td>Initiated by head movement towards the target. When the focus returns to the ball and the head is stationary.</td>
</tr>
<tr>
<td>Posture</td>
<td>Postural</td>
<td>Any movement of the lower body whilst the feet remain fixed. E.g. knee bend.</td>
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<td></td>
<td>Adjustment</td>
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<tr>
<td></td>
<td>Stepping</td>
<td>Change in foot position.</td>
</tr>
<tr>
<td>Club</td>
<td>Raised</td>
<td>Initiated when the club is raised off the ground behind the ball. Ended when the club is re-grounded behind the ball.</td>
</tr>
<tr>
<td></td>
<td>Practice</td>
<td>Initiated when the club is drawn back from the ball. Ended when the club returns to its start position behind the ball.</td>
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<tr>
<td></td>
<td>Swing</td>
<td></td>
</tr>
<tr>
<td>Still</td>
<td>No Movement</td>
<td>The time between when the player becomes still (no movement) and when ball strike is initiated.</td>
</tr>
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Finally, participants played four rounds on a local links course under matchplay conditions. In both the simulated and competition environments only the shots using the driver were selected for analysis. All three conditions involved the participants playing in pairs in an attempt to standardize the competitive requirements of the task. On the driving range participants were randomly assigned targets, which offered different distance, direction and topographic requirements for each shot played. In the golf simulator the next shot was determined by the following tee-shot, allowing for changes in the direction and topography for the subsequent tee-shot. Finally, in the competitive condition, the next shots specific requirements were determined by the demands of the next hole.

Data Analysis. An initial one-way between groups analysis of variance (ANOVA) was conducted to compare the overall duration of the PPRs across the environment types within participant.

A further one-way, within-participant multivariate analysis of variance (MANOVA) was conducted to investigate whether any significant differences existed in the temporal characteristics of the behavioural categories within the routines and across the three experimental conditions for the four dependent variables: ‘head’, ‘club’, ‘posture’ and ‘still’. The independent variable was the environmental condition (course, practice and simulator). Preliminary assumption testing was conducted to check for normality, linearity, univariate and multivariate outliers, homogeneity of variance-covariance matrices, and multicollinearity. There were no serious violations of these criteria. If significant differences were identified (p<.05) follow-up univariate t-tests were to be conducted.

Results

All six participants were very consistent within shot. Behaviourally each participant was engaged in the same things in the same order prior to ball strike within environment type.

The mean and standard deviation data in Table II. indicate differences in the overall mean duration of the routines and behavioural responses utilised by each of the participants across each of the experimental conditions.

However, when these differences were tested statistically (Table 3.), no significant differences were identified (participant one $F_{3,144} = .74, P = 0.66$; participant two $F_{3,144} = 1.52, P = 0.16$; participant three $F_{3,144} = 1.54, P = 0.16$; participant four $F_{3,144} = 0.74, P = 0.66$; participant five $F_{3,144} = 0.88, P = 0.54$; participant six $F_{3,144} = 1.72, P = 0.10$) for any of the six participants between the three environmental conditions of competition, practice and the golf simulator.

Discussion

The participants in this study had very consistent pre-performance behaviours across all three environmental conditions. Across the three conditions the participants exhibited the same behaviours in the same order prior to shot execution.
Despite the consistency in pre-performance behaviours and their sequencing, the overall durations of the behaviours differed. The overall duration of the pre-performance behavioural routines for all participants was greater in the competition condition than in the simulated and practice conditions. One factor contributing to the slight increase in the overall routine time for the competition condition could be the increased number of variables which need to be taken into account when playing in the real environment than in the golf simulator. In the simulator condition, the wind, rain, temperature and dampness of the course are all controlled thereby reducing the number of variables to be considered prior to executing the correct performance response for that particular situation. As a result, this reduction in variables needing attention can reduce the decision making time required. Indeed, a similar response was reported by Jackson and Baker (2001) when comparing concentration times for rugby kicking performance in practice and competition conditions. In the practice condition, due to the constant nature of the environment participants would have ‘stored’ the relevant environmental information then merely modified this stored information to play other similar shots in the same environment.

<table>
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<th>Posture</th>
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m – mean / s – standard deviation / % - duration of the behaviour as a percentage of the routine overall duration. SIM – Simulator.
The data in this study suggested that the behavioural characteristics of the routines and their relative duration were not significantly different across the three conditions. This outcome was predicted for the simulated condition but not for the practice condition where it was hypothesized that there would be significant differences in the composition of the routines due to environmental differences between that condition and playing in the ‘real’ environment. A possible reason for the practice condition not demonstrating significant differences from the real condition could have been the way the practice task was structured. The current study was designed to make the practice condition as close to the real environment regarding task constraints (competition, random variation, manipulation of task difficulty). This may have resulted in good ecological validity of this condition.

A word of caution must be offered when considering these results. Due to the small sample size the power of the study may not be as high as possible. In this study the alpha level was set conservatively at the 0.05% level. Also, the reported effect sizes ranged between 0.11 and 0.87. Future research should replicate this design with an increased number of participants to see if the results of this study are replicated.

The findings of this study do offer support to the suggestion by Davids (1988) and Paull et al. (1997) that the use of new technologies and simulated environments can be used as a potential alternative to the researcher while still maximising representative design. Paull, et al. (1997), reported the video-based simulation system used in their research appeared to overcome many of the representative design difficulties previously encountered in applied

<table>
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sports research. At a lower technology level, these findings also support the use of relevant controlled practice conditions (Lintern et al., 1989) if the realism of the task demands can be established.

The future use of environmental simulation systems in golf behaviour research could offer the researcher the opportunity to maximize the fidelity and therefore ecological validity of their experimental designs whilst further allowing them to control for a significant level of variables impacting upon the participants’ behaviours, allowing the researcher to understand more fully the behaviours of elite sports performers.

Conclusion

In an ideal world, golf performance research would occur in the real environment. However, because this is often not practical or possible both simulation and practice environments appear to offer ecologically valid alternatives. The key here appears to be the researcher’s ability to replicate the task requirements, demands, difficulty and variability (Davids, 1988). The potential use of computer-simulated environments offers an encouraging research environment due to its controllable nature and ability to satisfy Paul et al. (1997), crucial requirement of any simulated system using full-sized images and actual distances, to ensuring that perceptual cues from eye kinesthesis are consistent with features of the display.

The psychological fidelity of both practice and simulated environments however may require further attention. Participants do not appear to demonstrate significantly different behavioural characteristics across environment types, but this does not mean that they are utilising the same strategies of psychological skills across the different conditions. As a result, future research could explore in greater detail the role of each of the discrete components of the routines between conditions to ascertain whether the underlying psychological strategies are similar between the behavioural components. Future research could also seek to explore whether these lack of differences for experts across different environments is also replicated for novice performers, juniors and female golfers, or whether these results are specific to highly skilled male performers.

REFERENCES


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A new method to learn to start in speed skating: A differencial learning approach

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4 Department of Sport Sciences, University of Mainz, Mainz, Germany

The aim of this study was to examine whether it is possible to utilize the fluctuations in human motor behaviour to induce a self-organizing process in the athlete, which takes advantage of individual movement and learning characteristics. This recently developed approach is known as differencial learning and is compared to traditional learning. For that purpose, thirty-four recreational skaters participated and practised the speed skating start. A pre-post-test design was used together with a one week intervention period that included three practice sessions of one hour each. The pre- and post-test consisted out of 5 starts, and for each start, the finish time was recorded at a distance of 49 m, which included split time registrations at 5 m, 10 m, and 25 m. Based on the finish time in the pre-test, the participants were equally distributed over three practice groups: a differencial learning, learning by instruction, and control group. Analyses revealed a significant improvement for the differencial learning group in comparison to the control group. It is concluded that differencial learning is an effective method to teach the skating start to novices.

KEY WORDS: Differential learning, Traditional learning.

Introduction

For numerous skills, it has been shown that many repetitions are needed in order to achieve perfection. For instance, the classic Crossman learning
study (1959) of cigar-making indicated that even after 1 million repetitions of this skill, improvement was still possible, that is, a quicker time could be achieved. The common idea of learning is to repeat a particular movement as much as possible, accompanied with feedback from an expert. The desired outcome is based on an ideal movement pattern.

The Russian neuroscientist Bernstein (1967) noted that consecutive movements never repeat themselves exactly. He made cyclograms of rhythmic movements of an experienced smith who used his hammer on a stationary photographic plate. Bernstein discovered that every movement repetition was slightly different from the next. In other words, even in a relatively simple task such as hammering, the movements produced were never exactly the same (Bernstein, 1967). In sport, most tasks are complex with coaches and athletes repeating the desired movements a number of times in practice in order to improve the performance outcome. Ericsson (2005) described this as follows: “The crucial factor leading to continued improvement and attainment of expert performance is the engagement in special practice activities that allow performers to improve specific aspects of their performance with problem solving and through repetitions with feedback” (Ericsson, 2005, p 237). Underlying this definition is the assumption that there is an ideal way of performing a skill that applies to everybody. Second, any deviation from the required ideal performance is considered as an error (Schöllhorn et al., 2006).

Inspired by Bernstein’s hammering example, Schöllhorn investigated whether elite athletes could produce precisely the same movement twice. He studied two elite discus throwers and concluded that during a one-year period, the athletes did not produce the same throw twice (Schöllhorn, 2000), revealing highly individual characteristics of movement (Schöllhorn & Bauer, 1998; Schöllhorn, Nigg, Stefanyshyn, & Liu, 2002). For instance, Schöllhorn and Bauer (1998) were able to identify individual throwing patterns in world class javelin throwers, even across several years of championship experience. Evidence for a larger variability of international throwing patterns in comparison to national throwing techniques led him to question the idea of a person-independent ideal technique. In the study of Schöllhorn et al. (2002), 13 female participants could be identified (and separated) on the basis of biomechanical data during a single ground contact point within a gait cycle, even with differing heel heights of up to 5.4 cm. Most interesting was the fact that the best (100%) recognition rate was achieved in extreme conditions with an 8.1 cm heel height. Therefore, it is not logical to believe in one optimal motor pattern to which all learners should aspire. Based on these
findings, Schöllhorn (1999) suggested a learning theory that opposes the repetition of movement based on an ideal movement pattern: differential learning. Differential learning utilizes the fluctuations in human motor behaviour to induce a self-organising process to the learner that takes advantage of individual movement and learning characteristics. Therefore, during the acquisition phase, the learner is confronted with a variety of exercises that extend the whole range of possible solutions for a specific task. In other words, an athlete should practice a particular skill in many different ways, and as a result, s/he will discover an individually specific optimal way for her/him to perform the particular skill. Because differential learning is also associated with no repetition of an exercise, it is also claimed that a more adequate adaptation to constantly changing conditions will be achieved. One theoretical explanation for why differential learning would work is based on the dynamical systems theory. In this theory, fluctuations are considered as necessary for functional adaptation to changing environmental contexts and, the prevention of loss of system complexity as constraints change (Schöner & Kelso, 1988). Fluctuations can also be considered as noise in a system. Counterintuitively, this noise can enhance performance due to a phenomenon called stochastic resonance. In this phenomenon, the addition of noise can make a weak signal detectable (Moss et al., 2004). Through the addition of noise, in this case movement fluctuations during the learning process of a movement, one can detect the ideal movement or solution better, by adapting faster to the new situations in a more adequate way. Stochastic resonance has two important qualities: the signal cannot enhance itself, and secondly, the signal cannot spontaneously arise from the noise. Furthermore, there is an ideal level of added noise to the signal. Too much, or too little noise results in a weaker enhancement of the signal. In humans, it has been shown that interactions between noise and signal can improve sensori-motor integration and stochastic resonance effects. This has been reported in human studies of memory retrieval, perception, neuronal activity, and the peripheral nervous system (Cordo et al., 1996; Collins, Imhoff & Grigg, 1996; Nozaki et al., 1999; Wenning & Obermayer, 2003). By adding noise to a certain target movement, it can be assumed that a broader area of a potential space of solutions will be covered. Due to the assumption that no movement will be repeated twice (Bernstein 1967), it can be followed that in future situations, the probability to provide a known area of solutions for the athlete is higher which will result in faster and more adequate reactions in these new situations. The constructive influence of noise was also found in robot research by Miglino, Lund, and Nolfi (1995). When a robot is moving in a noisy (changing) environment during its training phase, the robot will work harder in the
application phase (post training), as well as in totally different environments. However, a robot that has been trained in a constant environment will subsequently fail in an altered environment. Artificial neural nets that are derived from biological neurons act in a similar way (Hertz, Krogh & Palmer, 1987).

In the current study, differencial learning was compared to traditional learning in the acquisition of a new task: the speed skating start. The official rule of the speed skating start is as follows: one has to stand still, and every variation in posture is allowed. The variation in posture provides opportunities for the application of differencial learning. Second, speed skating research carried out by De Koning et al. (1992) indicated that the acceleration in the first second of a speed skating race correlates highly ($r = -0.75$) with the eventual 500 m time. For this reason, it seems obvious and beneficial to improve the start in order to achieve a fast final time.

In the current study, the effectiveness of the differencial learning method is compared with the traditional learning method (learning by instruction), which are both applied to the skating start. The start was measured in time over 5, 10, 25 and 49 meters (m). It was hypothesized that the 5 m and 49 m times would correlate significantly, as predicted by the findings of De Koning et al. (1992). It was expected that the differencial group would show more progress than the traditional and control groups.

**Methods**

**Participants**

In this experiment, 34 adult (28-60 years, mean $44.2 \pm 9.8$) recreational male skaters, all of whom skated the 100 m no faster than 13 seconds (s), participated. All participants signed a written inform consent form before the start of the study. The institutional ethical committee approved the study.

**Apparatus**

The recording of performance took place on a 400 m ice rink. A track of 49 m long and 2 m wide was created on one of the straight sections of the ice rink. Five photoelectric reflex switches (Omron E3s-R1E4 & Sick WL 18-2P430) were placed on this ice track; one at the start line, and one each at the 5 m, 10 m, 25 m, and 49 m distances (Figure 1). The photoelectric reflex switches were attached to a SCXI1100 32 channel differential multiplex from National Instruments. From the SCXI1100, the signal went to a module (National Instruments) that was connected to a laptop. The data acquisition took place in LabVIEW.
**PROCEDURE**

The task was to skate the 49 m as fast as possible, from a stand still position (the start). A pre-post-test design was used, with an intervention of three training sessions, each being one hour in length. Four days before the pre-test, all participants took part in an introductory lesson which lasted one hour on the ice track. This was done in order to explain the procedure, as well as familiarise them with the required ‘motion’ of the start, that is, to stand still. No explicit rules were given about the transition from the point of standing still to the point of starting to skate.

In the pre-test, participants were instructed to skate the 49 m trial a total of 5 times within a one hour period, as fast as they could from a standing start. The time was recorded at 5 m, 10 m, 25 m, and 49 m. After the 49 m trial, the participants completed a 400 m lap, at a slow pace, in order to prevent them from standing still in the cold and to minimize the chance of an injury.

Based on the pre-test results, participants were randomly divided into one of three groups: the differental learning, the traditional learning, and the control group. All groups received the intervention of three sessions of practice in one week, each being one hour in length. Prior to each lesson, they participated in a 15 minute general warm-up session which was carried out next to the ice track. The lessons on the ice track consisted of a 10 minute specific warm up, followed by 50 minutes of practice.

The differental learning group began every start in a different posture. In appendix 1, the different postural positions are presented for each start and practice session. The participants did not receive any feedback about their performance. After the start, participants completed a 400 m lap at a slow pace, which resulted in 14 practice trials per session.

Because of its similarities to some traditional learning approaches, that is, variability of practice (Schmidt, 1975) and contextual interference approach (Magill & Hall, 1990), it is
worth noting that the changes of posture during the start can be associated with massive variations of the invariants ‘relative forces’ and ‘relative timing’ during the acceleration phase, which should have been kept constant in accordance with the variability of practice approach. The variability of practice approach recommends (at least for simple laboratory tasks) keeping the invariants constant while varying the variable parameters (Schmidt, 1975). According to the contextual interference approach (Magill & Hall, 1990), blocked, serial, and random order practice are distinguished. In the majority of the reported experiments, the order of practice is related to a discrete number of at least two or three different tasks that vary in their invariants or, in their variable parameters (Wulf & Shea, 2002). However, in differential learning, the random application of increased fluctuations (stochastic perturbations) is not only related to the order, but also to practice content. Here the variations were provided to induce some level of noise to help learners to explore different movement solutions.

The traditional group (learning by instruction) was taught to assume the postural start position that is described as the most ideal in the handbook of skating (Gemser & van Ingen Schenau, 1987). In appendix 2, the instructions given to the participants are presented with this group receiving feedback on their starting posture. The control group skated a total of three times in one week and participated in regular practise sessions. This group, however, did not practise the start. The post-test consisted of five trials, three days after the final practice session.

DEPENDENT VARIABLES AND STATISTICAL ANALYSIS

As dependent variables total skating time was split up into a finish time, as well as split times. The finish time was defined as the total time recorded between the start and the distance of 49 m. The split times were defined as the time recorded between the start and the 5, 10, and 25 m distances. The progress time was defined as the time difference between pre- and post-test for each distance separately (i.e. 4 progress times).

The correlations between the 5 m and the 49 m times were calculated and compared with the reported findings of De Koning et al. (1992). For skating time, a 3(group: differential vs. traditional vs. control) by 4(distance: 5 m vs. 10 m vs. 25 m vs. 49 m) by 2(test: pre vs. post) ANOVA with repeated measures on the last two factors was carried out. A 3(group: differential vs. traditional vs. control) by 4(distance: 5 m vs. 10 m vs. 25 m vs. 49 m) ANOVA with repeated measures on the last factor was carried out for progress time.

Results

From the 34 participants, 27 were included in the analysis. From the seven dropouts, five were ill or injured during the post-test. One of the dropouts admitted that he practiced a total of 16 times per week while being part of the control group. The final dropout was considered an outlier as he improved more than 2 x SD in comparison to the rest of the group.

The findings are reported in Table I and II The correlation between the 5 m and 49 m times are high, as well as significant for all three of the groups
for both tests, which is in agreement with the findings reported by De Kon-
ing et al. (1992).

In Table II, the results of the pre- and post-test per group are presented for the skating times. The ANOVA revealed main effects for distance (F(3, 24)= 38.81, p<0.01), and for test (F(1, 24)= 20.22, p<0.01). Significant interactions were found for distance by test (F(3, 72)= 14.87, p<0.01) as well as group by distance by test (F(6, 144)= 2.612, p=0.024). Within group subjects contrast shows that the last interaction is caused by differences between the groups for 25 m and 49 m distance. In Table 2, it can be seen that up until 25 m, minimal differences between the three groups existed. However, at 49 m, the differential group had a significantly faster skating time at the post-test in comparison to both other groups.

In Table III, the findings per group for progress time are presented with the ANOVA revealing a significant interaction for distance by group (F(6, 144)= 2.612, p=0.024). The contrast analyses showed that the distance by group effect was caused by a difference between the groups between 25 m and 49 m. The control group did not progress over the final part of the track,
in contrast to the differencial learning and traditional learning groups, who both improved over the final part of the track.

Discussion

The aim of the experiment was to compare two learning methods: the effectiveness of the differencial learning in comparison with learning by instruction (traditional group). For that purpose, we examined the ice skating start for two reasons: First, the start in the 500 m ice skating is not defined, except for the fact that one has to stand still, which leaves room for testing a number of types of variations in posture. Second, de Koning et al. (1992) showed that the acceleration in the first second of skating correlated highly with the final skating time at 500 m. Therefore, it was assumed that improving the start time would be beneficial to the skater. Our findings are in agreement with the results of de Koning et al. (2002) since a high correlation \( r > 0.8 \) was found between the first 1-2 seconds, and the final time of the race over 49 meters.

With respect to differencial learning, the interaction effect group by test by distance revealed that significant differences between the differencial learning, traditional learning, and control group arose between 25 m and 49 m. The effect is caused by the difference between the two learning groups and the control group. The first 10m was skated at a similar, fast speed by all participants of the three groups. The video recordings of the start showed that the control group could make the transition from standing still, to a sort of running-like technique, in an identical manner to both experimental

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<td>Differencial</td>
<td>0.09</td>
</tr>
<tr>
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<td>Traditional</td>
<td>0.07</td>
</tr>
<tr>
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<td>Control</td>
<td>0.10</td>
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<tr>
<td>10 m</td>
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<td>0.12</td>
</tr>
<tr>
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<td>0.07</td>
</tr>
<tr>
<td></td>
<td>Control</td>
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<tr>
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</tr>
<tr>
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<td>0.15</td>
</tr>
<tr>
<td></td>
<td>Control</td>
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</tr>
<tr>
<td>49 m</td>
<td>Differencial</td>
<td>0.32*</td>
</tr>
<tr>
<td></td>
<td>Traditional</td>
<td>0.24*</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>0.12*</td>
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groups. As a consequence of the control participants being able to apply this transition technique, the differences were very small in the initial 10 m. However, for the first few strokes of a speed skating start, a running-like technique is useful, but after these first few strokes, a gliding technique is more effective (De Koning, Thomas, Berger, de Groot, & van Ingen Schenau, 1995). De Koning and co-workers (1995) concluded from their research with elite level skaters that the transition between these two techniques has to take place at 4 m/s for men, and 3.7 m/s for women. After this point, the maximal push off velocity is lower than the skating velocity and therefore, a gliding technique has to be used to achieve a higher maximal velocity. In other words, the maximal velocity that can be reached with a running-like technique is lower than the maximal velocity reached with the gliding technique.

In the current experiment, the differencial group was trained to start from all kinds of positions, which forced them to find optimal acceleration from a much larger variety of body positions. This helped them to adapt to the practice circumstances and, as a consequence, they probably made this transition more easily. In contrast, the control group did not receive specific start training and did not make this transition. This observation would explain why the control participants were slower over the final part of the track in comparison to the other groups. At these speeds, the running-like technique is less energy efficient which may cause the phosphocreatine supply to run out at a faster rate (Wilmore & Costill, 1994), making it difficult to keep up the speed with this technique. This suggestion could explain the poor performance of the control group between 25 and 49 m.

There were no significant differences between the traditional and differencial groups, a quite remarkable finding since the differencial group did not receive any specific feedback or exercises. In fact, they were asked to obtain starting postures that, according to traditional methods, were completely incorrect. In contrast, the traditional group was given instructions on the proper technique and received feedback on performance. One would expect that this group would show the most improvement in performance, which was not the case (Table 3). In fact, the differencial learning group showed the most improvement in performance, which was quite impressive considering the small amount of practice undertaken: about 14-16 starts per session and thus, between 55-60 starts in total. This observation is in line with previous reported findings where traditional learning is compared with differencial learning. For instance for tasks such as shot put (Beckmann & Schöllhorn, 2003), hurdle sprint training, and soccer (Schöllhorn et al., 2006) a significant advantage is reported for the differencial learning in comparison to traditional learning group.
How can we explain these findings? As Bernstein (1967) has already pointed out, two consecutive movements never repeat themselves exactly. Differential learning seems to exploit this capacity and utilizes the fluctuations in human motor behaviour to induce a self-organising process in the learner that takes advantage of individual movement and learning characteristics. As a consequence, the learner is confronted with a variety of exercises in the acquisition phase and, will find out what is the most optimal way for her/him to perform the particular skill through exploration. This way of learning has a huge effect on the performance of skating, which is to skate faster.

A model for the explanation of this phenomenon is provided by artificial neural nets (ANN) (Haykin, 1994; Horak, 1992) and robot-like machines (Miglino et al., 1995). When a robot or ANN is trained in a fixed environment, it will have very limited areas of application in the subsequent test phase. When the robot or ANN is confronted with a continuously changing environment, it will be able to move in most environments, with which it is confronted during the subsequent testing phase. Similarly, once an ANN is trained in a narrow area, it will only reveal satisfying results when the stimuli that are offered in the test phase are very similar to the previously presented ones. This characteristic is assigned to the ability of interpolation, which the ANN are relatively successful at. ANN’s are much less successful in extrapolating towards an area that is outside the trained area. By training an ANN or robot, a lattice-like structure of neurons is formed (Bishop, 1995). The training of the ANNs by repetition of very similar data will lead to a very fine-grained mesh size only in a certain area of the net. This outcome is associated with an oversampling in the specific area, and an under-sampling just outside this area. Only if the mesh size, as well as the area is optimal, will the net be able to succeed in the subsequent test and application phase. The latter phase usually implies a test with data that have not been given to the net during the training phase (Schöllhorn, 2004). By giving the skaters the possibility to start from different starting positions, they were trained in a much bigger area, which allows them to interpolate in a broader spectrum.

In conclusion, the findings suggest that differential learning is an effective method to learn the skating start as a novice. Future research should investigate whether the same holds true for experts and, whether a longer training period results in a greater distinction in performance between the two groups. In addition, from a perception-action coupling perspective (e.g. Caljouw, van der Kamp & Savelsbergh, 2004; Van der Kamp, Bennett, Savelsbergh & Davids, 1999), it would be very interesting to examine which type of information the differential learners couple their movement behaviour to (Savelsbergh & Van der Kamp, 2000).
Appendix 1

Starting positions for the differential learning group.

Lesson 1:
The skates parallel to the left with hips to the front.
Three point start.
With two hands on the ice with the skates in a V-shape.
The skates parallel to the right with hands and arms moved backwards.
The skates leaning on the outside with the right arm in front.
The arms beside the body and make a jump before the start.
The skates in a V-shape with the arms in front.
The left skate in front and look downwards.
All the weight on the hind leg with the hips to the back.
The hips to the back with one step to the right before the start.
Make a 180° turn before the start.

Lesson 2:
Approach skating on the left leg.
Straight knees with the skates leaning on the inside.
The hips to the front and back straight up.
Weight on the front leg and look to the end of the track.
Step to the left before the start.
The right leg in front with right arm in front.
Skates parallel to the track with upper body horizontal.
The right hand on the ice.
Make very small steps.
Put your skates as perpendicular to the track as possible while performing running action.
Make an initial large step.
Regarding arm movement, only make use of the forearms.
Do not move the arms.
First step parallel to the track.

Lesson 3:
Knees bent and weight in the centre.
Take big steps.
Left foot in front with right arm behind.
Make wide steps.
Make narrow steps.
Take the first step very small.
Skates parallel to the left with hips to the front.
The left hand on the ice with right foot behind.
The right foot and left arm in front.
The skates parallel to the right with knees bent deep.
Both arms in the air.
Tap one skate with the other before the start.
Perform a pirouette before the start.
Touch a skate with one hand before the start.
Feet close together.

Appendix 2

Starting position for the traditional learning group.
(Deduced from 'Het handboek wedstrijdschaatsen (Handbook Ice skating), by H. Gemser and G.J. van Ingen Schenau')

Hind skate at a 60° angle to the track.
Bend knees.
Weight in the middle.
The hips to the front.
Make little movements with the arms.
Make small steps in the beginning.
REFERENCES


