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ORIGINAL RESEARCH

Increased Carry Distance and X-Factor Stretch in Golf Through an External Focus of Attention

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We examined the effects of attentional focus instructions on the learning of movement form and carry distance in low-skilled golfers. The X-factor describes the rotation of the shoulders relative to the pelvis, and its increase during the downswing (so-called X-factor stretch) is associated with the carry distance of the ball. X-factor stretch and carry distance have been shown to be associated with an early weight shift toward the front leg during the downswing. In our study, one group (internal focus, IF) was instructed to focus on shifting their weight to their left foot while hitting the ball, whereas another group (external focus, EF) was instructed to focus on pushing against the left side of the ground. A control (C) group was not given attentional focus instructions. Participants performed 100 practice trials. Learning was assessed after a 3-day interval in a retention test without focus instructions. The EF group demonstrated a greater carry distance, X-factor stretch, and higher maximum angular velocities of the pelvis, shoulder, and wrist than both the IF and C groups, which showed very similar performances. These findings demonstrate that both movement outcome and form can be enhanced in complex skill learning by providing the learner with an appropriate external focus instruction. Moreover, they show that a single external focus cue can be sufficient to elicit an effective whole-body coordination pattern.

Keywords**:** motor learning, instructions, coordination, efficiency

For more than a decade, studies have consistently demonstrated that instructions or feedback that induce an external focus by directing performers' attention to the effects of their movements (i.e., external focus), rather than their body movements (i.e., internal focus), result in more effective motor performance and learning (for reviews, see Lohse, Wulf, & Lewthwaite, 2012; Wulf, 2007, 2012; Wulf & Lewthwaite, 2010). In the first demonstration of this effect, the learning of dynamic balance tasks was enhanced when participants' attention was directed to the movements of the platform on which they were standing (specifically, wheels on a ski simulator platform or markers on a balance platform) as compared with the movements of their feet (Wulf, Höß, & Prinz, 1998). The external focus instructions produced more effective learning, as measured by delayed retention tests without focus instructions or reminders, than both the internal focus group or a control group which received no instructions regarding attentional focus. Since then, numerous researchers have replicated the benefits of an external focus. For example, studies have demonstrated performance or learning advantages of an external focus for sport skills, including hitting golf balls (e.g., Bell & Hardy 2009; Wulf, Lauterbach, & Toole, 1999; Wulf & Su 2007), basketball free-throw shooting (Al-Abood, Bennett, Hernandez, Ashford, & Davids, 2002; Zachry, Wulf, Mercer, & Bezodis, 2005), dart throwing (Marchant, Clough, & Crawshaw, 2007), long jump (Porter, Ostrowski, Nolan, & Wu, 2010), swimming (Freudenheim, Wulf, Madureira, Corrêa, & Corrêa, 2010), and volleyball serves and soccer kicks (Wulf, McConnel, Gärtner, & Schwarz, 2002). Overall, the benefits of an external compared with an internal focus have been shown not only for a variety of different skills, but also different levels of expertise (e.g., Wulf & Su, 2007), age groups (e.g., Chiviacowsky, Wulf, & Ávila, 2012; Chiviacowsky, Wulf, & Wally, 2010), as well as healthy individuals and those with motor impairments (e.g., Wulf, Landers, Lewthwaite, & Töllner, 2009) or stroke (Fasoli, Trombly, Tickle-Degnen, & Verfaellie, 2002).

The differential effects of internal versus external foci have been explained with the constrained action hypothesis (Wulf, McNevin, & Shea, 2001), according to which an internal focus on the body causes individuals to control their movements at a more conscious level. As a consequence, individuals tend to constrain their motor system by interfering with automatic control mechanisms that have the capacity to control movements effectively and efficiently. A focus on the movement effect, on the other hand, promotes a more automatic mode of control. Several converging lines of research support the notion that an external focus facilitates the utilization of unconscious, fast, and reflexive control processes. These include demonstrations of reduced attentional capacity demands (Wulf, McNevin, & Shea, 2001), high-frequency, reflex-

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based movement adjustments (e.g., McNevin, Shea, & Wulf, 2003; Wulf, Shea, & Park, 2001), reduced premovement times, representing more efficient motor planning (Lohse, Sherwood, & Healy, 2012), and reduced electromyographic (EMG) activity indicating greater movement efficiency (e.g., Lohse, Sherwood, & Healy, 2010).

Despite the ubiquity of the external focus benefits, an interesting question is whether, and how, a performer's *coordination pattern* might change as a function of instructions that induce an external versus internal focus. This issue pertains particularly to complex skills with numerous degrees of freedom that involve whole-body movements, such as a golf swing. The efficacy of a golf swing depends on many variables, including the correct weight transfer, sequencing of movements, swing plane, impact point, and others. Would a single external "swing thought" be able to enhance the effectiveness of the coordination pattern and result in an improved movement outcome (e.g., carry distance) relative to a similar but internal swing thought? The present study sought to address this question by examining movement kinematics as a function of different attentional focus instructions.

The issue of complex motor skill learning as a function of instructions seemed pertinent from both practical and theoretical perspectives. The predominance of instructions referring to body movements in practical settings (Porter, Wu, & Partridge, 2010) maybe partly related to teaching and coaching traditions, but presumably it is also based on assumptions that the coordination of body movements requires references to the movements of the respective body parts. While some coaches may have intuitively figured out instructional strategies that "work," such as the use of external cues, experimental evidence that a simple external focus instruction can affect both movement kinematics and outcome appears to be lacking. Previous studies examining attentional focus effects have predominantly used outcome measures, such as movement accuracy in throwing, kicking, or hitting an object (e.g., Bell & Hardy, 2009; Wulf et al., 2002; Zarghami, Saemi, & Fathi, 2012), stability on balance tasks (e.g., Jackson & Holmes, 2011), movement speed (e.g., Porter, Nolan, Ostrowski, & Wulf, 2010) or accuracy in force production tasks (e.g., Lohse, Sherwood, & Healy, 2011) as well as maximum force production (e.g., Marchant, Greig, & Scott, 2008). Other studies have looked at differences as a function of attentional focus at the neuromuscular level, including EMG activity and motor unit recruitment patterns in tasks involving force production (e.g., bicep curls; Vance, Wulf, Töllner, McNevin, & Mercer, 2004) or dart throwing (Lohse et al., 2010). Only a few studies have used kinematic measures to examine potential differences resulting from instructions that induced either an external or internal focus (Lohse, Sherwood, & Healy, 2010; Makaruk, Porter, Czaplicki, Sadowski, & Sacewicz, 2012; Parr & Button, 2009). In one study, using a rowing task, Parr and Button found that a group that was provided external focus instructions (i.e., related to the oar blade) outperformed another group that was given internal focus instructions (i.e., related to the performer's movements) in various kinematic measures (e.g., time from apex of reach to immersion of the blade) after a six-week training period. However, the kinematic measures used in that study were derived from the oar trajectories, and not from the performer's body movements. In addition, Parr and Button had a list of 11 possible instructional statements for each of the external and internal focus groups that the coaches used during 24 training sessions. The frequency and timing of the instructions given in each group was not reported. Furthermore, in addition to the attentional focus, participants' visual focus differed between conditions.

Given the limitations and gaps in previous research—in particular the dearth of kinematic analyses in studies on attentional focus—we wanted to examine possible changes in body mechanics in the performance of a complex motor skill (i.e., golf swing). One factor that is related to the carry distance of the golf ball is the so-called X-factor (Cheetham, Martin, Mottram, & St. Laurent, 2001). This term was first introduced by McLean (1992). The X-factor is a popular term for the rotation of the shoulders relative to the pelvis during the golf swing. The larger X-factor angle at the top of the backswing seems to be critical for generating a high club head speed (McTeique et al., 1994). Healy et al. (2011) demonstrated that golfers with a greater hitting distance (using a 5 iron) had larger X-factors than those with shorter carry distances. The proximal-to-distal acceleration pattern of body segments seen in skilled golfers (Tinmark, Hellström, Halvorsen, & Thorstensson, 2010) is similar to other skills in which the maximum acceleration of an object is the goal (e.g., javelin throwing, shot put, baseball pitching). What seems to be even more important than the X-factor at the top of the backswing, however, is the degree to which the X-factor increases or "stretches" during the first part of the downswing, the so-called "X-factor stretch" (Cheetham et al., 2001). A greater X-factor angle early in the downswing is indicative of the pelvis turning earlier toward the target than the torso (Cheetham et al., 2001; Hellström, 2009; Hume, Keogh, & Reid, 2005). The X-factor stretch is more pronounced in highly-skilled golfers than in less skilled golfers (Cheetham et al., 2001; Hellström, 2009; Hume, Keogh, & Reid, 2005). A greater X-factor stretch is assumed to make use of the principle of the summation of forces as well as the stretch-shorten cycle. The greater stretch of the trunk muscles presumably allows them to create higher forces. As a consequence, greater torque is applied to the club before impact and the carry distance of the ball is increased.

In the current study, we measured the X-factor stretch as well as the carry distance of the ball, and angular velocities of the pelvis, shoulder, and wrist during the downswing as a function of training with an internal or external focus instruction. Each group was given only one instructional cue, which referred to the weight shift during the downswing. An early weight transfer to the lead foot is associated with a greater X-factor stretch, and therefore ultimately plays a key role in increasing the carry distance (e.g., Hume et al., 2005; Okuda, Gribble, & Amstrong, 2010). In the external focus condition, the instruction directed the learners' attention to the force exerted against the ground, whereas in the internal focus condition attention was directed at the lead foot. Learning was assessed three days later in a retention test without instructions or reminders. Based on previous findings showing greater movement effectiveness and efficiency with an external relative to an internal focus or no instructed focus (control conditions), we hypothesized that the external focus instructions would lead to enhanced learning of the movement pattern, as evidenced by a greater X-factor stretch, carry distance, and maximum angular velocities of the pelvis, shoulder, and wrist on the retention test.

Method

Participants

Twenty-four low-skilled golfers (all males), with an average age of 27.3 years (*SD*: 2.05 years), participated in this experiment. All participants had completed a 1-semester golf class at a South Korean university (2 hr per week over 15 weeks). They were all right-handed. The study was approved by the university's institutional review board, and all participants gave their informed consent.

Apparatus and Task

The experiment was conducted in a laboratory. Participants were asked to hit golf balls off a golf mat (25 × 63 cm) with a 7-iron, using a full swing, into a net. The dome-shaped net was located 4 m in front of the participant. A Flightscope 3D Doppler tracking golf radar (EDH, Inc., Orlando, FL, USA) was used to measure the carry distance of the ball. It tracks the ball for the entire trajectory in 3D (elevation angles, horizontal angles, and velocity) until it lands. Accuracy of the carry distance is typically within 2–4 yards at 250 yards, and within 1–2 yards at 150 yards (see: http://www.flightscope.com/index.php/FlightScope-Radar/flightscope-kudu.html). To measure body coordination patterns, including the X-factor stretch, kinematic data were obtained using a motion capture analysis system (Qualisys OQUS500; Gothenburg, Sweden) with 8 infrared cameras. The sampling frequency was 200 Hz. The experimental set-up is illustrated in Figure 1.

Procedure

Participants were asked to hit the ball as far as possible, aiming at the swing net. All participants wore form-fitting athletic (spandex) clothing so that reflective markers could be attached to the relevant landmarks, and to minimize movements of the markers relative to those landmarks during the hitting motion. Nine reflective markers were attached: to the thigh (2: left and right greater trochanter), shoulder (2: left and right acromion), left elbow (1: lateral epicondyle), left wrist (1: between ulna and radial styloid processes), and club shaft (3 rings of marker tape: 65 cm, 45 cm, and 28 cm from the base). Before the beginning

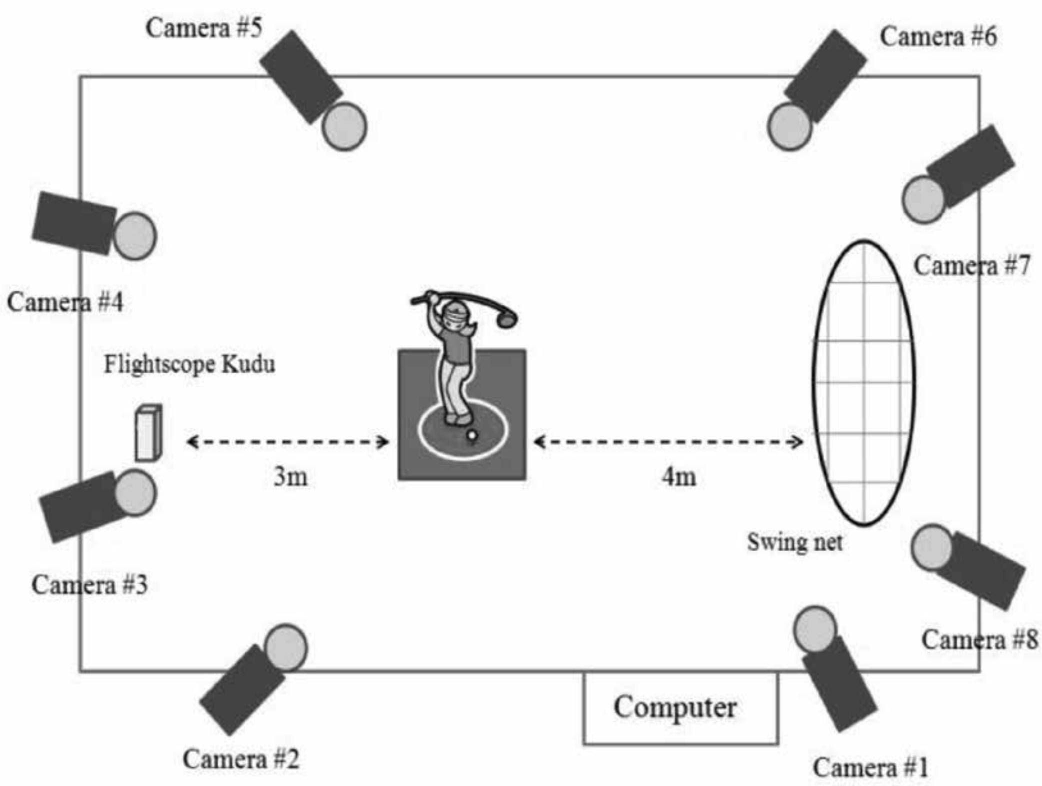

Figure 1 — Experimental set-up.

of data collection, the experimenter described and demonstrated to the participant the basic technique of a golf swing. All participants received the same instructions regarding grip, stance, alignment, and posture. They were allowed to warm up and practice until they felt comfortable with the task. Participants were randomly assigned to one of three groups, with eight participants each: The internal focus (IF), external focus (EF), and control (C) groups. Before the beginning of the practice phase, all participants completed a pretest, consisting of 10 trials (without attentional focus instructions). After the pretest, attentional focus instructions were given. The instructions were directed at the transition movement during the downswing. Specifically, IF group participants were instructed to "transfer your weight to your left foot as you hit the ball," whereas EF group participants received the instruction to "push against the left side of the ground as you hit the ball." Participants in the control condition were not given attentional focus instructions. They were simply reminded to hit the ball as far as possible. The practice phase consisted of 100 practice trials. Between blocks of 25 trials, participants were given a break of approximately four minutes. Before each trial of the practice phase, the experimenter reminded the IF and EF group participants to maintain their respective focus. As a manipulation check, IF and EF group participants were asked after each trial to what extent they adhered to the instructed attention focus. Specifically, they were asked to indicate (in percentage points) to what degree they used the respective focus on the previous trial. Three days after practice, participants performed a retention test consisting of 10 trials. No instructions or reminders were given on that day.

Dependent Variables and Data Analysis

The 10 pretest trials, the last 10 trials of each of the four practice blocks, and the 10 retention test were captured by the Flightscope and motion analysis systems so that an equal number of trials was available for comparison. For the data analysis, the five trials with the longest carry distance in each of the captured sets of 10 trials (i.e., pretest, practice trials, retention test) were selected for further analysis, as some trials were mishits and the ball could not be sensed by the Flightscope. For each set of five trials, the carry distance, X-factor stretch during the downswing, and maximum angular velocities of the pelvis, shoulder, and wrist were determined. Carry distance was calculated by the Flightscope system. For the kinematic analyses, the swing was divided into two phases, defined by three events. The first event (E1; top of the backswing) was defined as the frame where the left wrist marker was at the highest point from the ground (in the global z-direction). The second event (E2; midpoint of the downswing) was determined as the frame in which the line between the markers of right greater trochanter and the top marker (tape) on the club shaft was parallel to the ground. The third event (E3; end of downswing) was determined as the frame in which the bottom marker on the club shaft was at the lowest point from the ground. All kinematic data were smoothed using a second-order, bidirectional, low-pass Butterworth filter with the cut-off frequency set at 6 Hz, which was selected based on a residual analysis (Winter, 2005). Maximum angular velocities of the pelvis, shoulder, and wrist were then computed. For this purpose, pelvis orientation was defined as the angle between the line connecting the two hip markers at address (i.e., just before takeaway) and during the downswing motion. Shoulder orientation was defined as the angle between the line connecting the two shoulder markers at address and during the downswing. The wrist angle was defined by the markers on the left elbow, left wrist, and the marker on top of the shaft of the golf club (65 cm from its base). Angular velocities were calculated by derivation of the changing angles as a function of time. The maximum pelvis and shoulder angular velocity were measured during the phase from E1 to E2. The maximum wrist angular velocity was measured during the phase from E1 to E3. Finally, the X-factor stretch was calculated by subtracting the X-factor at the top backswing (E1) from the maximum X-factor value during the downswing (E1-E2). All kinematic and temporal parameters were calculated using Visual 3D version 3.90 beta and version 3.99 (C-Motion, Inc., Rockville, MD, USA).

Carry distance, X-factor stretch, and maximum angular velocities for pelvis, shoulder, and wrist were averaged for the five trials with the longest carry distance on the pretest, practice blocks, and retention test. The pretest results were used as a covariate in all analyses of the practice and retention data. The practice data were analyzed in 3 (group: EF, IF, C) × 4 (block) analyses of covariance (ANCOVAs) with pretest performance as the covariate. The retention results were analyzed in one-way ANCOVAs with the pretest score as the covariate. Bonferroni adjustments were made for all post hoc tests.

Results

Manipulation Check

Participants in the EF and IF groups indicated that they used the instructed attentional foci to a relatively large degree. Specifically, on the last 10 trials of each of the four practice blocks, which were included in the analyses of the performance data, EF group participants reported the following average percentages: 81.6 (Block1), 81.1 (Block 2), 81.8 (Block 3), and 82.6 (Block 4), with an average of 81.8% (*SD*: 5.4). The numbers were similar for IF group participants: 79.6 (Block1), 80.4 (Block 2), 83.6 (Block 3), and 82.3 (Block 4), with an average of 81.5% (*SD*: 6.5).

Carry Distance

Practice. Carry distances can be seen in Figure 2. The EF group generally outperformed the two other groups. The Group main effect was significant, $F(1, 20) = 3.76$, $p < .05$, $\eta^2 = .27$. Post hoc tests indicated that the EF group hit the ball farther than the C group, $p < .05$. None of the other group differences were significant, ps > .05. Due to only a small distance increase in the IF group and no increase in the C group, the main effect of block was not significant, $F(3, 60) < 1$. In addition, the interaction of group and block was not significant, $F(3, 60) = 1.35$, $p > .05$.

Retention. On the retention test 3 days later, the EF group (114 m) demonstrated clearly greater carry distances than both the IF (83 m) and C groups (78 m). The group main effect was significant, with $F(2, 20) = 10.03$, $p < .001$, $\eta^2 = .50$. Post hoc test confirmed that the EF group differed significantly from both other groups ($ps < .05$), which performed similarly.

X-Factor Stretch

Practice. The X-factor stretch is shown in Figure 3. Similarly to carry distance, the only group that showed an improvement across practice blocks was the EF group. This group had an average X-factor stretch of 3.7 degrees

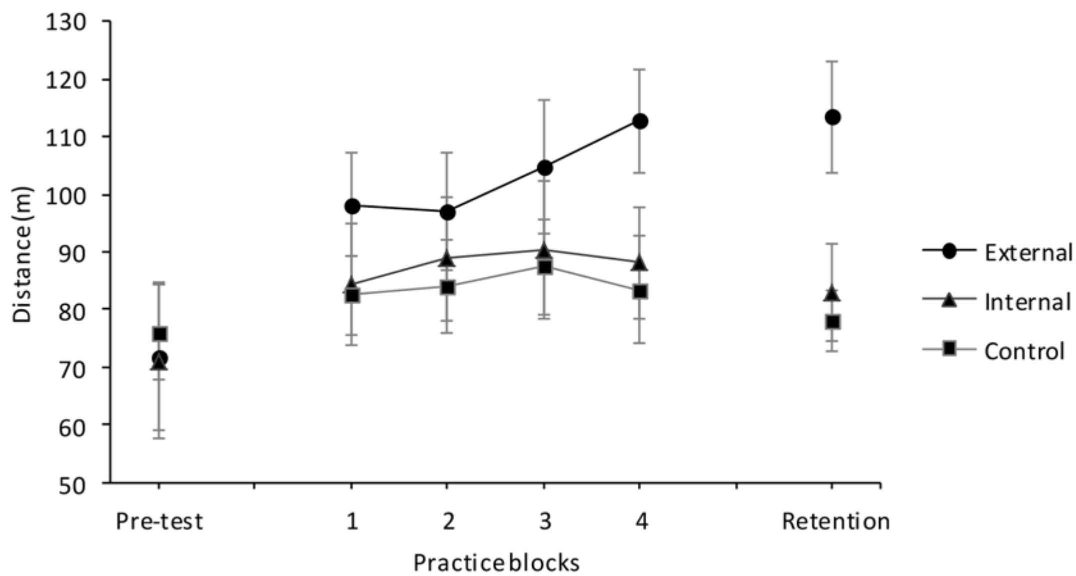

Figure 2 — Carry distance for the external focus (EF), internal focus (IF), and control (C) groups on the pretest, during practice, and on the retention test. Error bars represent standard errors.

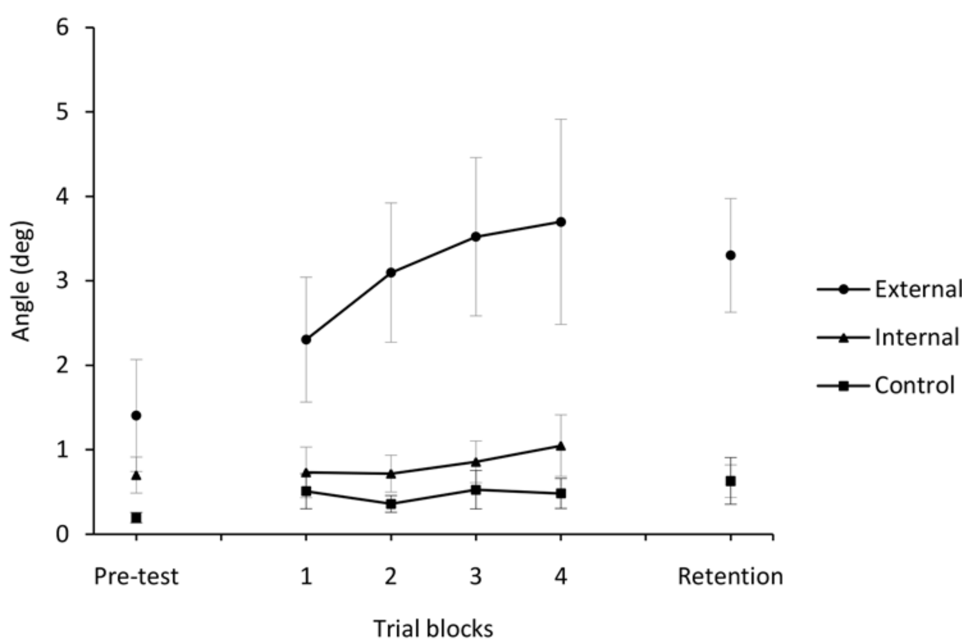

Figure 3 — X-factor stretch for the external focus (EF), internal focus (IF), and control (C) groups on the pretest, during practice, and on the retention test. Error bars represent standard errors.

on the last block, whereas those of the IF and C group remained below 1 degree for most of the practice phase. The main effect of group was significant, $F(2, 20) = 9.37$, $p < .001$, $\eta^2 = .48$. Post hoc test indicated that the EF group differed from both the IF and C groups (ps < .05), which did not differ from each other. The main effect of block and the interaction of group and block were not significant, Fs(3, 60) < 1.

Retention. The EF group had a larger X-factor stretch (3.3 degrees) than the IF and C groups (both 0.63 degrees) on the retention test. The main effect of group was significant, $F(2, 20) = 10.82$, $p < .001$, $\eta^2 = .52$. The superiority of the EF group compared with both other groups was confirmed by post hoc tests (ps < .001).

Maximum Angular Velocities

Practice. Pelvis velocities tended to increase across practice blocks (see Figure 4a), but the main effect of block only reached borderline significance, $F(3, 60) = 2.58$, $p = .062$. The main effect of group, $F(2, 20) = 2.38$, $p > .05$, and the interaction of group and block, $F(6, 60) = 1.10$, $p > .05$, were not significant.

In contrast to the IF and C groups, the EF group increased their shoulder maximum angular velocities across practice (see Figure 4b). The interaction of group and block, $F(6, 60) = 2.37$, $p < .05$, $\eta^2 = .19$, as well as the main effect of block, $F(3, 60) = 4.41$, $p < .01$, $\eta^2 = .18$, were significant. The main effect of group just failed to reach significance, $F(2, 20) = 2.99$, $p = .073$.

Maximum angular velocity of the wrist can be seen in Figure 4c. Neither the main effects of group, $F(2, 20) < 1$, or block, $F(3, 60) < 1$, nor their interaction, $F(6, 60) < 1$, were significant.

Retention. The EF group had clearly higher maximum angular velocities of the pelvis than the IF and C groups in retention. The Group main effect was significant, with $F(2, 20) = 9.48$, $p < .001$, $\eta^2 = .49$. Post hoc test confirmed the difference between the EF and both other groups (ps < .01), which did not differ from each other.

The EF group also outperformed the IF and C groups in terms of shoulder angular velocity. The main effect of group was significant, $F(2, 20) = 12.43$, $p < .001$, $\eta^2 = .55$. The superiority of the EF group was confirmed by post hoc comparisons (ps < .01). There was no difference between the latter two groups.

Finally, the EF group demonstrated higher maximum velocities of the wrist than the IF and C groups, $F(2, 20) = 3.64$, $p < .05$, $\eta^2 = .27$. Post hoc tests indicated that the difference between the EF and C groups was significant ($p < .05$), whereas the difference between the EF and IF groups was marginally significant ($p = .056$). There was no difference between the IF and C groups ($p > .05$).

Discussion

The present findings demonstrate that a single external focus instruction can be sufficient to elicit a more advanced coordination pattern and result in a more effective movement outcome than a comparable instruction that directs attention internally or no specific focus instruction. Directing learners' attention to the force exerted against the ground (EF), as opposed to the force exerted by their foot (IF) or no instructions (C), led to a greater X-factor stretch, higher maximum velocities of the pelvis, shoulder, and wrist, and consequently a greater carry distance of the ball. While the enhanced movement outcome resulting from the external focus replicates the findings of many other studies (for a review, see Wulf, 2012), to our knowledge a change in body movement kinematics as a function of one external cue (or "swing thought") has not been reported before. This finding demonstrates that, to shape the performer's coordination pattern, one does not necessarily have to refer to body movements.

In line with other studies (e.g., Marchant, Clough, Crawshaw, & Levy, 2009; Porter, Nolan, Ostrowski, & Wulf, 2010), participants reported a relatively high degree of adherence to the focus instructions. In addition, this degree was similar in both the IF and EF groups (about 80%). Thus, even though learners may not use (or may not think they used) the instructed attentional focus 100% of the time, the instructions are usually sufficient to create differences in performance or learning, as seen in the current study as well as many previous studies.

Wulf and Lewthwaite (2010) recently argued that any mention of body part appears to act as a "self-invoking trigger" that activates self-regulatory processes (e.g., Carver & Scheier, 1978). A focus on the self has been shown to tax the performer's attentional capacity through the use of more conscious control processes, and to be associated with more widespread and inefficient muscular activation (e.g., Gray, 2004; Pijpers, Oudejans, & Bakker, 2005; Slobounov, Yukelson, & O'Brien, 1997). Several studies have demonstrated increases in EMG activity in agonist as well as antagonist muscle groups (e.g., Lohse, Sherwood, & Healy, 2012; Marchant et al., 2008; Vance et al., 2004) with an internal as compared with an external focus. In addition, motor unit recruitment has been shown to be optimized when the performer adopts an external focus (Lohse, Sherwood, & Healy, 2012), which can result in greater movement efficiency and reduced fatigue (Marchant, Greig, Bullough, & Hitchen, 2011) or increased maximum force production, even with decreased EMG activity (e.g., Wulf, Dufek, Lozano, & Pettigrew, 2010). The superfluous and counterproductive muscular activity typically seen when the attentional focus is directed at the self (i.e., internally) may have prevented the IF (and perhaps the C) group participants in the current study from showing clear increases in the X-factor stretch and velocities of the pelvis, shoulder, and wrist motions. In contrast, if the focus is on the movement effect, such as the force exerted against the ground (EF group), the motor system seems to have the capacity to optimize the coordination within and among muscles to achieve that effect—in essence resulting in movement patterns representative of a more advanced skill level than those achieved with an internal focus (see Wulf, 2007). Indeed, an increase in X-factor stretch and carry distance

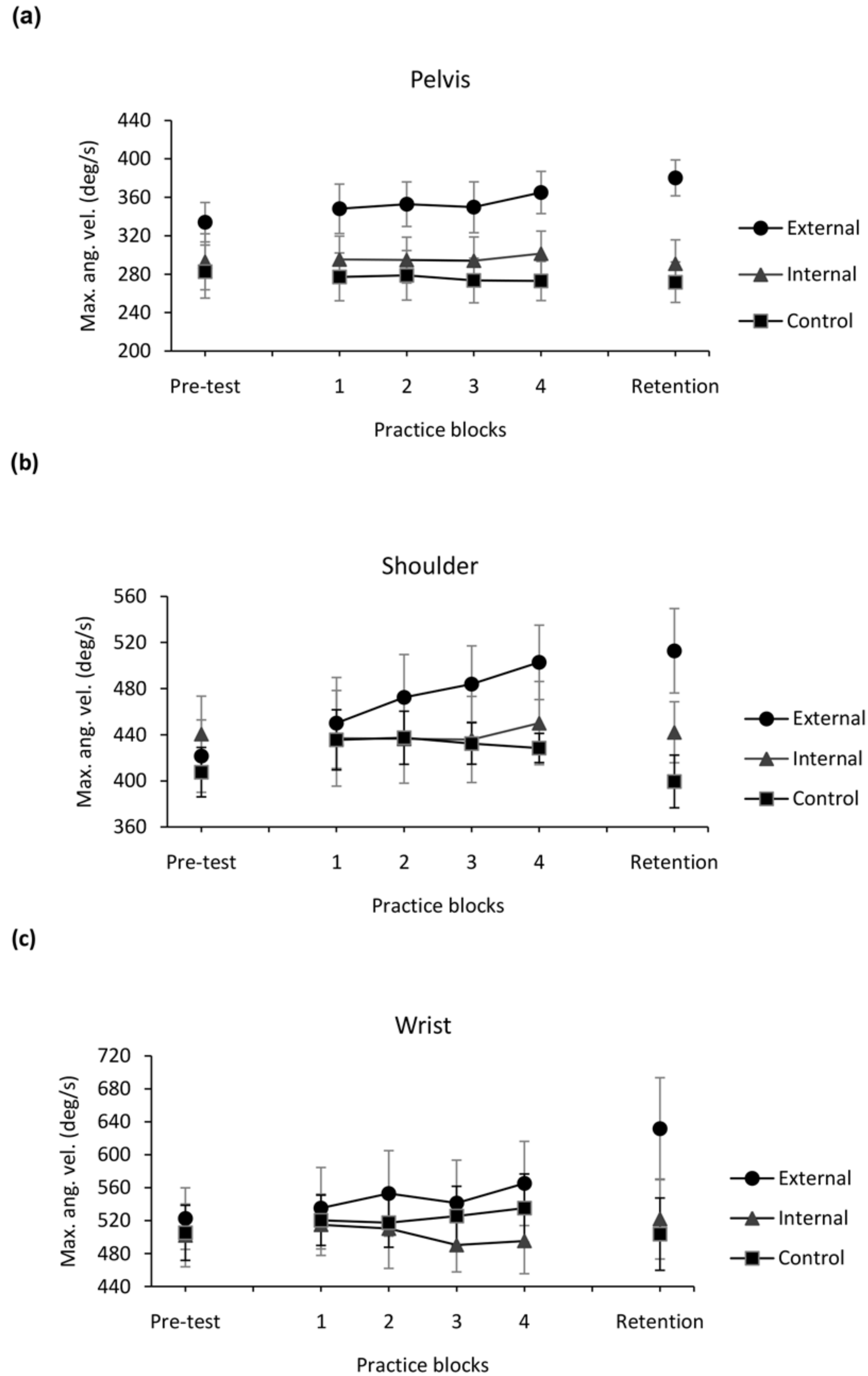

Figure 4 — Maximum angular velocity of the pelvis (a), shoulder (b), and wrist (c) for the external focus (EF), internal focus (IF), and control (C) groups on the pretest, during practice, and on the retention test. Error bars represent standard errors.

are characteristics associated with a higher skill level in golf (both factors were highly correlated on the retention test in the current study: $r = .68$, $p < .001$.) Thus, the motor system seems to be able to generate effective and efficient coordination patterns—provided the performer's focus is on the desired movement effect—rather than his or her own movements.

The IF and C groups showed very similar performances with regard to all dependent measures. In other words, the internal focus instructions were no more effective than no instructions. This finding is also in line with many previous studies that included control conditions (e.g., Freudenheim et al., 2010; Marchant et al., 2008; Wulf et al., 1998, Experiment 1; Wulf, Weigelt, Poulter, & McNevin, 2003, Experiment 2). It has been argued that, in the absence of external focus instructions, participants may spontaneously focus on their movements, resulting in the almost identical performances typically seen under internal focus and control conditions (Wulf, 2007). While this may be the case (Stoate & Wulf, 2011; but see the findings of Porter, Nolan, Ostrowski, & Wulf, 2010), it is interesting to note that, in the current study, the IF group participants received instructions and reminders that could have provided them with an advantage over the C group participants (see also Wulf et al., 1998, Experiment 1). Even though the weight shift from the right side (backswing) to the left side (forward swing, follow-through) was mentioned in the general instructions given to all groups, it was clearly emphasized more in the IF condition through initial focus instructions and frequent reminders. Yet, this arguably helpful information did not translate into enhanced movement form or outcome—presumably because any informational advantages were thwarted by the drawbacks in terms of motor coordination associated with an internal focus.

Creative teachers, coaches, physical therapists, and researchers will be able to come up with effective instructions that do not direct performers' attention to their body movements—or invoke the self—and instead direct attention to the desired effect. As the present results demonstrate, simple attentional focus instructions cannot only affect the movement outcome but also movement kinematics or form. Importantly, the enhanced form resulting from the external focus instructions (X-factor stretch) also improved the movement outcome (e.g., carry distance).

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