

The Effects of Avoiding Instructions Under Pressure: An Examination of the Volleyball Serving Task

by

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Wegner predicts that under pressure self-avoiding instructions not to perform in a certain manner will break down precisely where it is least desired that is the hypothesis of the present study. Specifically, the aim was to test the hypothesis that when instructed not to serve into a certain zone, ironic error would be more prevalent under pressure. Our sample comprised 43 female participants between the age of 13 and 16 ($M_{age} = 14.51$, $SD = 1.35$) who were active volleyball players ($M_{training\ years} = 5.40$, $SD = 2.38$). We measured the participants' psychophysiological indications of anxiety via the heart rate, heart rate variability as well as the self-reported Mental Readiness Form-3. To measure performance, we counted the number of target and non-target serving zones under different anxiety conditions. Participants scored +5 points for serving into the target zone, scored -5 points for serving to the out or hitting the net and 1 point for serving into the court except the target zone. A 2 (anxiety) \times 3 (serving zone) fully repeated measures ANOVA revealed a significant anxiety \times serving zone interaction $F(2, 84) = 36.52$, $p < .001$. When instructed not to serve in a certain zone, players' overall performance did not change across anxiety conditions $t(42) = .68$, $p = .50$. Results did not provide support for the Wegner's theory as expected, but instead revealed evidence for the Woodman et al.'s (2015) differentiation of ironic performance error. The results demonstrate that the theory of ironic processes may account for practical instruction-based solution for reducing the susceptibility to ironic errors in the serving type of task in volleyball.

Key words: performance, anxiety, ironic error, mental control.

Introduction

Competitive volleyball requires excellent fitness and mental focus for optimal performance. For an optimal level of performance, athletes at all levels (e.g., olympic, collegiate, high school, club teams and youth sports) experience certain amount of pressure. Research has shown that even skilled performers can struggle under pressure (Beilock, 2010). This can be even worse for volleyball players' who experience a lot of pressure during the season (Storch et al., 2005). It is not surprising that the influence that pressure exerts on performance continues to be a major area of interest for many researchers (Lautenbach et al., 2016; Moore et al., 2015; Woodman and Hardy, 2003). There have been various theories to explain the manner in which excessive pressure can act to break down performance. Despite

extensive research devoted to determining the nature of the pressure (e.g., anxiety, stress) and performance relationship via several different theories such as conscious processing hypothesis (Baumeister, 1984; Masters, 1992), attentional control theory (Eysenck et al., 2007), and catastrophe models (Hardy, 1990; Hardy et al., 2004, 2007), there has been little systematic examination of the mechanisms underlying this relationship in a precise manner which can be better explained by the Wegner's (1989-2009) theory of ironic processes of mental control.

Wegner's (1994) theory of the ironic process of mental control explains the "tendency to feel, act, and think in ways that are opposite to the intended direction of emotion, behaviour, and cognition" (Janelle, 1999). Specifically, foundational to Wegner's (1994) theory is the idea

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that when the brain seeks to make the body perform in a particular desirable way, it requires two processes in order to work effectively and achieve the desired state. First, an intentional *operating process* carries out effortful regulation by consciously searching for, and directing the person toward, mental contents that will yield an intended emotional state or the preferred outcome. Active engagement in this mentally demanding search increases the likelihood that regulation will be maintained and the desired state will be reached. Second, an ironic *monitoring process* subconsciously searches for signals of failure to achieve the desired state; the monitoring process is unconscious, autonomous, and less demanding of mental effort. If this subconscious *monitor* identifies any such failures, then it reactivates the intentional *operating process*, which aims to bring about the regulation by filling the mind with mental contents that are relevant to the desired state. Under normal circumstances, both processes work within one control system and operate together as part of a feedback loop that provides effective mental control for an individual (Wegner, 1994). "In other words, one does what one intends to do and one does not do what one does not intend to do" (Woodman et al., 2015).

However, under certain conditions where there is a competition for resources within our limited attentional capacity, for example if anxiety increases and burdens our conscious attention with worrisome thoughts, there will be a limited cognitive space for the effortful operating process to work effectively. Conversely, the functionality of the monitoring process remains mainly unaffected due to its subconscious and uninterrupted feature that yields a search for components related to the failure of the desired state of mind and therefore behaviour. Due to this diminishing effectiveness of the operating process, the monitoring process becomes relatively more prevalent with increasing pressure, namely anxiety, and mental control paradoxically starts working against itself by attending to those unwanted thoughts (Janelle, 1999), meaning problems arise primarily when the cognitive load, such as anxiety, increases (Wegner, 1994).

Empirical support for the ironic process theory has been found in a number of studies related to sport. In a seminal study, Wegner et al.

(1998) conducted the first ironic effects study in sport using a golf-putting task. In their experiment, participants were specifically asked not to hit the ball past the glow spot on a carpeted surface. The results showed that participants under a high-cognitive load (e.g., recollection of a six-digit number) hit the ball past the glow spot significantly more times than those in the non-cognitive load condition (Wegner et al., 1998) which provides support for the ironic processes of mental control theory. Dugdale and Eklund (2003) investigated the incidence of ironic effects in the well-learned wobble board balancing task for twenty seconds with and without a backwards counting secondary task. As hypothesized, the experienced dancers were less stable when given instructions to avoid wobbling as compared to dancers who were given instructions to maintain stability, and the cognitive load associated with the backwards counting made the ironic effect more pronounced.

However, the above-mentioned studies mainly focused on individual sports and they lack the generalizability of their results especially for team sports (e.g., volleyball). More recently, Woodman et al. (2015) found that under anxiety provoking (e.g., competition, financial incentives and social evaluation) conditions across two different studies — one in hockey penalty shooting and another one in dart throwing task — provide considerable support for the Wegner's (1994) theory of ironic processes of mental control. More specifically, Woodman et al. (2015) conceptualized an ironic error zone as the to-be-avoided zone and hockey players hit more shots into that zone under high-anxiety conditions compared with the low-anxiety conditions. Similarly, in the second study, novices were asked to perform a dart throwing task under low- and high-anxiety conditions and results provide support for the theory that participants threw more darts into the to-be-avoided side of the dart board called "ironic zone" under high-anxiety conditions compared with low-anxiety conditions (Woodman et al., 2015). Furthermore, Barlow et al. (2016) found that under pressurized penalty shooting task, soccer players who reported high in neuroticism suffered more from ironic errors compared with their more emotionally stable counterparts. Although sports related ironic effect studies are mostly conducted in laboratory

settings. Research shows both practical importance and theoretical interest to understand how ironic processes and avoidant instructions operate in highly automatized tasks (Malhotra et al., 2018) in sports such as dart-throwing, penalty shooting in soccer and hockey.

Contradictory to the ironic processes theory, De la Pena et al. (2008) revealed conflicting results by proposing an implicit overcompensation hypothesis. Evidence in support of implicit overcompensation hypothesis was found in golf players who were instructed not to putt short of the hole (e.g., do not undershoot or do not overshoot) overcompensated when cognitively loaded (e.g., visual, cognitive, auditory, or self-presentation) and putted significantly farther than under conditions of no cognitive load. Recently, Malhotra et al. (2018) found similar results in highly automatized skills in driving when drivers were given avoidant instructions (e.g., stay away from the centreline), results revealed overcompensatory behaviour and therefore participants drove further away from the centreline that is in line with De la Pena et al. (2008) implicit overcompensation hypothesis. However, De la Pena et al. (2008) stated that in their investigation the method of inducing mental load may have failed to tax the participants' cognitive resources sufficiently. Woodman et al. (2015) acknowledged that future investigations of ironic processes of mental control theory (Wegner, 1994) should continue to ensure that participants' cognitive resources are significantly taxed in an ecologically valid manner. Research to date that has demonstrated overcompensatory behaviour in response to avoidant instructions is limited (Beilock et al., 2001; De la Pena et al., 2008) with a few number of studies tested in this area of research.

Therefore, to increase scientific rigor, the aim of the current study was to examine the effects of avoidant instructions on a volleyball serving task under conditions of low- and high-anxiety. To date, there is no research that has examined the effects of avoidant instructions on volleyball serving under different pressurized conditions at any level of sports. In the current investigation, young female volleyball players were given a set of neutral instructions to maintain their serving performance under normal

training conditions and then a set of the combination of financial incentives and ego threatening instructions under high-anxiety conditions. Therefore, In line with Wegner's theory, we hypothesized that volleyball players would hit more balls into the ironic error zone when specifically asked not to under high-anxiety condition compared to the low-anxiety condition. We also hypothesized that participants would demonstrate no-change in their serves to the non-ironic zone across both anxiety conditions (low and high).

Methods

Participants

Forty-three female ($M_{age} = 14.51$, $SD = 1.35$) volleyball players ($M_{years\ of\ experience} = 5.40$, $SD = 2.38$) volunteered to participate in the current study. The inclusion criterion was to be an officially licenced volleyball player for at least 2 years of experience. We approached female volleyball players before their team training session and invited them to participate in the study. All participants reported being free from illness and injury at the time of the data collection. We obtained informed consent from all participants and from their coaches. An institutional ethical approval for the current study was granted by the local institution.

The GPower 3.1 (Faul et al., 2007) power calculation software indicated that by adopting an alpha of .05 and a sample size of 43 the experiment was powered at .80 to detect significant differences between conditions for effect sizes exceeding $f = .20$ (i.e., small-to-medium size effects) by repeated measures analysis of variance (Cohen, 1992). While there are limited previous data upon which to base these calculations, Woodman et al.'s (2015) test of ironic effects, adopting a similar design, revealed large within-subject effects ($\eta p^2's = .25$). Accordingly, if similar effects were to emerge here, the current study was more than adequately powered to detect them.

Measures

Anxiety

To measure psychophysiological indications of anxiety, the heart rate (HR) and heart rate variability (HRV) were recorded using a Polar V800 heart rate monitor. Previously, researchers used the HR and HRV as successful

indicators of individuals' psychophysiological reactions to anxiety (e.g., Cervantes et al., 2009; Janelle et al., 1999; Laborde et al., 2011; Mateo et al., 2012; Murray and Raedeke, 2008; Rainville et al., 2006). Recordings were subsequently imported into the PolarFlow and the Kubios HRV 2.2 software (Tarvainen et al., 2014). Specifically, we computed the heart rate (beats per minute) as well as the standard deviation of R-wave to R-wave intervals (SDNN) and root mean square of successive R-R intervals (r-MSSD), as two time-domain measures of heart rate variability. We chose these measures because the increased heart rate and decreased SDNN and r-MSSD have previously been associated with elevated pre-competitive anxiety (Barlow et al., 2016; Mateo et al., 2012; Murray and Raedeke, 2008).

Furthermore, Mental Readiness Form-3 (MRF-3; Krane, 1994) was used to measure cognitive anxiety, somatic anxiety and self-confidence. The MRF-3, which comprises three single-item factors, requires participants to express how they feel right now by placing a mark on three separate 10 cm visual-analogue scales. From left to right the scales are anchored: not worried – worried (cognitive anxiety); not tense – tense (somatic anxiety); and not confident – confident (self-confidence). Thus, high scores represent high cognitive anxiety, high somatic anxiety and high self-confidence (Woodman et al., 2015). The MRF-3 has been widely used in recent research (Barlow et al., 2016; Gorgulu et al., 2019; Woodman et al., 2015) to evaluate anxiety in competitive settings.

Performance

We measured performance using a volleyball serving task under different anxiety conditions. The task consisted of three serving areas on the volleyball court namely a target zone, a non-ironic and an ironic error zone. We measured the zones with a tapeline and marked out using disc cones. The target zone was the right back area (named zone 1) in a volleyball court and the size of the area was 3 x 1.5 m (Figure 1). Consequently, participants scored +5 points for serving into the target zone and scored minus 5 points for serving to the out (ironic error zone) or hitting the net and 1 point for serving into the court (non-ironic error zone). Participants performed the serving task individually based on the target and non-target zones.

Procedures

Upon entry to the indoor volleyball court, we first informed each participant about the procedures and described the scoring system for the serving task. Next, participants completed an informed consent and demographic information sheet (e.g., age, sex and years of experience in volleyball). Participants then wore a Polar H7 heart rate chest strap transmitter in order to obtain their heart rate variability before and during the experiment. Before the experiment began, participants were allowed to warm up as they usually do prior to training or competition.

Participants were given an instructional set as "Please try to serve to the target zone in order to get 5 points for each ball you hit, however, please be careful not to hit the net or the ball out as you will score minus five points for each ball you hit and finally any ball you hit within the serving area rather than the target zone you will get only one point for each attempt". The experimental procedure consisted of three trials followed by a five-minute rest interval between each trial. First, participants completed a familiarization trial as a warm up, comprising 5 balls. This allowed them to become more accustomed to the nature of the task and allowed the researchers to verify that participants understood the instructional set before the main experimental conditions under the low- and high-anxiety. Upon completion of the first trial (warm up) participants responded to the MRF-3 and then performed 10 serves under the low-anxiety conditions in the second trial. We followed the same procedure in the last trial with one exception that before completing the MRF-3, participants were informed that they were about to enter the competition by participating in this research and the highest scoring participant would receive a present from the research team immediately at the end of the experiment and the results will be announced as a part of ceremony in front of all team members. The aim was to manipulate anxiety using multiple ecologically valid performance stressors (i.e., competitive environment, financial incentive, and social evaluation) (Barlow et al., 2016; Bell and Hardy, 2009; Gorgulu et al., 2019; Woodman et al., 2015). Then they performed 10 serves under the high-anxiety condition. Each participant finalised the serving task individually. Additionally, they were

informed that their scores during the performance and all serves were observed as beyond controversy while entering one of the three distinct areas. Finally, we announced the scores to all participants at the end of the study.

Results

Anxiety Manipulation

Paired samples *t*-tests on the self-report MRF-3 and heart rate variability as an indication of anxiety confirmed the contradictory results for the anxiety manipulation check. Specifically, results obtained from the MRF-3 demonstrated an expected increase in participants' cognitive anxiety ($t_{42} = 2.07, p < .05$) and somatic anxiety ($t_{42} = 2.68, p < .001$) from low- to high-anxiety condition. However, participants' self-confidence did not change across anxiety conditions ($ts < 1, ps > .5$). According to our psychophysiological data, participants' heart rate was significantly increased ($t_{41} = 2.13, p < .05$), however, as there is a contradictory relationship between the heart rate and heart rate variability, SDNN and r-MSSD did not significantly change from the low- to the high-anxiety condition. The results for the anxiety manipulation are summarized in Table 1.

Performance

A 2 (anxiety: low, high) \times 3 (ironic error zone, target zone, non-ironic error zone) fully repeated measures ANOVA was employed to analyse performance. This yielded no significant main effect for anxiety $F(1, 42) = .01, p > .05$, a significant main effect for zone, $F(2, 84) = 16.43, p < .001$, and a significant anxiety \times zone interaction, $F(2, 84) = 36.52, p < .001$. The sphericity assumption was satisfied, $\chi^2(2) = 7.609, p = .022$. Bonferoni-corrected follow-up paired samples *t*-tests revealed that anxious scores for the individual serving zones did not change from low- to high-anxiety conditions ($ts < 1, ps > .5$). However, contrary to our expectations, although the error rates were similar in the target zone ($M = 2.38, SD = 1.37$) and the ironic error zone ($M = 2.50, SD = 1.54$) under both anxiety conditions, the error rates were unexpectedly different in the non-ironic error zone ($M = 5.07, SD = 1.90$) which provides support for the Woodman et al. (2015) categorization of the outcome that is a more specific differentiation between ironic error and non-ironic error (Table 2).

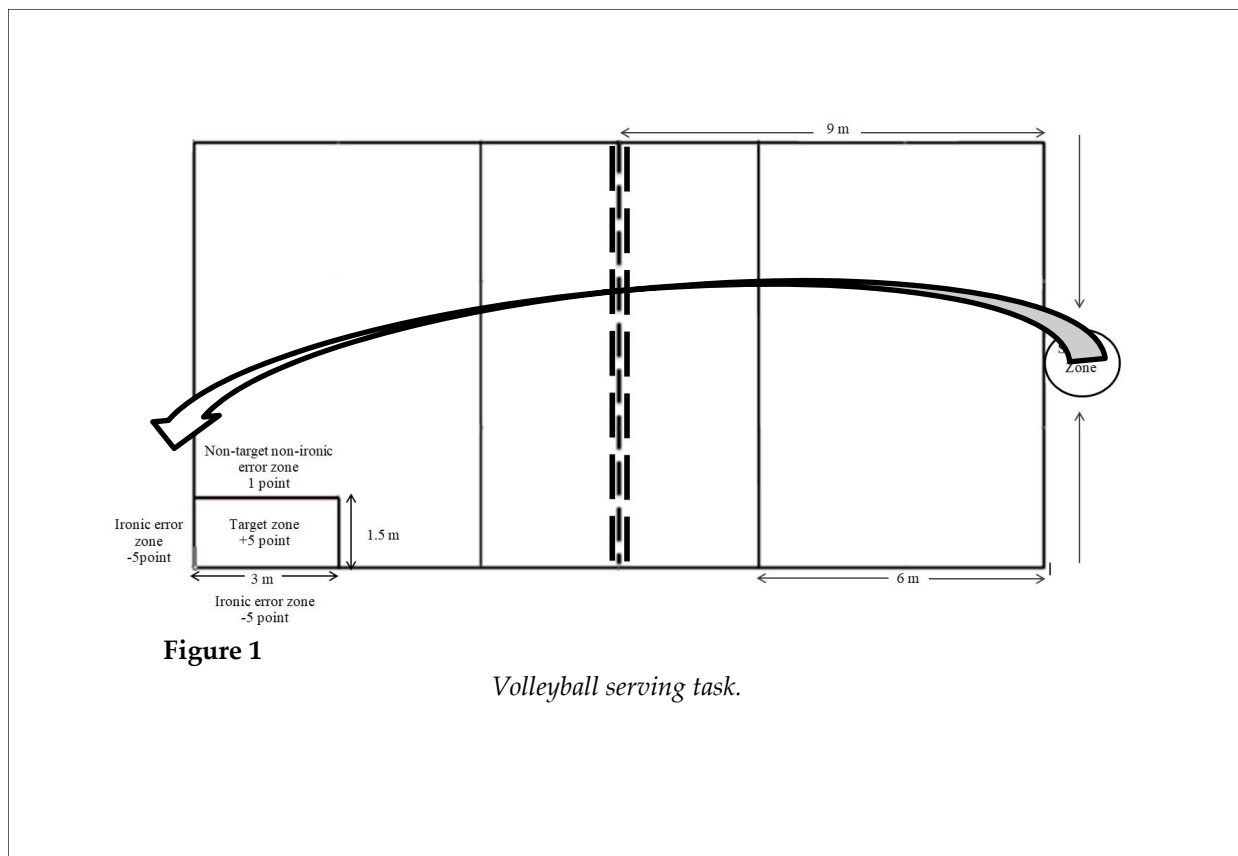


Figure 1

Volleyball serving task.

Table 1*Descriptive statistics of the anxiety manipulation and heart rate, heart rate variability.*

| Measure | Condition | | <i>t</i> (<i>df</i>) |
|-------------------|----------------|----------------|------------------------|
| | Low-Anxiety | High-Anxiety | |
| | Mean (SD) | Mean (SD) | |
| Cognitive Anxiety | 4.96 (2.69) | 7.35 (2.58) | 5.66* |
| Somatic Anxiety | 5.47 (2.58) | 7.45 (2.18) | 2.68** |
| Self-confidence | 6.03 (1.95) | 5.00 (2.23) | .77 |
| | | | <i>t</i> (41) |
| Heart rate (bpm) | 133.14 (29.71) | 137.80 (27.13) | 2.13* |
| | | | <i>t</i> (30) |
| SDNN (ms) | 63.99 (26.87) | 57.40 (22.23) | 1.03 |
| | | | <i>t</i> (29) |
| r-MSSD(ms) | 27.01 (11.89) | 29.59 (13.81) | .97 |

Note: * $p < .05$; ** $p < .01$.**Table 2***Mean number of serves (SD) in the target, ironic and non-target non-ironic error zones, under the low-anxiety and high-anxiety conditions.*

| Serving Zones | Condition | | <i>t</i> (<i>df</i>) |
|-------------------|-------------|--------------|------------------------|
| | Low-Anxiety | High-Anxiety | |
| | Mean (SD) | Mean (SD) | |
| Target Zone | 2.39 (1.46) | 2.37 (1.29) | .89 |
| Ironic Error Zone | 2.40 (1.62) | 2.68 (1.46) | -.85 |
| Non Ironic Error | 5.18 (1.91) | 4.97 (1.90) | .65 |

Discussion

The primary purpose of the current study was to examine Wegner's (1994) theory of ironic processes of mental control in an ecologically valid volleyball serving task. We examined participants' performance under manipulative conditions (e.g., low- and high-anxiety) with the increased mental load in order to tax participants' cognitive resources. Our results revealed that

when participants were instructed not to serve in a certain zone that was the ironic error zone, participants' scores did not change significantly across anxiety conditions, but instead provided support for the Woodman et al.'s (2015) methodological differentiation of the ironic performance outcome.

Contradictory to our predictions and regardless of ironic effects, our results demonstrated that neither participants' target

serves nor ironic error serves did change across anxiety conditions. This is not in line with previous research (Binsch et al., 2009; Dugdale, and Eklund, 2003; Wegner et al., 1998; Woodman et al., 2015). For example, Barlow et al. (2016) found that participants decreased their target hits in soccer penalty shooting and suffered more from ironic errors under elevated anxiety conditions. If anxiety leads to errors specifically for the attended ironic error zone, this seems like it would provide better support for Wegner's (1994) theory of ironic processes of mental control. According to Wegner's (1994) theory, ironic effects are more likely to occur when cognitive resources are successfully taxed and the conscious operating process is disrupted. However, the only indication of successful manipulation check for the mental load (e.g., anxiety) in the current study was the increase in cognitive and somatic anxiety based on the self-report measure of the MRF-3 (Krane, 1994). Furthermore, we did not observe a significant change in heart rate variability measures (e.g., SDNN, r-MSSD) as the psychophysiological indication of anxiety. Arguably this provides support for the notion that our participants' dual-process system may have continued to work effectively enabling them successfully to avoid the to-be-avoided state (Woodman et al., 2015). Although results from the anxiety manipulation check indicated an increase in self-report anxiety, there was no change in heart rate variability under manipulated, high-anxiety condition. In line with the Barlow et al.'s (2016) study, we were expecting a significant decrease in heart rate variability from low- to high-anxiety conditions as such physiological responses reflect a decrease in physiological efficiency (Arabaci et al., 2020) when our limited resources are taxed (Cooke et al., 2010; 2011; Eysenck et al., 2007; Weinberg and Hunt, 1976). Arguably this may not be the case in the current study as both self-report measures and psychophysiological measures of anxiety have contradictory results with each other. Thus, future ironic processes of mental control examinations should continue to ensure that participants' cognitive resources are significantly taxed.

In the present research we did not primarily aim to test directly De la Pena et al.'s (2008) implicit overcompensation hypothesis that has revealed conflicting results with Wegner's

(1994) theory. For example in the recent study, Malhotra et al. (2018) found that overcompensation occurred when avoidant instruction was given without a secondary task (e.g., tone counting) while driving. However, there is limited research that has demonstrated overcompensation effect in response to avoidant instructions (Beilock et al., 2001; De la Pena et al., 2008) to compare with Wegner's (1994) ironic processes theory. Thus, future research is required to establish the prevalence of ironic and overcompensatory effects amongst other (e.g., skilled) performers (Moran and Toner, 2017) and consider the specific differences between the ironic processes research (Wegner, 1994) and that of De la Pena et al. (2008) to elucidate reasons for these inconsistent results.

It is well established that elite volleyball players use more psychological skills than their non-elite peers when practicing serving (Kitsantas and Zimmerman, 2002) such as self-regulation and self-monitoring which are directly linked with ironic processes theory in order to control thoughts. However, the present study neither provides support for the Wegner's (1994) theory nor for De la Pena et al.'s (2008) implicit overcompensation hypothesis. However, differentiation of performance outcome between ironic error and non-ironic error is the most parsimonious applied implication of the current study. For example, a strategic shift in planning may have an important role for the production of ironic error, rather than more acceptable non-ironic error, under different anxiety conditions especially for a volleyball player in serving when pressure is on (e.g., serving in the final set). With this type of design, it is conceivable that given the small chance of winning the prize, participants might aim more towards the non-ironic error zone (1 point) rather than target zone (5 point) and risking more balls landing in the ironic error zone (- 5 point) which is close to the target zone, as they try to gain more points and secure their winning. Another approach also worth considering is taking into account the point scores (e.g., overall performance scores). One could argue that although there is an increase for the anxiety-induced ironic errors the overall score might be even higher under pressure due to a strategic shift in aiming to the more secure zone (e.g., non-ironic error zone). However, this is not the case in the

present study and participants' overall performance did not change across anxiety conditions. Although this study is an ecological advancement on previous research given the field based (e.g., volleyball) examination of Wegner's (1994) ironic processes theory, the study is not without its limitations. First, our sample size was relatively small and, even though we applied Cohen's *d* effect size in order to estimate the sample and also employed repeated measures design, the results should be interpreted with caution. More importantly, the mean age of our participants was relatively low (*M*_{age} = 14.53) to compare with previous ironic effects research (Barlow et al., 2016, *M*_{age} = 22.82; Gray et al., 2017, *M*_{age} = 22.6; Gorgulu, 2019, *M*_{age} = 21.02; Gorgulu et al., 2019, *M*_{age} = 22.65; Woodman et al., 2015, *M*_{age} = 20.25) and therefore, it may cause some problems in terms of participants interpretation of the experimental task and conditions. Second, regarding performance in the volleyball serving task, it should be noted that there were no opponent players, which lacks ecological validity. However, to be able to classify serves separately and differentiate ironic performance error from non-ironic performance error, this study represents an improvement in ecological validity compared with previous laboratory-based penalty shooting tasks (Bakker et al., 2006; Binsch et al., 2010) or a dart throwing task (Barlow et al., 2016; Woodman et al., 2015).

Beyond the methodological limitations, it is also worth considering individual differences, for instance the moderating role of neuroticism (Barlow et al., 2016) and the repressors (Woodman and Davis, 2008) are the only focus in the ironic effects research to date. However, other individual differences such as alexithymia or narcissism certainly seem worthy of future research attention. Despite anecdotal evidence of distinctly perverse counter-intentional performance errors, alexithymia is one such a personality trait that surprisingly received little research attention in the performance domain (Roberts and Woodman, 2015). Furthermore, the extent to which narcissism moderated the occurrence of ironic performance errors is also an important research question for future investigations. Research has suggested that narcissistic individuals thrive in competitive situations because of the opportunity for glory

that such environments provide to their low-narcissistic counterparts (Roberts and Woodman, 2015; Roberts et al., 2013; Wallace and Baumeister, 2002). Therefore future work would do well to investigate the relationship between narcissism and ironic performance errors under pressure. The last shortcoming which remains in the limited research to date is externally paced movement. Previous and current research has considered only self-paced aiming movements that arguably comprise a limited portion of sport (in any type of sports). However, making decisions in a split second and making reaction based on the environmental changes can sometimes become very important. Interestingly, there is no research that has tested the incidence of ironic performance errors in such reactive, externally paced tasks in sport, except Gorgulu et al. (2019) who tested this in a laboratory based motor control study, but obviously not in a specific sport such as volleyball or basketball. This can clearly be remedied in future research and is worthy of research attention.

Conclusions

The results of the study have extended the theoretical understanding of Wegner's (1994) ironic processes of mental control theory in a sporting context, more specifically in the volleyball serving task. Therefore, coaches and practitioners should consider modifying their instructions during training and competition in order to avoid their players from ironic errors. Furthermore, future research utilising alternative measures of Wegner's (1994) theory in more ecologically valid performance tasks (e.g., non-laboratory) may add more clarity to incidence of ironic performance breakdown in other events (e.g., receiving a tennis serve, baseball batting) which may occupy a larger portion of the sporting environment.

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