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**Investigating the protective role of mastery imagery ability in buffering debilitating
stress responses**

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Abstract

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Mastery imagery has been shown to be associated with more positive cognitive and emotional responses to stress, but research is yet to investigate the influence of mastery imagery ability on imagery's effectiveness in regulating responses to acute stress, such as competition. Furthermore, little research has examined imagery's effectiveness in response to actual competition. This study examined (a), whether mastery imagery ability was associated with stress response changes to a competitive stress task, a car racing computer game, following an imagery intervention, and (b), the effects of different guided imagery content on pre-task cognitive and emotional responses. In Session 1, 78 participants (M age = 20.03 years, $SD = 1.28$) completed ratings of pre-task anxiety intensity and direction, confidence, and perceived control. Imagery ability was also assessed before completing the task. In Session 2, participants were randomly allocated to an imagery condition (positive mastery, negative mastery, relaxation) or control group (no imagery) before completing the task and outcome measures again. For the negative mastery group, greater positive mastery imagery ability was associated with greater perceived control and perceiving anxiety as more facilitative. Furthermore, mastery imagery ability moderated the relationship between anxiety intensity and direction. Altogether, results suggest that positive mastery imagery ability may act as a potential buffer against the effects of negative images.

Keywords: anxiety; confidence; sport imagery ability; coping; control

Investigating the protective role of mastery imagery ability in buffering debilitating stress responses

Acute psychological stress is a common occurrence in everyday life, eliciting a range of psychological (e.g., increases in anxiety) and cardiovascular (e.g., increases in heart rate) responses (Moore, Vine, Wilson, & Freeman, 2012; Skinner & Brewer, 2004; Turner, 1994). Excessive stress can be detrimental towards physical and psychological health (Schneiderman, Ironson, & Siegel, 2005), therefore, individuals self-regulate stress responses by modifying the symptoms of stress (e.g., relaxing) or changing the perception of these symptoms (e.g., reappraisal; Jamieson, Mendes, & Nock, 2013). Stress can be appraised as facilitative or debilitating (Crum, Salovey, & Achor, 2013). Facilitative stress responses are characterized by better task performance, greater confidence, helpful anxiety perceptions, and/or a more favorable cardiovascular profile, whereas debilitating responses can consist of poorer performance, lower confidence, hurtful anxiety perceptions, and/or a less favorable cardiovascular profile (Trotman, Williams, Quinton, & Veldhuijzen van Zanten, 2018; Turner, Jones, Sheffield, Barker, & Coffee, 2014; Williams, Cumming, & Balanos, 2010). Consequently, it is important to establish strategies to elicit more facilitative responses to stress.

Competition is a type of stress that individuals do not always try to avoid as readily as other types of stress. Thus, when developing strategies to elicit more facilitative responses to stress, considering situational factors such as the competition context may help researchers understand the stress responses experienced (Jones, 1995). For example, 30% of the population in England engage in some type of sport at least once a week (Sport England, 2016), a proportion of which would be classified as competition. Thus in the sport setting, competition is typically not feared by individuals and is often enjoyed and actively engaged in. Unlike the clinical literature, responses to stress in the form of a competition can be more

1 beneficial than experiencing no response (Skinner & Brewer, 2004). Indeed, although
2 anxiety is one of the most common and debilitating responses to stress (NHS Digital, 2018),
3 athletes often report higher anxiety levels and feeling “psyched up” to be helpful for
4 performance in an upcoming competition (Hanton, Neil, & Mellalieu, 2008) and therefore do
5 not want to reduce these levels.

6 In support of not simply reducing anxiety levels, Jones (1995) proposed that strategies
7 to elicit more facilitative competitive anxiety responses should target both the intensity
8 experienced (i.e., severity of anxiety symptoms) and the direction (i.e., facilitative or
9 debilitating towards performance). Importantly, anxiety direction perceptions can be a
10 stronger predictor of performance success than anxiety intensity (Chamberlain & Hale,
11 2007). This research suggests interventions to regulate anxiety responses to stress in the form
12 of competitions should focus more on the interpretation of the anxiety rather than reducing its
13 intensity.

14 More positive perceptions of anxiety symptoms are thought to be influenced by
15 perceptions of control (i.e., greater control leads to more facilitative anxiety; Jones, 1995).
16 Furthermore, Jones, Meijen, McCarthy, and Sheffield (2009) posit that in a motivated
17 performance situation like competition, higher confidence and greater perceived control are
18 associated with positively appraising stress as a challenge, which is a state characterized by
19 more facilitative anxiety perceptions and better performance (Moore et al., 2012; Williams et
20 al., 2010). By contrast, a threat appraisal, resulting from lower perceived control and less
21 confidence, is associated with more debilitating anxiety perceptions and worse performance
22 (Moore et al., 2012; Turner et al., 2014; Williams et al., 2010). Therefore, strategies for
23 effectively regulating anxiety perceptions to competition could be focused on raising
24 confidence and perceived control.

1 Imagery is a technique that can alter the intensity and perceptions of
2 psychophysiological stress with athletes (Cumming, Olphin, & Law, 2007; Williams et al.,
3 2010; Williams, Veldhuijzen van Zanten, Trotman, Quinton, & Ginty, 2017). Given that
4 imagery is more effective when people can image sufficiently (Williams, Cooley, &
5 Cumming, 2013), imagery ability has been identified as a key factor for effectively regulating
6 stress (Williams et al., 2017). Imagery ability is “an individual’s capability to form vivid,
7 controllable images and retain them for sufficient time to effect the desired imagery
8 rehearsal” (Morris, 1997, p. 37). Mastery imagery ability - the ease with which individuals
9 can image mastering challenging or difficult situations - has been linked to more adaptive
10 stress appraisals and more facilitative anxiety perceptions via greater self-confidence levels
11 (Williams & Cumming, 2012b; 2015). Thus, those with higher mastery imagery ability, who
12 are better at regulating their anxiety through self-confidence, may be less affected by negative
13 imagery. Additionally, recent research has found that negative mastery imagery ability - the
14 ability to image low feelings of confidence and a lack of control - predicted anxiety intensity
15 and negative appraisals of stress, and both positive and negative mastery imagery ability were
16 mediators between confidence and individuals’ dispositional stress responses (Quinton,
17 Cumming, & Williams, 2018). Altogether, this research highlights the important role played
18 by mastery imagery ability in regulating stress. What is still unclear, however, is whether
19 positive mastery imagery ability is associated with stress response changes to competition.
20 Clarifying this question would advance theoretical thinking, provide clear guidelines to those
21 with clients participating regularly in competition (e.g., sport), and encourage developing
22 mastery imagery ability through techniques such as layered stimulus response training
23 (LSRT; Cumming et al., 2016) for optimal performance.

24 Although the impact of mastery imagery ability on responses to competition stress are
25 not yet known, hypotheses can be developed based on research demonstrating the effect of

1 different imagery content on responses to various types of stress. Williams et al.'s (2010,
2 2017; Williams & Cumming, 2012a) studies found that imaging low feelings of confidence
3 and control (termed threat imagery) led to the situation being perceived as more stressful,
4 lower confidence, and more debilitating anxiety interpretations compared to imagery of
5 feeling confident and in control of the stress (i.e., mastery type imagery) and neutral imagery.
6 However, other findings from these studies were mixed, as one study found a neutral script
7 was most helpful towards regulating stress (Williams et al., 2017), whereas others found the
8 mastery type script was most effective (Williams et al., 2010; Williams & Cumming, 2012a).
9 This difference is likely due to using different tasks (i.e., public speaking, dart throwing, and
10 a competitive experience), and using an actual stress task (i.e., public speaking, dart
11 throwing; Williams & Cumming, 2012a; Williams et al., 2017) compared to hypothetical
12 stress (i.e., script based on previous competitive experience; Williams et al., 2010).
13 However, research is yet to investigate imagery's effectiveness in altering responses to actual
14 competition, which would be important to address to recommend particular imagery types for
15 athletes regularly participating in competition. Therefore, it would be interesting to compare
16 a mastery script, designed to enhance confidence and control, to a relaxation script
17 (Cumming et al., 2007) to clarify which is most effective in regulating anxiety responses to
18 actual competition. Clarifying this question could inform evidence-based imagery
19 interventions and help practitioners to recommend particular types of imagery for athletes
20 who find it difficult to cope with competition stress. As the revised applied model of
21 deliberate imagery use (RAMDIU; Cumming & Williams, 2013) proposes that imagery
22 content for a particular function can be influenced by the situation, it is likely that the
23 findings of this study may be in line with Williams et al. (2010) due to a similar situation
24 (competition), and therefore it could also be feasible that the mastery script would be more
25 effective than a relaxation script.

1 **Aims and Hypotheses**

2 The primary aim was to determine whether mastery imagery ability is associated with,
3 and moderates, stress response changes following an imagery intervention (positive mastery,
4 negative mastery, or relaxation script). Affect imagery ability was included as a comparison
5 imagery ability due to emotional content that is commonly associated with a stress response,
6 such as nervousness and excitement (Williams & Cumming, 2011). Assuming the
7 competition elicited a stress response, it was hypothesized that higher levels of positive
8 mastery imagery ability would (a) be associated with more favorable stress responses for the
9 positive mastery and relaxation intervention groups, and (b) be less detrimental for the
10 negative mastery intervention group compared to those with lower positive mastery imagery
11 ability in the same group. It was also hypothesized that (c) mastery imagery ability would
12 positively moderate the relationship between anxiety intensity and direction at both sessions
13 (i.e., greater mastery imagery ability would help participants perceive increased anxiety as
14 more facilitative).

15 The secondary aim was to investigate how different types of imagery can alter
16 cognitive and emotional responses to an actual competition task (state anxiety intensity and
17 direction, state confidence, and perceived control), rather than hypothetical or different tasks
18 used previously (Williams et al., 2010; 2017). It was hypothesized that (d) the positive script
19 would elicit the most facilitative stress responses for the competition task and the negative
20 script would elicit the most debilitating responses, (e) anxiety intensity would increase from
21 Session 1 to Session 2 for the positive and negative groups, but decrease for the relaxation
22 group, (f) compared to Session 1, anxiety would be perceived as more facilitative for the
23 positive group and more debilitating for the negative group, and (g) confidence would
24 increase from Session 1 for the positive and relaxation groups but decrease for the negative
25 group.

Method

Participants

Seventy-eight male undergraduate athletes (M age = 20.03 years, SD = 1.28) participated in the study with the option of gaining course credit. Only males were recruited due to sex differences in stress responses (Bale & Epperson, 2015). The sample mainly consisted of team (n = 48) and individual (n = 25) sport athletes, with the majority coming from rugby (n = 16), golf (n = 16), and football (n = 14). Athletes ranged in competitive levels from elite (n = 10), regional (n = 14), club (n = 41), and recreational (n = 10). Participants were healthy with no history of epileptic seizures, cardiovascular, immune, metabolic, or kidney disease, and had no current illness or prescribed medication in the last four weeks at the time of the study. Participants were instructed to abstain from heavy exercise and alcohol consumption 24 hours before testing, and from eating and drinking caffeine two hours before testing. Following ethical approval, participants provided informed written consent after being recruited by experimenters over an eight week period through social media, emails, and class announcements at the university where the authors are based.

Psychological Measures

Mastery and affect imagery ability. Participants completed the mastery and affect subscales of the Sport Imagery Ability Questionnaire (SIAQ; Williams & Cumming, 2011). Participants imaged three items reflecting positive mastery content (staying positive after a setback, giving 100% effort when things are not going well, and remaining confident in a difficult situation), and three items reflecting affect content (positive emotions felt while doing sport, anticipation and excitement associated with sport, excitement associated with performing) before rating ease of imaging on a 7-point Likert type scale from 1 (*very hard to image*) to 7 (*very easy to image*). The ratings were averaged to give one mastery and one affect imagery ability score. The internal reliability in this study was just below adequate

1 (Cronbach α mastery and affect = .66, .69 respectively). However, validity and reliability
2 evidence has previously been found in support of SIAQ test scores (Williams & Cumming,
3 2011; Quinton et al., 2018).

4 **Imagery script evaluation.** Six items evaluated the generated imagery on 7-point or
5 10-point Likert type scales (Cumming et al., 2007). Two items asked how easily and vividly
6 participants could image the scripts (1 = *very hard/no image at all*, 7 = *very easy/perfectly*
7 *clear*). One item asked the extent to which participants were engaged when listening to the
8 script (1 = *none of the time*, 10 = *all of the time*). Two items assessed how imagery was
9 perceived to impact confidence and anxiety intensities (1 = *decreased confidence/anxiety*
10 *symptoms a lot*, 7 = *increased confidence/anxiety symptoms a lot*). The final item assessed
11 how imagery was perceived to influence anxiety symptom interpretation (1 = *anxiety viewed*
12 *as being much more hurtful*, 7 = *anxiety viewed as being much more helpful*).

13 **State anxiety and self-confidence.** The Immediate Anxiety Measurement Scale
14 (IAMS; Thomas, Hanton, & Jones, 2002) assessed cognitive and somatic anxiety intensity
15 and direction and self-confidence in relation to the task. Participants were provided with
16 definitions of these constructs to ensure understanding. Participants rated the extent to which
17 they felt cognitively anxious, somatically anxious, and self-confident on a 7-point Likert type
18 scale from 1 (*not at all*) to 7 (*extremely*) before indicating how they perceived these
19 symptoms from -3 (*very debilitating/negative*) to +3 (*very facilitative/positive*). Validity and
20 reliability evidence has been found in support of IAMS test scores (Thomas et al., 2002).

21 **Perceived control.** A single item assessed perceived control prior to completing the
22 task, asking “how much control do you think you will have over the outcome of the task?”.
23 Participants responded on a 7-point Likert type scale from 1 (*none*) to 7 (*total*).

24 **Task evaluation.** Three items assessed the level of task stressfulness, difficulty, and
25 effort experienced (e.g., Williams et al., 2017). Ratings were made on a 7-point Likert type

1 scale from 1 (*not at all stressful/not at all difficult/did not try at all*) to 7 (*extremely*
2 *stressful/extremely difficult/tried throughout the whole task*).

3 **Cardiovascular Measures**

4 Heart rate (beats per min; bpm) was measured as a manipulation check to ensure the
5 competition task elicited a stress response. Heart rate was recorded continuously using the
6 Vrije Universiteit Ambulatory Monitoring System (VU-AMS5fs, TD-FPP, Amsterdam, The
7 Netherlands; De Geus, Willemsen, Klaver, & Van Doornen, 1995; Willemsen, De Geus,
8 Klaver, Van Doornen, & Carroll, 1996). The VuAMS5fs used seven Ag/AgCl spot
9 electrodes (Invisatrace, ConMed Corporation), three of which recorded electrocardiography
10 (ECG). The ECG was recorded using three electrodes: below the right collar bone 4cm to the
11 right of the sternum, between the lower two ribs on the lateral right hand side and at the apex
12 of the heart on the left lateral margin of the chest. Following automated R-peak detection, the
13 interbeat interval signal was visually inspected and corrected if necessary.

14 **Competition Task**

15 The competition task was the car racing computer game Need for Speed:
16 Underground (Electronic Arts Games). The primary objective was to win a car race in the
17 quickest time possible against three computer controlled opponents, while avoiding traffic
18 and other obstacles. Game manipulations allowed the computer opponents to match the
19 ability of the participant to ensure there was never a clear win or loss. To enhance task
20 competitiveness, a leaderboard was displayed in the lab and participants were informed that
21 the fastest time (for each session) at the end of the study would be awarded a £10 voucher.
22 Pre-recorded instructions informed participants about the keypad controls, that their race
23 position would be displayed throughout the race, and that they would have one practice lap
24 (Session 1 only) before completing the three lap race. The experimenters provided
25 participants with verbal encouragement throughout (e.g., Veldhuijzen van Zanten et al.,

1 2002). The conditions for both races were pilot tested and similar in difficulty but included a
2 different car and track than Session 1 to ensure the novelty of the task was maintained. This
3 task has been used as a competition task in previous research and was valid for eliciting a
4 stress response (Trotman, Williams et al., 2018¹).

5 **Imagery Scripts**

6 The three imagery scripts (positive mastery, negative mastery, and relaxation)
7 described the moments prior to the task, including cognitive and physiological responses.
8 Scripts were based on those previously employed (Cumming et al., 2007; Williams et al.,
9 2010) and included characteristics of positive and negative mastery imagery (Quinton et al.,
10 2018). Scripts included stimulus (e.g., “you look around and notice the experimenters
11 watching you”), response (e.g., “your heart is beating faster than usual”), and meaning (e.g.,
12 “...but you feel ready”) propositions (Lang, 1979). Scripts were pilot tested but no further
13 changes were made. All three scripts were matched in terms of the amount of content and
14 script length and lasted approximately 3 min. The scripts were audio recorded and played on
15 an mp3 player.

16 The positive and negative mastery scripts were matched for stimulus and response
17 propositions and described how participants would cope with the task based on theories from
18 the stress literature (Blascovich & Mendes, 2000; Jones et al., 2009). For example, altered
19 meaning propositions were attempted through manipulating perceptions of self-efficacy and
20 control, which influence how stressful situations are appraised (Jones et al., 2009). The
21 relaxation script was developed with the aim of making participants feel comfortable and
22 calm prior to completing the task. The script included details about cognitions, body

¹ Please note this study marginally overlaps with the current study in terms of data (Session 1 only). However, the manuscripts are sufficiently distinct to not warrant concern.

1 position, and physiological responses. This script predominantly included response
2 propositions to focus on inducing a state of relaxation².

3 **Procedure**

4 **Session 1.** On arrival at the lab, eligibility criteria were confirmed and all procedures
5 were explained to the participants. Participants were randomly allocated to an intervention
6 group (1, 2, 3, or 4) from a randomly generated list devised by the experimenters; positive
7 mastery ($n = 18$), negative mastery ($n = 20$), relaxation ($n = 19$), or control ($n = 19$). Session
8 1 was the same for all participants regardless of intervention condition.

9 Participants were connected to the cardiovascular recording equipment and
10 comfortably seated where they remained throughout the session. A 15 min baseline period
11 then ensued where participants watched a nature documentary to establish resting heart rate
12 values. ECG recordings analyzed, in the 9th, 11th, 13th, and 15th minutes. Following baseline,
13 participants were introduced to the task and completed the IAMS. Participants then
14 completed the task, whilst heart rate was measured at 30 s and 2 min into the task.
15 Participants completed the task evaluation form immediately after the task, had
16 cardiovascular equipment removed, and were reminded about their second session.

17 **Session 2.** Session 2 for the control group was identical to Session 1. The protocol
18 was also similar for the imagery groups except that on arrival at the lab, participants were
19 provided with White and Hardy's (1998) definition of imagery. Following baseline, but
20 before participants listened to their allocated imagery script, they received LSRT (Cumming
21 et al., 2016) from an experimenter trained in the technique to ensure they could image as
22 clearly and vividly as possible. Next, participants received instructions for the task before
23 listening to their allocated imagery script. Participants were instructed to image as clearly
24 and vividly as possible in their preferred visual perspective. After listening to the script,

² Scripts can be found in supplement file 1.

1 participants completed the pre-task questionnaires and the task. Finally, participants
2 completed measures of imagery ability, imagery perceptions, and task evaluation before the
3 removal of equipment and being thanked for participation. Each visit lasted between 90 and
4 120 min.

5 **Data Reduction and Analyses**

6 Data were analyzed using SPSS, including the process macro for moderation (version
7 24; Hayes, 2017). Data were first screened and cleaned in accordance with recommendations
8 by Tabachnick and Fidell (2013), resulting in one participant (negative mastery group)
9 excluded from the analysis as a result of univariate and multivariate outlier checks. Baseline
10 measurements were averaged to give an overall baseline score for heart rate. Task scores
11 were the average of the 30 s and 2 min values. Where dependent variables were correlated,
12 to reduce the likelihood of a Type 1 error, MANOVAs were chosen over ANOVAs
13 (Williams et al., 2010). Pillai's Trace values were reported for all MANOVAs as this
14 multivariate test is most robust (Olson, 1976). For MANOVAs including repeated measures,
15 Greenhouse Geisser values were reported if Mauchly's test of sphericity was violated. The
16 probability value threshold for all analyses was set at .05 and 95% confidence intervals were
17 reported. All significant effects were followed up with Bonferroni post hoc pairwise
18 comparisons.

19 The Benjamini-Hochberg method was used to control for multiple comparisons in the
20 analyses (Benjamini & Hochberg, 1995; McDonald, 2014). This method reduces the
21 likelihood of Type 1 error whilst avoiding the loss of power associated with other alpha
22 adjustments considered too conservative (e.g. Bonferroni; Shi, Pavey, & Carter, 2012). For
23 each set of multiple analyses (e.g., correlations, MANOVAs), the p values were ranked from
24 smallest to largest and compared with Benjamini-Hochberg critical values at a false discovery
25 rate of 0.05 (Benjamini & Hochberg, 1995; McDonald, 2014). This method has been used

1 previously in laboratory-based stress-evoking research (Trotman, Gianaros, Veldhuijzen van
2 Zanten, Williams, & Ginty, 2018).

3 To verify that a stress response was elicited, two paired sampled t-tests examined
4 differences in heart rate from baseline to the competition task at both sessions. To examine
5 the extent to which mastery and affect imagery ability impacted the effects of the scripts,
6 partial correlations (controlling for Session 1 scores) were conducted for each imagery group
7 to investigate the relationships between mastery and affect imagery ability with Session 2
8 IAMS and perceived control scores. To investigate mastery imagery ability as a moderator
9 between anxiety intensity and direction, analyses were separately conducted for cognitive and
10 somatic anxiety using the process macro for SPSS (Hayes, 2017). To evaluate how well
11 participants were able to image the scripts and the perceived effect on certain outcomes, a
12 one-way ANOVA analyzed imagery script engagement, and two one-way MANOVAs
13 analyzed ease and vividness of imaging the script, and the effect of the script on confidence,
14 anxiety intensity, and anxiety perception.

15 To investigate if the different scripts influenced the task stress responses, two separate
16 2 Time (Session 1, Session 2) \times 4 Group (positive mastery, negative mastery, relaxation,
17 control) MANOVAs with repeated measures on the first factor were conducted to analyze
18 differences in IAMS constructs (cognitive and somatic anxiety intensity and direction and
19 confidence) and task stressfulness, difficulty, and effort. A 2 Time (Session 1, Session 2) \times 4
20 Group (positive mastery, negative mastery, relaxation, control) repeated measures ANOVA
21 was also conducted to investigate if the scripts influenced perceived control prior to the task.

22 **Results**

23 **Stress Response**

24 Two paired sampled t-tests revealed the competition task elicited significant heart rate
25 responses from baseline at Session 1, $t(68) = -11.30, p < .001$, and Session 2, $t(66) = -8.05, p$

1 < .001. Significant results remained following the Benjamini-Hochberg correction. Heart
2 rate was significantly higher during the competition task at Session 1 ($M = 86.05$, $SD =$
3 14.82) and Session 2 ($M = 83.13$, $SD = 17.61$) in comparison to the respective baselines
4 (Session 1 – $M = 70.12$, $SD = 9.48$; Session 2 – $M = 70.16$, $SD = 9.34$). This data was further
5 supported by self-report task stressfulness ratings reported below.

6 **Imagery**

7 **Positive mastery imagery ability.**

8 **Correlations.** All correlations are shown in Table 1. There was a significant
9 relationship between positive mastery imagery ability and confidence for the positive mastery
10 group ($p = .043$). However, following the Benjamini-Hochberg correction, this correlation
11 was no longer significant. For the negative mastery group, positive mastery imagery ability
12 was positively correlated with cognitive ($p = .005$) and somatic ($p = .016$) anxiety direction
13 and perceived control ($p = .005$). These results remained significant following the
14 Benjamini-Hochberg correction. Better imagery ability was associated with more facilitative
15 anxiety symptom perceptions in Session 2 for the negative mastery group. There were no
16 significant correlations for the relaxation group.

17 **Moderation.** At Session 2, mastery imagery ability moderated the relationship
18 between cognitive ($B = .24$, $t(72) = 2.31$, $p = .024$, 95% CI [.03, .45]) and somatic ($B = .26$,
19 $t(72) = 2.63$, $p = .01$, 95% CI [.06, .45]) anxiety intensity and direction. Significant results
20 remained following the Benjamini-Hochberg correction. Graphs were then plotted to
21 illustrate the simple slopes for low ($M - 1 SD$), average (M), and high ($M + 1 SD$) mastery
22 imagery ability (Figure 1). For the low mastery imagery ability condition, there was a
23 significant and negative relationship between cognitive, $B = -.30$, $t(72) = -2.22$, $p = .029$ [-
24 $.57$, $-.03$], and somatic, $B = -.29$, $t(72) = -2.17$, $p = .033$ [-.56, -.02], anxiety intensity and
25 direction. For those with lower mastery imagery ability, increased cognitive and somatic

1 anxiety intensity was regarded as more debilitating. Although no significant relationships
2 were found between anxiety intensity and direction for average and high mastery imagery
3 ability (Table 2), there was a pattern for those with greater mastery imagery ability to regard
4 increased anxiety as more facilitative (Figure 1).

5 Despite the non-significant Session 1 moderation results for cognitive ($B = .12, t(72)$
6 $= .84, p = .406, 95\% \text{ CI } [-.17, .42]$) and somatic ($B = .15, t(72) = 1.18, p = .243, 95\% \text{ CI } [-$
7 $.10, .40]$) anxiety, the data followed the same pattern whereby greater mastery imagery ability
8 was associated with regarding increased anxiety as more facilitative (Figure 2).

9 **Affect imagery ability.** All correlations are shown in Table 1. There were no
10 significant relationships between affect imagery ability and Session 2 variables.

11 **Imagery script evaluation.** Means and standard deviations are reported in Table 3.
12 For script ease and vividness, there was a significant main effect for group at the multivariate
13 level, Pillai's Trace = .21, $F(2, 53) = 3.09, p = .019$. At the univariate level, significant group
14 differences were for vividness, $F(2, 53) = 5.17, p = .009, \eta_p^2 = .16$, but not ease ($p = .079$).
15 Post hoc analyses showed the positive mastery group imaged their scripts significantly more
16 vividly than the negative mastery group ($p = .007$). For script engagement, there was a
17 significant difference between groups, $F(2, 53) = 10.29, p < .001, \eta_p^2 = .28$. The positive
18 mastery and relaxation groups were significantly more engaged than the negative mastery
19 group ($p = .011, p < .001$ respectively). For the scripts' effect on confidence, overall anxiety,
20 and anxiety direction for both tasks, results of the one-way MANOVA revealed there was a
21 significant main effect for group, Pillai's Trace = .52, $F(2, 53) = 6.15, p < .001$. At the
22 univariate level, there were significant group differences for confidence, $F(2, 53) = 8.62, p =$
23 $.001, \eta_p^2 = .25$, anxiety intensity, $F(2, 53) = 13.27, p < .001, \eta_p^2 = .33$, and anxiety direction,
24 $F(2, 53) = 4.77, p = .012, \eta_p^2 = .15$. The positive mastery and relaxation scripts elicited a
25 greater effect on confidence than the negative mastery script ($p = .009; p = .001$,

1 respectively). The positive and negative mastery scripts were more anxiogenic than the
2 relaxation script ($p = .008, p < .001$), and the positive mastery script was perceived as more
3 helpful for anxiety symptoms than the negative mastery script ($p = .010$). Significant results
4 remained following the Benjamini-Hochberg correction.

5 **State Anxiety and Self-Confidence**

6 All means and standard deviations are reported in Table 4. Note that higher direction
7 scores mean that anxiety was perceived as more facilitative. A 2 Time (Session 1, Session 2)
8 \times 4 Group (positive mastery, negative mastery, relaxation, control) MANOVA revealed a
9 significant multivariate main effect for time, Pillai's Trace = .24, $F(5, 68) = 4.17, p = .002$,
10 and a significant time by group interaction, Pillai's Trace = .42, $F(3, 72) = 2.24, p = .006$.
11 Significant results remained following the Benjamini-Hochberg correction. Univariate
12 analyses revealed the main effect was for cognitive intensity, $F(1, 72) = 12.87, p = .001, \eta_p^2 =$
13 $.15, 95\% \text{ CI } [.30, 1.05]$, cognitive direction, $F(1, 72) = 9.54, p = .003, \eta_p^2 = .12, 95\% \text{ CI } [-$
14 $.85, -.18]$, and somatic direction, $F(1, 72) = 10.38, p = .002, \eta_p^2 = .13, 95\% \text{ CI } [-.63, -.02]$.
15 Participants had higher cognitive anxiety levels and perceived both cognitive and somatic
16 symptoms as more debilitating at Session 2 compared to Session 1.

17 For the time by group interaction, univariate analyses revealed this effect was for
18 somatic intensity, $F(3, 72) = 3.45, p = .021, \eta_p^2 = .13$, and approached significance for
19 somatic direction, $F(3, 72) = 2.55, p = .063, \eta_p^2 = .10$. Participants in the positive mastery, p
20 $= .035, 95\% \text{ CI } [.06, 1.50]$, and negative mastery, $p = .006, 95\% \text{ CI } [.30, 1.70]$, groups had
21 higher somatic intensity levels at Session 2 than at Session 1. For somatic direction, there
22 was a trend for the positive mastery and control groups to perceive their symptoms as more
23 debilitating at Session 2 compared to Session 1. At the multivariate level, there was no main
24 effect for group and no time by group interaction for confidence intensity, cognitive intensity,
25 or cognitive direction.

1 **Perceived Control**

2 All means and standard deviations are reported in Table 4. A 2 Time (Session 1,
3 Session 2) \times 4 Group (positive mastery, negative mastery, relaxation, control) ANOVA
4 revealed no main effects for time, $F(1, 71) = .05, p = .823$, or group, $F(3, 71) = 1.41, p =$
5 $.246$, and no time by group interaction, $F(3, 71) = 1.67, p = .182$.

6 **Task Evaluation**

7 All means and standard deviations are reported in Table 4. A 2 Time (Session 1,
8 Session 2) \times 4 Group (positive mastery, negative mastery, relaxation, control) MANOVA
9 revealed a significant multivariate main effect for time, Pillai's Trace = .18, $F(3, 69) = 4.63$,
10 $p = .004$. Significant results remained following the Benjamini-Hochberg correction.
11 Univariate analyses revealed this effect was for task stressfulness, $F(1, 71) = 7.57, p = .008$,
12 $\eta_p^2 = .10$, 95% CI [.12, .78], and task effort, $F(1, 71) = 4.80, p = .032, \eta_p^2 = .06$, 95% CI [-
13 .65, -.03], but not for difficulty. Participants found Session 2 significantly more stressful, but
14 put in significantly less effort compared to Session 1. There was no significant multivariate
15 main effect for group, or time by group interaction.

16 **Discussion**

17 The present study examined whether positive mastery imagery ability was associated
18 with stress response changes to a competition task following an imagery intervention, while
19 also investigating how positive mastery, negative mastery, and relaxation imagery influenced
20 the cognitive and emotional (anxiety, confidence, and perceived control) pre-task responses.
21 The task elicited a stress response in accordance with previous literature (Veldhuijzen van
22 Zanten et al., 2002). Also, when considering manipulation checks, the mean values support
23 that participants appeared motivated and engaged in the task.

24 A key strength of the present study, in comparison to previous research (e.g.,
25 Williams et al., 2010; 2017), is the theoretical underpinning of the RAMDIU (Cumming &

1 Williams, 2013). The use of this framework allowed for the discovery of a new buffering
2 role for mastery imagery ability against the debilitating effects of imagery and therefore a
3 novel theoretical contribution to existing literature. Another strength of this study was the
4 use of actual competition as a stress task. Competition is a unique type of stress that people
5 approach rather than avoid compared to most types of stress studied, which means these
6 results can contribute to the broader implications of what can be learned from a type of stress
7 that people choose to engage in, and the strategies used to regulate such stress (e.g., mastery
8 imagery ability).

9 **Key Findings and Implications: Primary Aim**

10 In support of our hypotheses, results suggest that the imagery's effectiveness was
11 determined by imagery ability. In particular for the negative mastery group, greater positive
12 mastery imagery ability was associated with greater perceived control and a lower reduction
13 in anxiety direction (i.e., less likely to perceive anxiety symptoms as debilitating). In other
14 words, those in the negative imagery group with poorer positive imagery ability were more
15 greatly impacted by their assigned imagery condition, suggesting that positive mastery
16 imagery ability acts as a buffer against imagery eliciting debilitating stress responses (e.g.,
17 debilitating anxiety). This finding supports the RAMDIU as imagery ability influenced
18 outcomes experienced from a stress task (Cumming & Williams, 2013). However, the
19 novelty of our finding provides an additional theoretical contribution to this model by
20 suggesting imagery ability can also buffer against the debilitating effects of negative imagery,
21 therefore extending beyond what the revised model hypothesized.

22 Support that mastery imagery ability acts as a buffer against negative imagery was
23 demonstrated using moderation analyses: those with lower mastery imagery ability perceived
24 increased levels of anxiety as more debilitating. Although the moderation relationships were
25 not significant at Session 1, this could be explained by increased task stressfulness ratings at

1 Session 2. At the first visit, participants were likely still acclimatizing to the laboratory
2 conditions and learning how to perform the task. Although there were some differences
3 introduced in Session 2 to maintain a degree of task novelty (e.g., different race track), the
4 learning from Session 1 would enable participants to focus more on performing and the
5 results, hence the increased ratings of stressfulness but reduced effort. That this moderation
6 effect was significant for all participants, regardless of their condition, indicates that the
7 stress inducing factors of competition were strong enough to elicit an anxiety response for all
8 groups. Moreover, this anxiety response was of a sufficient level for participants' mastery
9 imagery ability to exert a moderating effect. Recent research has found positive mastery
10 imagery ability to be associated with either anxiety intensity or anxiety direction (Quinton et
11 al., 2018; Williams et al., 2019). However, the current study extends these findings by
12 suggesting the role of mastery imagery ability as a correlate of anxiety may be more complex
13 than previously thought, playing a moderating role in perceiving anxiety as more facilitative.
14 This novel finding should be explored in future research to determine its replicability and
15 generalizability to other settings (e.g., other competitive and stress evoking situations). If
16 replicated, developing mastery imagery ability could be a significant strategy for promoting
17 more facilitative anxiety interpretations during stress.

18 During stressful scenarios, spontaneous negative images can be experienced (Van de
19 Braam & Moran, 2011). The present results allude to the importance of mastery imagery
20 ability in protecting against the debilitating effects of negative images. The importance was
21 further emphasized by the lack of any significant results with affect imagery ability.
22 Although research shows that the ability to image intervention content can influence
23 imagery's effectiveness (McKenzie & Howe, 1997), this study highlights the importance of
24 more general imagery ability, positive mastery, by demonstrating that the ability to image this
25 content may play a role in the effectiveness of a particular imagery intervention. More

1 broadly, findings demonstrate the importance of imagery ability impacting upon the
2 effectiveness of imagery use, and in line with Jones' (1995) framework, suggest that
3 individual factors such as imagery ability should be considered when investigating responses
4 to stress and how they are perceived.

5 Another type of imagery ability in this study, although employed as a manipulation
6 check, could be imagery script engagement. Supported by the computational theory of
7 imagery (Kosslyn, Thompson, & Ganis, 2006), the ability to remain engaged in a script could
8 reflect the maintenance stage of image generation. The negative mastery group was less
9 engaged in their script, which although could be noted as a limitation, it could also imply
10 lower script engagement acts as a protective factor against debilitating imagery. It is possible
11 that higher engagement with facilitative imagery could elicit more positive responses.
12 Although engagement is crucial for imagery effectiveness in clinical settings (Steenbergen,
13 Craje, Nilsen, & Gordon, 2009), scarce research has explored engagement within other
14 settings, such as sport and competition. As debilitating imagery can be more powerful in
15 eliciting stress responses than facilitative imagery (Nordin & Cumming, 2005), it is important
16 to understand this relationship and what strategies (e.g., imagery rescripting) may be most
17 effective to prevent debilitating stress responses and poor performance.

18 **Key Findings and Implications: Secondary Aim**

19 In accordance with our hypotheses and previous research (Williams et al., 2010,
20 2017), the scripts containing positive and negative mastery content reported higher cognitive
21 and somatic anxiety levels. However, in contrast to our hypothesis, there was a trend for
22 anxiety to be perceived as more debilitating for the positive mastery and control groups but
23 not the negative mastery group. These results were unexpected and also in contrast to
24 research where participants who imaged neutral or coping based content perceived anxiety
25 symptoms as facilitative (Cumming et al., 2007; Williams et al., 2010, 2017) and those who

1 imaged negative content perceived anxiety as debilitating (Cumming et al., 2007; Williams et
2 al., 2010). Although some of these studies included hypothetical competitions or low stress
3 evoking situations, the scripts provided stimulus propositions based on personal experiences,
4 which likely contributed to an increased meaning, and therefore effectiveness, of the imagery
5 (Lang, 1979). In this study, the unexpected results could be due to the imagery of the task
6 being less familiar compared to previous studies, and subsequently less meaningful and
7 effective for participants. This notion is supported by the RAMDIU (Cumming & Williams,
8 2013) which posits that the meaning of an image influences what function (e.g., anxiety
9 producing) the image content (e.g., positive mastery) serves. Importantly, when using
10 positive mastery imagery, results suggest practitioners should ensure imagery is meaningful
11 and that it has the intended facilitative effect for actual performance scenarios.

12 Interestingly, additional results were also in contrast to our hypotheses and previous
13 research. In contrast to Williams et al.'s (2010, 2017; Williams & Cumming, 2012a) studies,
14 there were no significant group differences for confidence or perceived control in relation to
15 the competition task. Furthermore, although Williams et al. (2017) found that the neutral
16 script was occasionally more facilitative than the challenge script, this was not the case for
17 the relaxation script used in this study. These results could be due to the variation between
18 these imagery groups in the vividness and engagement of the scripts. Although there were no
19 group differences in ease of imaging (i.e., one indicator of imagery ability), the positive
20 mastery group imaged their scripts significantly more vividly than the negative mastery
21 group, and the positive and relaxation groups were significantly more engaged in their scripts
22 than the negative group. These findings suggest that participants found it easier to image the
23 positive script content compared to negative, which could have influenced the effect of the
24 imagery on task responses (i.e., confidence and perceived control). Therefore, researchers
25 and practitioners conducting imagery interventions should ensure adherence to scripts and

1 verify during the intervention (i.e., rather than after) whether participants can sufficiently
2 image all aspects of the scripts, providing extra training where necessary (e.g., LSRT;
3 Cumming et al., 2016).

4 Findings expand on Williams et al.'s (2010, 2017; Williams & Cumming, 2012a)
5 research by investigating imagery's effect on responses to actual competition, and highlights
6 the importance of considering the situation associated with the imagery (i.e., public speaking
7 or competition, hypothetical or real). This study supports that responses to an actual
8 competition task are different to a real task in the form of dart throwing (Williams &
9 Cumming, 2012a), a speech preparation task (Williams et al., 2017), and hypothetical
10 competition (Williams et al., 2010). The collective results from these studies may
11 demonstrate that imagery scripts (challenge or positive mastery, threat or negative mastery, or
12 relaxation) might not be as effective for a stressful task where stimuli are constantly
13 presented (i.e., car racing competition) and performance was evaluated, in comparison to a
14 hypothetical task or a task which involves greater internal concentration (i.e., public speaking
15 preparation task or dart throwing). Thus, in accordance with the RAMDIU (Cumming &
16 Williams, 2013), the content (e.g., imagery script), situation (e.g., stress task, hypothetical or
17 real), and individual components (e.g., positive mastery imagery ability) appear crucial to
18 consider when implementing imagery interventions for stressful situations.

19 **Limitations and Future Research**

20 Although the current study provides some important contributions to the literature, it
21 is not without limitations. Numerous tests were run in a small sample, however multiple
22 comparisons were controlled for using a conservative method which allowed statistical power
23 to be maintained (Benjamini & Hochberg, 1995). Task novelty may have been influenced by
24 previous task experiences, thus research should test this consideration as a confounding
25 variable (e.g., Williams & Cumming, 2012a). Also, the competition task differed in

1 stressfulness across sessions. Although these tasks could have been counterbalanced (e.g.,
2 race track) to rule out the order being a confounding variable, the nature of the imagery
3 intervention meant that participants had to be exposed to the task twice and therefore it was
4 likely that the novelty, and stress response, would be reduced. Stress research makes the
5 issue of novelty difficult to control, as the unique aspect of stress is that it is often associated
6 with fear of the unknown. Therefore, undertaking a task twice is likely to yield differences in
7 the stress response. However, this difference could also be viewed as a strength as
8 completing a task twice often results in a loss of stressfulness of the task, but in this case the
9 task was more stressful the second time. Future research should expand on combining
10 imagery interventions in repeated exposures to stress tasks and the subsequent influence on
11 the stress response experienced. Future research should also ensure daytime is controlled for
12 between laboratory visits.

13 **Conclusion**

14 Findings demonstrated that positive mastery imagery ability can determine the
15 effectiveness of imagery's use. Results found a new buffering role for mastery imagery
16 ability against the debilitating effects of negative imagery (e.g., debilitating anxiety),
17 providing a novel theoretical contribution to the RAMDIU (Cumming & Williams, 2013) and
18 a new understanding of how this type of imagery interacts with anxiety intensity and
19 direction. Results also suggested, in contrast to Williams et al. (2010, 2017), that the imagery
20 type used may not be more/less beneficial for a novel computer car racing task, which may be
21 due to the different nature of hypothetical vs. real competition experiences or competition vs.
22 other stress tasks (e.g., public speaking). Altogether, in accordance with and extending the
23 RAMDIU (Cumming & Williams, 2013), positive mastery imagery ability varied across
24 individuals and acted as a buffer, which together with the situation (e.g., competition task)
25 likely influenced what function (e.g., anxiogenic) the image content (e.g., positive mastery)

- 1 served, and therefore the outcomes experienced (e.g., more debilitating anxiety
- 2 interpretations). Positive mastery imagery ability should be developed to reduce the impact
- 3 of debilitating imagery and maladaptive responses to stress.

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Table 1

1 *Mastery and affect imagery ability correlations by imagery group for Session 2 variables, controlling for*
 2 *Session 1 scores*

Variable	Positive mastery	Negative mastery	Relaxation
		Mastery IA	
Cognitive intensity	-.488	.177	-.189
Cognitive direction	.269	.723**	-.400
Somatic intensity	-.410	.078	-.029
Somatic direction	.455	.653*	-.533
Confidence intensity	.592†	.398	-.151
Perceived control	.010	.730**	-.351
		Affect IA	
Cognitive intensity	-.001	.085	-.307
Cognitive direction	-.246	-.079	.134
Somatic intensity	-.102	.175	-.326
Somatic direction	-.334	.176	-.117
Confidence intensity	-.106	.386	.262
Perceived control	.217	.160	.096

3 *Note.* IA represents imagery ability.

4 * $p < .05$. ** $p < .01$.

5 † No longer significant after Benjamini-Hochberg correction.

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1 Table 2

2 *Simple slopes for differing levels of mastery imagery ability moderating between anxiety intensity and*
3 *direction at Session 2.*

	Levels of mastery imagery ability		
	-1SD	Mean	+1SD
Cognitive intensity →	B = -.30, $t(72) = -2.22$,	B = -.06, $t(72) = -.66$,	B = .17, $t(72) = 1.15$, p
Cognitive direction	$p = .029$ [-.57, -.03]	$p = .513$ [-.26, .13]	$= .250$ [-.12, .47]
Somatic intensity →	B = -.29, $t(72) = -2.17$,	B = -.04, $t(72) = -.39$,	B = .21, $t(72) = 1.54$,
Somatic direction	$p = .033$ [-.56, -.02]	$p = .695$ [-.23, .15]	$p = .128$ [-.06, .49]

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1 Table 3

2 Means (standard deviation) for imagery evaluation items according to intervention group

Imagery item	Imagery script		
	Positive mastery	Negative mastery	Relaxation
Imagery script engagement (1 = none of the time, 10 = all of the time)	7.29 (1.31) ^{a*}	5.95 (1.47)	7.85 (1.23) ^{a***}
Ease of imaging script (1 = very hard, 7 = very easy)	5.29 (1.11)	4.45 (1.32)	5.25 (.85)
Vividness of imaging script (1 = no image at all, 7 = perfectly clear)	5.18 (.95) ^{a**}	4.16 (1.11)	4.60 (.75)
Effect on confidence (1 = decreased confidence a lot, 7 = increased confidence a lot)	5.00 (.61) ^{a**}	4.05 (1.13)	5.20 (.89) ^{a**}
Effect on anxiety intensity (1 = decreased anxiety symptoms a lot, 7 = increased anxiety symptoms a lot)	3.76 (1.15) ^{b**}	4.37 (.90) ^{b****}	2.70 (1.03)
Effect on anxiety direction (1 = anxiety viewed as being much more hurtful, 7 = anxiety viewed as being much more helpful)	4.88 (1.22) ^{a*}	3.53 (1.26)	4.20 (1.44)

3 Note. ^a Significantly greater than the negative mastery script. ^b Significantly greater than the relaxation
4 script.

5 * $p < .05$. ** $p < .01$. *** $p < .001$.

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1 Table 4

2 *Means (standard deviation) by session and intervention group*

Imagery group	Session 1	Session 2
Cognitive anxiety intensity		
Positive mastery	2.94 (1.16)	3.72 (1.74)
Negative mastery	2.47 (1.22)	3.89 (1.82)
Relaxation	3.15 (1.57)	3.60 (1.93)
Control	3.37 (1.30)	3.42 (1.47)
Total	2.99 (1.34)	3.66 (1.73) ^{a**}
Cognitive anxiety direction		
Positive mastery	.06 (1.59)	.11 (1.64)
Negative mastery	-.21 (1.58)	-.74 (1.41)
Relaxation	.20 (1.51)	-.45 (1.64)
Control	.42 (1.58)	-.53 (1.07)
Total	.12 (1.55)	-.41 (1.46) ^{a**}
Somatic anxiety intensity		
Positive mastery	2.67 (1.28)	3.44 (1.76) ^{a*}
Negative mastery	2.42 (1.12)	3.42 (1.54) ^{a*}
Relaxation	3.15 (1.46)	2.95 (1.54)
Control	3.37 (1.17)	3.11 (1.45)
Total	2.91 (1.30)	3.22 (1.55)
Somatic anxiety direction		
Positive mastery	.67 (1.41)	.06 (1.55)
Negative mastery	-.21 (1.51)	-.68 (1.16)
Relaxation	-.45 (1.57)	-.30 (1.46)
Control	.58 (1.35)	-.37 (1.07)
Total	.13 (1.52)	-.33 (1.32) ^{a**}
Self-confidence		
Positive mastery	4.17 (1.65)	4.44 (1.20)
Negative mastery	4.11 (1.20)	3.79 (1.08)
Relaxation	4.55 (.95)	4.35 (1.31)
Control	4.68 (1.38)	3.89 (.99)
Total	4.38 (1.31)	4.12 (1.17)
Perceived control		
Positive mastery	5.61 (1.29)	5.50 (1.15)
Negative mastery	5.26 (1.15)	4.79 (1.40)
Relaxation	5.45 (1.00)	5.80 (1.11)
Control	5.39 (1.04)	5.50 (1.04)
Total	5.43 (1.11)	5.40 (1.22)
Task stressfulness		
Positive mastery	3.44 (1.46)	3.44 (1.58)
Negative mastery	3.53 (1.02)	4.32 (1.11)
Relaxation	3.70 (1.26)	4.10 (1.25)
Control	3.17 (1.51)	3.78 (1.31)
Total	3.47 (1.31)	3.92 (1.33) ^{a**}
Task difficulty		
Positive mastery	3.72 (1.36)	3.78 (1.59)
Negative mastery	4.32 (1.16)	4.32 (1.06)
Relaxation	4.05 (1.00)	4.25 (1.48)
Control	3.56 (1.42)	3.89 (1.13)
Total	3.92 (1.25)	4.07 (1.33)
Task effort		
Positive mastery	5.61 (1.50)	5.67 (1.28)
Negative mastery	5.89 (1.10)	5.68 (1.25)

Imagery group	Session 1	Session 2
Relaxation	6.40 (1.05)	5.80 (1.80)
Control	6.28 (.96)	5.67 (1.28)
Total	6.05 (1.18)	5.71 (1.40) ^{a*}

1 *Note.* ^a Significantly different than Session 1.

2 * $p < .05$. ** $p < .01$. *** $p < .001$.

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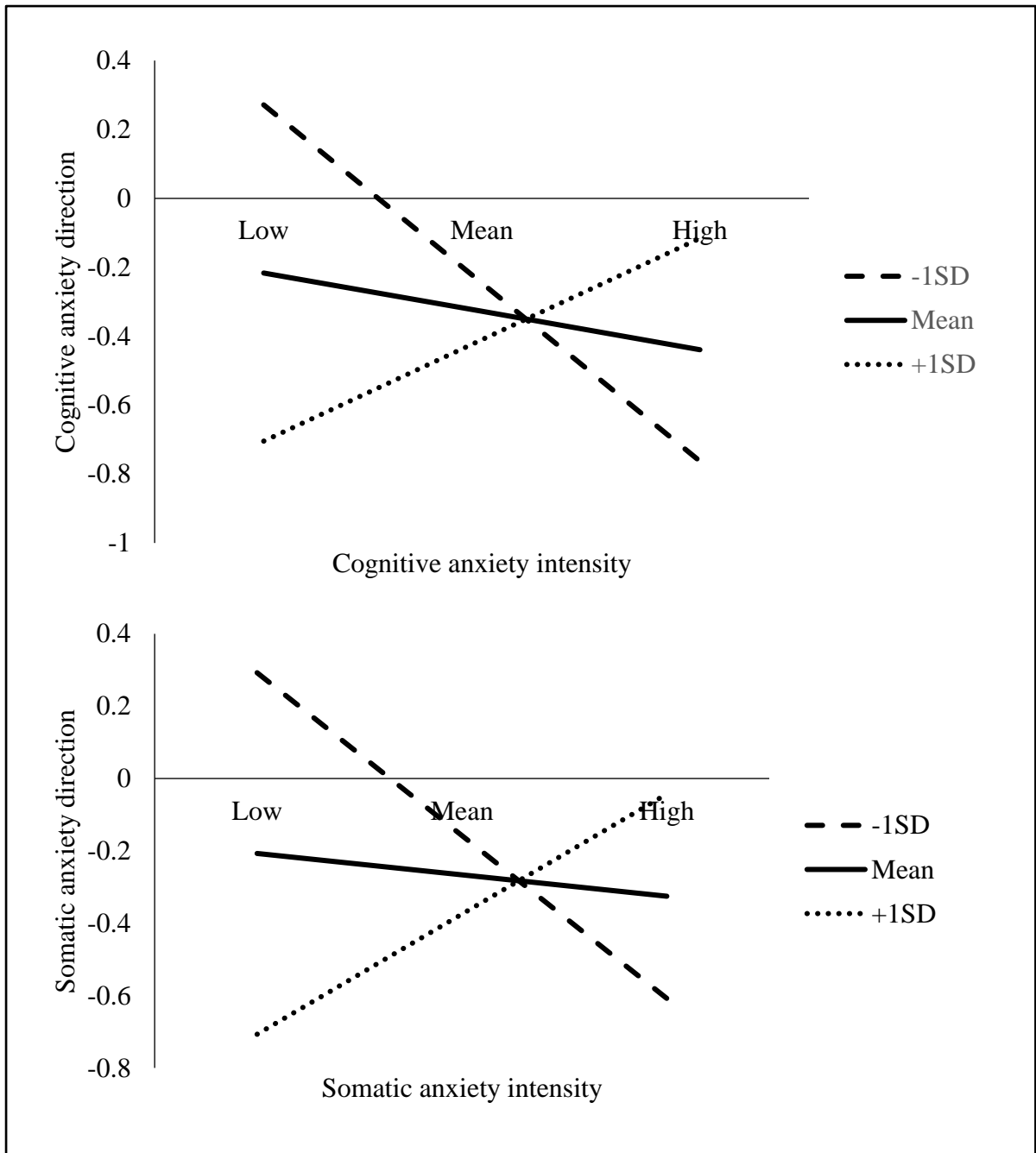


Figure 1. Plots for the interaction effects of cognitive and somatic anxiety intensity and mastery imagery ability on anxiety direction at Session 2.

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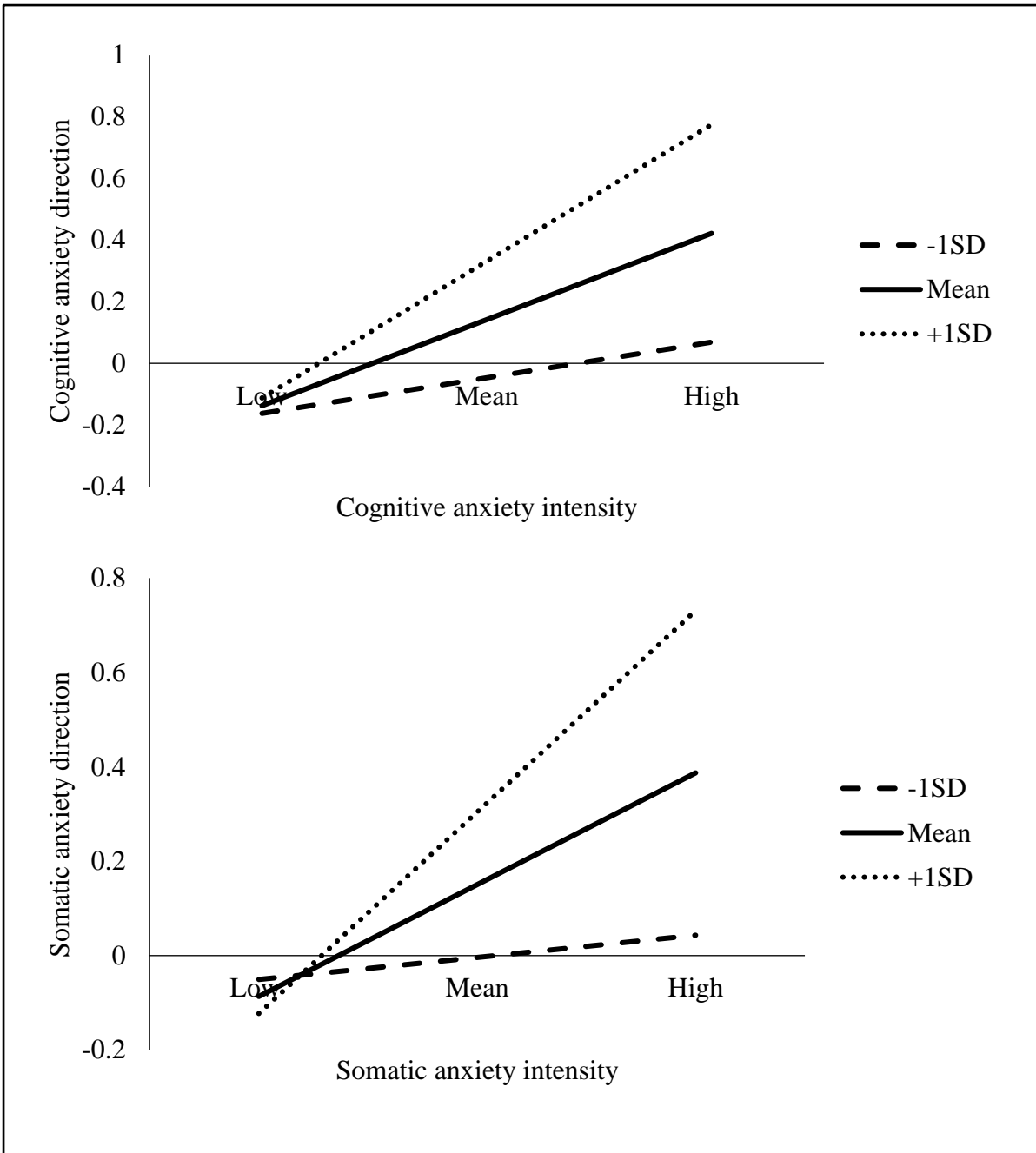


Figure 2. Plots for the interaction effects of cognitive and somatic anxiety intensity and mastery imagery ability on anxiety direction at Session 1.