

Emotion regulation predicts imagery ability

Anuar, Nurwina; Cumming, Jennifer; Williams, Sarah

DOI:

[10.1177/0276236616662200](https://doi.org/10.1177/0276236616662200)

Document Version

Peer reviewed version

Citation for published version (Harvard):

Anuar, N, Cumming, J & Williams, S 2016, 'Emotion regulation predicts imagery ability', *Imagination, Cognition and Personality*. <https://doi.org/10.1177/0276236616662200>

[Link to publication on Research at Birmingham portal](#)

Publisher Rights Statement:

Checked for eligibility: 22/09/2016. The Author(s) 2016.

Anuar, Nurwina, Jennifer Cumming, and Sarah Williams. "Emotion Regulation Predicts Imagery Ability." *Imagination, Cognition and Personality* (2016): 0276236616662200.

<http://ica.sagepub.com/content/early/2016/08/09/0276236616662200>

General rights

Unless a licence is specified above, all rights (including copyright and moral rights) in this document are retained by the authors and/or the copyright holders. The express permission of the copyright holder must be obtained for any use of this material other than for purposes permitted by law.

- Users may freely distribute the URL that is used to identify this publication.
- Users may download and/or print one copy of the publication from the University of Birmingham research portal for the purpose of private study or non-commercial research.
- User may use extracts from the document in line with the concept of 'fair dealing' under the Copyright, Designs and Patents Act 1988 (?)
- Users may not further distribute the material nor use it for the purposes of commercial gain.

Where a licence is displayed above, please note the terms and conditions of the licence govern your use of this document.

When citing, please reference the published version.

Take down policy

While the University of Birmingham exercises care and attention in making items available there are rare occasions when an item has been uploaded in error or has been deemed to be commercially or otherwise sensitive.

If you believe that this is the case for this document, please contact UBIRA@lists.bham.ac.uk providing details and we will remove access to the work immediately and investigate.

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19

Emotion Regulation Predicts Imagery ability

Nurwina Anuar^{ab*}, Sarah E. Williams^a and Jennifer Cumming^a

^aUniversity of Birmingham

^bUniversiti Teknolgi Malaysia

* Corresponding author:

Nurwina Anuar,

School of Sport, Exercise & Rehabilitation Sciences,

University of Birmingham, Edgbaston, Birmingham,

B15 2TT. UK.

wynakmal@gmail.com

+441214158187

1 **Abstract**

2 This study explored the relationship between athletes' emotion regulation and imagery
3 ability. 648 athletes (57% female; $M_{age} = 20.79$ years, $SD = 4.36$) completed the Sport
4 Imagery Ability Questionnaire (SIAQ) and Emotion Regulation Questionnaire (ERQ).
5 Structural Equation Modelling supported the hypothesised model in which reappraisal
6 positively predicted all SIAQ subscales. However, suppression had no significant association
7 with imagery ability despite being predicted to be negatively associated. Results support the
8 revised applied model of deliberate imagery use that individual characteristics will influence
9 the imagery experience. Specifically, athletes who reappraise their emotions more frequently
10 find it easier to image sport related content.

11

12 *Keywords:* Emotion regulation, reappraisal, suppression, imagery ability, Revised Applied

13 Model of Deliberate Imagery Use.

14

15

16

1 This is due to an individual's characteristics influencing both the different reasons for
2 imaging (i.e., why image) as well as the imagery content used to achieve these functions
3 (Harwood, Cumming & Fletcher, 2004). For example, in exercise settings, women tend to
4 use imagery more frequently for health and appearance reasons whereas men tend to use
5 imagery more frequently for motivational purposes (Cumming, 2008). Despite research
6 highlighting a relationship between individual characteristics and reasons for imaging, there
7 has been less attention on how these characteristics may impact upon an individual's imagery
8 ability.

9 A number of studies have shown that athletes of higher competitive level often
10 display greater imagery ability compared to their lower level counterparts (Murphy, Nordin,
11 & Cumming, 2008; Roberts, Callow, Hardy, Markland, & Bringer, 2008; Williams &
12 Cumming, 2011). Literature has also suggested possible gender differences in imagery
13 ability (Isaac & Marks, 1994; Williams & Cumming, 2011), but this finding has been rather
14 inconsistent across studies (Callow & Hardy, 2004; Gregg & Hall, 2006). As well as gender
15 and competitive level differences, recent research has highlighted imagery ability tends to be
16 negatively associated with a threat appraisal and anxiety, and positively associated with a
17 challenge appraisal and confidence (Williams & Cumming, 2015). These initial findings
18 suggest that individual's cognitive and emotional dispositions are likely to relate to their
19 imagery ability.

20 The association between emotional dispositions and imagery ability is in line with
21 Lang's bioinformational theory (1977, 1979), which proposes that more emotive images will
22 likely lead to more vivid imagery. Specifically, Lang (1977) proposed that the imagery
23 process involves activating a network of propositionally coded information which is stored in
24 the long-term memory. An emotive image is thought to more readily tap into this memory
25 network (Murphy et al., 2008). Indeed, the inclusion of response propositions including

1 verbal responses (e.g., shouting), somatomotor events (e.g., muscle tension), visceral events
2 (e.g., increased heart rate), processor characteristics (e.g., disorientated in time), and sense
3 organ adjustments (e.g., postural changes) are thought to result in certain physiological
4 responses and higher imagery ability (Lang, 1979; Williams, Cooley & Cumming, 2013). As
5 found with vividness, research suggests a more emotive image is also associated with greater
6 ease of imaging (Holmes & Mathews, 2005). Despite the evident relationship between
7 emotions and imagery ability, it may be somewhat surprising that research is yet to examine
8 whether emotion regulation relates to imagery ability.

9 Emotion regulation involves changing the response (i.e., increase, maintain or
10 decrease) of positive or negative emotions (Gross, 1999). Athletes frequently regulate their
11 emotions to assist with their performance. Although there are thought to be over 400
12 strategies used to regulate emotions, the two fundamental processes are emotion reappraisal
13 and emotion suppression. Reappraisal refers to changing how you think about a particular
14 situation to decrease its emotional impact (Gross, 2002), which occurs before experiencing
15 the emotion (Gross & John, 2003). For example, if athletes feel embarrassed about making
16 mistakes when in training or competition, they may change the embarrassment to a
17 motivational thought by accepting it as a learning experience. Consequently, the feelings
18 associated with embarrassment are experienced as motivation resulting in a reduced
19 emotional impact. Suppression refers to inhibiting ongoing emotion-expressive behaviour.
20 This response comes later in the emotion process, which decreases the behaviour expression
21 but not the emotion experienced (Gross, 2002). For example, in a football penalty situation, a
22 footballer may disagree with the refereeing decision but may forcibly accept it and continue
23 the game while still feeling angry (Jones, 2003). Typically, reappraisal is associated with
24 pleasant emotions whereas suppression is associated with more negative emotion (Jones,

1 2003). However, in sport, suppression has not been found to be associated with either
2 positive or negative emotions (Uphill, Lane, & Jones, 2012).

3 It is likely that athletes' emotion regulation is related with their imagery ability due to
4 the associations that both imagery and emotion regulation have with emotions and memory.
5 Hayes et al. (2010) explained that emotion regulation influences an individual's cognitive
6 function, especially, the encoded memory function. They suggested that reappraisal will
7 boost memory function whereas suppression impairs memory (Hayes et al., 2010; Gross,
8 2007). However, research is yet to sufficiently examine to what extent reappraisal and
9 suppression would have on the relationship with memory function and subsequently relate to
10 an individual's imagery ability.

11 D'Argembeau and Van der Linden (2006) were the first to highlight the potential
12 relationship between emotion regulation and imagery ability. They found that the ability to
13 picture past and future events is related to memory function and emotion regulation.
14 D'Argembeau and Van der Linden suggested that individuals who suppress emotions would
15 have difficulty accessing memory and would therefore not be able to construct an image as
16 readily. Although picturing past and future events was negatively associated with
17 suppression, there was no association with emotion reappraisal. However, this study was
18 limited by the measurement of imagery ability to past and future events, and the events and
19 emotion regulation not being sport specific.

20 Therefore, the primary aim of this study was to comprehensively explore emotion
21 reappraisal and suppression predicted ease of imaging different sport related content. Based
22 on previous literature (D'Argembeau & Van der Linden, 2006), it was hypothesised that
23 emotion suppression would negatively predict ease of imaging the five types of imagery
24 assessed (i.e., skill, strategy, mastery, goal, and affect). Based on bioinformational theory
25 (Lang, 1979), it was hypothesised that emotion reappraisal would positively predict ease of

1 imaging all five types of imagery. As this is the first study to examine the relationship, we
2 also examined which type of imagery ability emotion regulation most strongly predicted.
3 The hypothesised model can be seen in Figure 1.

4 —Insert Figure 1 here—

5 **Method**

6 **Participants**

7 Six hundred and forty eight (276 males, 372 females; $M_{\text{age}} = 20.79$ years, $SD = 4.36$)
8 athletes participated in the study. The most commonly represented team sports were football
9 ($n = 197$), cheerleading ($n = 50$), basketball ($n = 35$), rugby ($n = 28$), and netball ($n = 19$), and
10 the most commonly represented individual sports were athletics ($n = 37$), swimming ($n = 27$),
11 dance ($n = 23$), road running ($n = 23$), badminton ($n = 19$), and tennis ($n = 14$). All
12 participants had been participating in their sport for an average of 7.67 years ($SD = 6.50$).
13 Participants were either recreational athletes ($n = 367$) who reported playing their sport for
14 leisure, and competitive athletes ($n = 281$) who played sport in more competitive setting.

15 **Measures**

16 **Individual characteristics.** Participants provided information regarding their age,
17 gender, sport played, competitive level, and years of playing experience.

18 **Sport Imagery Ability Questionnaire.** The Sport Imagery Ability Questionnaire
19 (SIAQ; Williams & Cumming, 2011) was used to assess athlete's imagery ability specific to
20 their sport. The SIAQ consists of 15 items in which 3 items represent one of the five
21 subscales; skill imagery ability (e.g., "refining particular skill"), strategy imagery ability (e.g.,
22 "making up new plan strategy in my head"), goal imagery ability (e.g., "myself winning a
23 medal"), affect imagery ability (e.g., "the excitement associated with performing"), and
24 mastery imagery ability (e.g., "staying positive after the setback"). Participants indicate their
25 ease of imaging each item on a 7-point scale (1 = *very hard to image*, 7 = *very easy to*

1 *image*). The SIAQ is a valid and reliable measure of imagery ability (Williams & Cumming,
2 2011). In the present study, internal reliability was good with the Cronbach alpha coefficient
3 of each subscale being .70 or above (skill = .80, strategy = .82, goal = .84, affect = .75,
4 mastery = .70).

5 **Emotion Regulation Questionnaire.** The Emotion Regulation Questionnaire for
6 Sport (ERQ; Uphill et al., 2012) was used to assess athlete emotion regulation. This measure
7 was developed from the original Emotion Regulation Questionnaire (Gross & John, 2003).
8 Participants indicate the extent to which they generally regulate their emotions when training
9 or competing in their sport. Six items represent an individual's tendency to reappraise
10 emotions (e.g., "I control my emotions by changing the way I think about the situation I am
11 in") and four items represent an individual's tendency to suppress emotions (e.g., "I keep my
12 emotions to myself"). Responses are made on a 7-point scale ranging from 1 (*strongly*
13 *disagree*) to 7 (*strongly agree*). The ERQ for sport is a valid and reliable measure of athlete
14 emotion regulation (Uphill et al., 2012). In the present study, the questionnaire demonstrated
15 good internal reliability with Cronbach alpha coefficients of .75 (suppression) and .85
16 (reappraisal).

17 **Procedures**

18 Participants were recruited following ethical approval for the study from the
19 university where the authors are based. Participants were recruited by contacting local team
20 coaches as well as from an undergraduate sport psychology class who were awarded with a
21 course credit on completion of the study. All potential participants were provided with a
22 questionnaire pack containing an information sheet explaining the nature of the study, a
23 consent form, an individual characteristic form, the SIAQ, and the ERQ. Prior to completion
24 of the questionnaire pack participants were informed that participation was voluntary, they
25 had the right to withdraw at any time, and the information they provided would be

1 confidential. Those who agreed to participate provided written consent and then completed
2 the questionnaire pack which took no longer than 15 minutes.

3 **Data Analyses**

4 Data was inspected for missing values, outliers, and univariate and multivariate
5 normality. To examine whether the hypothesised model should control for gender and/or
6 competitive level, two separate two-way gender (male, female) × competitive level
7 (recreational, competitive) MANOVAs were conducted to examine whether there were any
8 differences in emotion regulation and imagery ability. Pillai's trace value is reported as it is
9 considered the most robust multivariate significance test (Olson, 1976).

10 To test the hypothesised model data were analysed using AMOS 22.0 software
11 (Arbuckle, 2013). Following the two step approach of structural equation modelling (SEM),
12 maximum likelihood was employed to estimate both the SIAQ and ERQ before exploring the
13 structural model (Kline, 2005). Separate CFAs were first performed on the ERQ and SIAQ
14 questionnaires before the measurement model was examined as a whole. Goodness of fit was
15 tested by the chi-squared likelihood statistic ratio (χ^2 ; Jöreskog, & Sörbom, 1993). Following
16 the recommendations by Hu and Bentler (1999), additional fit indices were examined and
17 reported. The standardized root mean square residual (SRMR; Bentler, 1995) and Root Mean
18 Square Error of Approximation (RMSEA) were both included as indicators of the absolute fit
19 with values of < .06 and < .08 reflecting a good fit (Hu & Bentler, 1999). The Comparative
20 Fit Index (CFI) and Tucker Lewis Index (TLI) were included to reflect incremental fit with
21 values for both of > .95 and > .90 reflecting an excellent and good fit respectively (Hu &
22 Bentler, 1999). Nevertheless, Hopwood and Donnellan (2010) suggest a more relaxed cut off
23 value for CFI of > .90 and RAMSEA of < .10. Although there is still a debate surrounding
24 the appropriate values for demonstrating an appropriate model fit (see, Markland, 2007;

1 for gender, Pillai's Trace = .06, $F(5, 640) = 8.54, p < .001, \eta_p^2 = .06$. There was no significant
2 multivariate effect for competitive level, Pillai's Trace = .01, $F(5,640) = 1.73, p < .13, \eta_p^2 =$
3 .01, and no significant interaction between gender and competitive level, Pillai's Trace = .02,
4 $F(5,640) = 2.01, p < .08, \eta_p^2 = .02$.

5 Results at the univariate level revealed significant gender differences in strategy, $F(1,$
6 $644) = 17.72, p < .001, \eta_p^2 = .03$, observed power = 99%; goal, $F(1, 644) = 29.92, p < .001,$
7 $\eta_p^2 = .04$, observed power = 100%; affect $F(1,644) = 6.68, p = .01, \eta_p^2 = .01$, observed power
8 = 73%; and mastery imagery, $F(1,644) = 14.46, p < .001, \eta_p^2 = .02$, observed power = 97%,
9 but no significant difference for skill imagery, $F(1, 644) = 2.28, p = .132, \eta_p^2 = .004,$
10 observed power = 33%. A comparison of the means as shown in Table 1 revealed that males
11 found it significantly easier to image strategy, goal, affect, and mastery images compared to
12 females. Due to these differences, gender was controlled for in the main analyses.

13 —Insert Table1 here—

14 **Measurement Models**

15 Overall, the separate CFA measurement models revealed a good fit to the data for the
16 ERQ, $\chi^2(68) = 339.68, p < .001, CFI = .94, TLI = .92, SRMR = .05, RMSEA = .06$ (90% CI
17 = 0.05 – 0.06), with the inter-factor correlation being 0.31. The measurement model for the
18 SIAQ also fit the data well, $\chi^2(160) = 471.87, p < .001, CFI = .96, TLI = .95, SRMR = .04,$
19 $RMSEA = .06$ (90% CI = 0.04 – 0.04). The inter-factor correlations ranged between 0.30 and
20 0.44 in magnitude. The measurement model for the ERQ and SIAQ as a whole also revealed
21 a good fit to the data, $\chi^2(264) = 634.71, p < .001, CFI = .94, TLI = .95, SRMR = .08, RMSEA$
22 = .05 (90% CI = .04 – .05). The internal reliability for the ERQ and SIAQ subscales is
23 reported in Table 1.

24

25

1 **Structural Model**

2 To test the hypothesized model presented in Figure 1, regression lines from
3 suppression and reappraisal were drawn to all SIAQ subscales (i.e., skill, strategy, goal,
4 affect, and mastery imagery ability) while controlling for gender. The structural model
5 revealed a less than adequate fit to the data, $\chi^2(264) = 1133.52, p < .001, CFI = .85, TLI =$
6 $.84, SRMR = .12, RMSEA = 0.07(90\% CI = 0.07 - 0.08)$. Inspection of the regression
7 weights revealed no significant paths from suppression to all five SIAQ subscales (skill, $p =$
8 0.14 ; strategy, $p = 0.17$; goal, $p = 0.96$; affect, $p = 0.55$; mastery, $p = 0.85$), indicating that
9 suppression had no association with ease of imaging. These paths were therefore removed
10 from the model. The second model demonstrated an adequate fit to the data, $\chi^2(287) =$
11 $895.38.19, p < .001, CFI = 0.90, TLI = 0.90, SRMR = 0.10 RMSEA = 0.06 (90\% CI = 0.05 -$
12 $0.06)$. Reappraisal was found to positively predicted skill, strategy, goal, affect, and mastery
13 imagery ability at ($p < .001$) value. The final model and standardized regression weights can
14 be seen in Figure 2.

15 —Insert Figure 2 here—

16 **Discussion**

17 The aim of the present study was to examine the relationship between emotion
18 regulation and imagery ability. Specifically, we investigated whether athlete emotion
19 regulation (i.e., reappraisal and suppression) predicted ease of imaging skill, strategy, goal,
20 affect, and mastery imagery. It was hypothesised that reappraisal would positively predict
21 and suppression negatively predict the five types of imagery ability.

22 The findings partially support our hypothesis. As expected, reappraisal positively
23 predicted all five types of imagery ability. That is, athletes who reappraise their emotions
24 more frequently tend to display higher levels of skill, strategy, goal, affect, and mastery
25 imagery ability. Based on the size of the regression weights, it is interesting to note that

1 reappraisal tendencies most strongly predicted mastery imagery ability, closely followed by
2 skill and affect imagery ability.

3 The strong relationship between reappraisal and mastery imagery ability is
4 unsurprising. Regulating emotions by reappraisal also involves maintaining or decreasing the
5 emotions experienced in a situation. Athletes who are more frequently reappraising their
6 emotions are likely to be more able to image negative or difficult situations more positively.
7 This can be attributed to the motivational reasons for athletes to reappraise, to decrease the
8 emotional impact (Gross, 2002). Therefore, the stronger of the negative emotion and the
9 more difficult situation the athlete is in, the more vivid mastery imagery content can be.

10 The association between emotion reappraisal and skill imagery as the second
11 strongest prediction is interesting given that the associated imagery content is more cognitive
12 in nature. This is perhaps due to more of the image information being encoded from
13 memory. As, explained by Gross (2002), reappraisal boosts memory function. Similarly,
14 cognitive neuroscience literature demonstrates that reappraisal enhances encoding in memory
15 (Hayes et al., 2010). Therefore, it is possible that for athletes who tend to reappraise more
16 frequently memories of performing these skills are recalled more easily when imaging. This
17 explanation between imagery and memory function may also apply to imagery strategy and
18 goal as the result appear positives association between reappraisal and the two as well.

19 The next highest relationship with reappraisal is affect imagery ability. This is
20 unsurprising given that when an athlete reappraises emotions, they change the emotion.
21 Being able to call upon various emotions is likely to facilitate an image incorporating positive
22 feelings and emotions. Also, during reappraisal, the emotion proposition is likely tapped
23 during imagery as suggested by Lang`s (1979) bioinformational theory. These results may
24 also be partly explained by Lang`s assertion that experiencing more emotions when imaging
25 would likely produce more vivid images (Lang, 1979). Importantly, the result of emotion

1 regulation predicting all five types of imagery ability demonstrate that reappraisal is not only
2 related to imagery ability of motivational content, but also the ability to image cognitive
3 content (i.e., skills and strategies).

4 Contrary to our hypothesis, no relationship was found between suppression and the
5 SIAQ subscales. This finding suggests that suppression as an emotion regulation strategy is
6 not associated with how easily athletes are able to image content in relation to their sport. In
7 contrast, D`Argembeau and Van der Linden (2006) found that suppression negatively
8 predicted imagery of past and future events. They suggested that suppression may affect
9 memory function by diverting attention from encode the details of imaging rather to focus on
10 the emotional responses. In support, studies have documented that suppressing emotions
11 impair memory by blocking the brain pathway involved in retrieval of information, and result
12 in experiencing fewer sensory, contextual and emotional details (D`Argembeau & Van der
13 Linden, 2006; Gross, 2002). However, evidence regarding the suppression that impedes
14 memory encoding (Hayes et al., 2010) does not apply to athletes and sport context. Thus,
15 Uphill et al. (2012) attributed the idea that within the sport context suppression does not tend
16 to be associated with either positive or negative emotions. This is because athletes' suppress
17 emotion if they find it will benefit competition (Gross & Thompson, 2007) meaning it may
18 not be detrimental to memory. This may explain why there appears to be no relationship
19 between athlete emotion suppression and imagery ability.

20 A second potential explanation could be due to the relationship between reappraisal
21 and suppression. Although, literature has typically identified no relationship between
22 emotion reappraisal and suppression (Hayes et al., 2010; Gross & John 2003), the present
23 study identified a moderate positive relationship. Similarly, Uphill et al. (2012) found
24 reappraisal and suppression were correlated, suggesting that athletes who suppress their
25 emotions more frequently tend to reappraise their emotions more frequently. Consequently,

1 suppression may not be associated with lower levels of imagery ability due to being
2 overridden by the association between emotion reappraisal and imagery ability. To examine
3 this further, future research could re-examine the relationship between imagery ability and
4 emotion regulation in athletes who display high levels of reappraisal and low levels of
5 suppression, and athletes who display high levels of suppression and low levels of
6 reappraisal.

7 Although the present study found no differences in emotion regulation due gender or
8 competitive level, and no differences in imagery ability due to competitive level, there were a
9 number of differences in imagery ability due to gender. Specifically, males have reported
10 being able to image strategy, goal, affect, and mastery imagery more easily than females.
11 Traditionally, gender differences were thought to only exist in spatio-visual imagery tasks
12 (Campos, Pérez-Fabello, & Gómez-Juncal, 2004) as studies have typically found no self-
13 report differences in imagery ability (e.g., Callow & Hardy, 2004). However, the majority of
14 these studies, (Abma, Fry, Li, & Relyea, 2002; Callow & Hardy, 2004) have used movement
15 based questionnaires such as Vividness of Movement Imagery Questionnaire-2 (VMIQ-2;
16 Roberts et al., 2008) and Movement Imagery Questionnaires (MIQ-R; Hall & Martin, 1997).
17 The more recent emergence of the SIAQ which assesses sport content beyond just
18 movements has resulted in the emergence of more gender differences (Williams & Cumming,
19 2011). These results along with the present study suggest that gender differences in imagery
20 ability may apply to other imagery content except movement imagery ability (i.e., skill
21 imagery) and is something research should continue to investigate.

22 The present study findings have important implications for future practice. They
23 provide new insight into the potential relationship between the “who” (i.e., emotion
24 regulation) and “imagery ability” components of the RAMDIU (Cumming & Williams,
25 2013). Although a direct relationship is not proposed in the model, the results of the present

1 study indicate that this is something to consider. From an applied perspective, it is worth
2 considering these findings when planning imagery interventions. Due to the positive
3 association between imagery ability and emotion reappraisal, it can be suggested that athletes
4 who more frequently reappraise their emotions may experience greater imagery ability and
5 thus benefit more from an imagery intervention compared to those who reappraise emotions
6 less often. Furthermore, the use of emotion reappraisal techniques may have the potential to
7 increase an athlete's imagery ability. In this way, emotion reappraisal training may be an
8 effective "tool" for athletes who struggle to image. It could also be suggested that imagery
9 techniques designed to improve imagery ability and alter appraisals and perceptions of
10 situations such as layered stimulus response training (LSRT; Cumming et al., in press) could
11 encourage more frequent emotion reappraisal in athletes. Additionally, due to the lack of
12 association between emotion suppression and imagery ability, it can be suggested that
13 suppression of athlete emotions is not likely to have a negative impact on imagery ability and
14 thus the effectiveness of an imagery intervention.

15 A key strength of the present study is the large sample size and comprehensive
16 assessment of both types of emotion regulation and five types of imagery ability, and
17 analytical procedures employed. Although this study provides an important contribution to
18 the literature, it is not without its limitations. The scope of this study was limited by its cross
19 sectional nature. While this study provides important insight into the relationships between
20 emotion regulation and imagery ability, it is important to remember that these relationships
21 do not infer causation. As such, the next logical step in continuing this line of research is to
22 examine the extent to which emotion reappraisal training is able to alter imagery ability.

23 In conclusion, this is the first study to explore the relationship between the "who" and
24 "imagery ability" components of the RAMDIU, specifically athletes' emotion regulation and
25 ease of imaging. Results revealed that reappraisal was positively associated with skill,

1 strategy, goal, affect, and mastery imagery ability, whereas suppression had no association
2 with imagery ability. These findings suggest that different athlete characteristics are
3 associated with differences in athlete imagery ability. Therefore, it contributes to the
4 growing body of literature in support of the RAMDIU. Future research should explore the
5 extent to which reappraisal training impacts athlete imagery ability.

References

- 1
- 2 Abma, C. L., Fry, M. D., Li, Y., & Relyea, G. (2002). Differences in imagery content and
3 imagery ability between high and low confident track and field athletes. *Journal of*
4 *Applied Sport Psychology, 14*, 67-75. doi:10.1080/10413200252907743
- 5 Arbuckle, J. L. (2013). *IBM® SPSS® Amos™ 22 User's Guide*. Chicago, IL: IBM.
- 6 Bentler, P. M. (1995). *EQS structural equations program manual*. Encino, CA: Multivariate
7 Software Inc.
- 8 Byrne, B.M. (2009). *Structural equation modeling with AMOS: basic concepts, applications,*
9 *and programming (2nd ed.)*. New York: Taylor and Francis.
- 10 Callow, N., & Hardy, L. (2004). The relationship between the use of kinaesthetic imagery
11 and different visual imagery perspectives. *Journal of sports sciences, 22*, 167-177.
12 doi:10.1080/02640410310001641449
- 13 Campos, A., Pérez-Fabello, M. J., & Gómez-Juncal, R. (2004). Gender and age differences in
14 measured and self-perceived imaging capacity. *Personality and Individual*
15 *Differences, 37*, 1383-1389. doi:10.1016/j.paid.2004.01.008
- 16 Cumming, J. (2008). Investigating the relationship between exercise imagery, leisure-time
17 exercise behavior, and self-efficacy. *Journal of Applied Sport Psychology, 20*, 184-
18 198. doi; 10.1080/10413200701810570
- 19 Cumming, J., & Williams, S. E. (2013). Introducing the revised applied model of deliberate
20 imagery use for sport, dance, exercise, and rehabilitation. *Movement & Sport*
21 *Sciences, 82*(4), 69-81. doi: 10.1051/sm/2013098
- 22 Cumming, J., & Williams, S.E. (2012). Imagery: The role of imagery in performance. In S.
23 Murphy (Ed.), *Oxford Handbook of Sport and Performance Psychology*. (pp. 213-
24 232). doi: 10.1093/oxfordhb/9780199731763.013.0011

- 1 Cumming, J., Cooley, S. J., Anuar, N., Kosteli, M. C., Quinton, M. L., Weibull, F., & Sarah
2 E. Williams (in press). Developing Imagery Ability Effectively: A Guide to Layered
3 Stimulus Response Training. *Journal of Sport Psychology in Action*.
- 4 D'Argembeau, A., & Van der Linden, M. (2006). Individual differences in the
5 phenomenology of mental time travel: The effect of vivid visual imagery and emotion
6 regulation strategies. *Consciousness and cognition*, *15*, 342-350.
7 doi:10.1016/j.concog.2005.09.001
- 8 Gregg, M., & Hall, C. (2006). The relationship of skill level and age to the use of imagery by
9 golfers. *Journal of Applied Sport Psychology*, *18*, 363-375. doi:
10 10.1080/10413200600944140
- 11 Gross, J. J. (1999). Emotion regulation: Past, present, future. *Cognition & Emotion*, *13*, 551-
12 573. doi; 10.1080/026999399379186
- 13 Gross, J. J. (2002). Emotion regulation: Affective, cognitive, and social consequences.
14 *Psychophysiology*, *39*, 281-291. doi: 10.1017.S0048577201393198
- 15 Gross, J. J., & John, O. P. (2003). Individual differences in two emotion regulation processes:
16 implications for affect, relationships, and well-being. *Journal of Personality and*
17 *Social Psychology*, *85*, 348 -362. Retrieved from [http://dx.doi.org/10.1037/0022-](http://dx.doi.org/10.1037/0022-3514.85.2.348)
18 [3514.85.2.348](http://dx.doi.org/10.1037/0022-3514.85.2.348)
- 19 Gross, J.J., & Thompson, R.A. (2007). *Emotion regulation: Conceptual foundations*. In J.J.
20 Gross (Ed.), *Handbook of emotion regulation* (pp. 3–26). New York: Guilford
- 21 Hall, C. (2001). *Imagery in sport and exercise*. In *Handbook of Sport Psychology* (edited by
22 R. Singer, H. Hausenblas and C. Janelle), pp. 529-549. New York: Wiley
- 23 Hall, C., & Martin, K. (1997). Measuring movement imagery abilities: A revision of the
24 Movement Imagery Questionnaire. *Journal of Mental Imagery*, *21*, 143–154.
25 Retrieved from : <http://psycnet.apa.org/psycinfo/1997-04645-004>

- 1 Harwood, C., Cumming, J., & Fletcher, D. (2004). Motivational profiles and psychological
2 skills use within elite youth sport. *Journal of Applied Sport Psychology, 16*, 318-332.
3 doi:10.1080/10413200490517986
- 4 Hayes, J. P., Morey, R. A., Petty, C. M., Seth, S., Smoski, M. J., McCarthy, G., & LaBar, K.
5 S. (2010). Staying cool when things get hot: emotion regulation modulates neural
6 mechanisms of memory encoding. *Frontiers in Human Neuroscience, 4*(230), 1-10.
7 doi: 10.3389/fnhum.2010.00230
- 8 Hu, L., & Bentler, P. M. (1999). Cut off criteria for fit indexes in covariance structure
9 analysis: Conventional criteria versus new alternatives. *Structural Equation*
10 *Modelling: A Multidisciplinary Journal, 6*, 1–55. doi:10.1080/10705519909540118
- 11 Holmes, E.A. & Mathews, A. (2005). Mental imagery and emotion: A special relationship?
12 *Emotion, 5*, 489–495. doi: 10.1037/1528-3542.5.4.489
- 13 Hopwood, C. J., & Donnellan, M. B. (2010). How should the internal structure of personality
14 inventories be evaluated? *Personality and Social Psychology Review, 14*, 332-346.
15 doi : 10.1177/1088868310361240
- 16 Isaac, A. R., & Marks, D. F. (1994). Individual differences in mental imagery experience:
17 developmental changes and specialization. *British Journal of Psychology, 85*, 479-
18 500. doi: 10.1111/j.2044-8295.1994.tb02536.x
- 19 Jones, M. (2003). Controlling emotions in sport. *The Sport Psychologist, 17*, 471-486.
20 Retrieved from: http://works.bepress.com/marc_jones/8/
- 21 Jöreskog, K. G., & Sörbom, D. (1993). LISREL 8 *user's reference guide*. Chicago, IL:
22 Scientific Software.
- 23 Kline, R.B. (2005), *Principles and Practice of Structural Equation Modeling* (2nd Edition
24 ed.). New York: The Guilford Press

- 1 Lang, P. J. (1977). Imagery in therapy: An information processing analysis of fear. *Behavior*
2 *Therapy*, 8, 862-886. doi:10.1016/S0005-7894(77)80157-3
- 3 Lang, P. J. (1979). A bio-informational theory of emotional imagery. *Psychophysiology*, 16,
4 495-512. doi: 10.1111/j.1469-8986.1979.tb01511.x
- 5 Martin, K. A., Moritz, S. E., & Hall, C. R. (1999). Imagery use in sport: a literature review
6 and applied model. *The Sport Psychologist*, 13, 245-268. Retrieved from
7 <http://journals.humankinetics.com/tsp>
- 8 Markland, D. (2007). The golden rule is that there are no golden rules: A commentary on
9 Paul Barrett's recommendations for reporting model fit in structural equation
10 modelling. *Personality and Individual Differences*, 42, 851-858.
11 doi:10.1016/j.paid.2006.09.023
- 12 Marsh, H.W., Hau, K-T., & Wen, Z. (2004). In search of golden rules: Comment on
13 hypothesis-testing approaches to setting cutoff values for fit indexes and dangers in
14 overgeneralizing
- 15 Murphy, S., Nordin, S. M., & Cumming, J. (2008). *Imagery in sport, exercise and dance*.
16 *Advances in sport psychology* / [ed] T. Horn, Champaign, IL: Human Kinetics
- 17 Nordin, S.M., & Cumming, J. (2005). More than meets the eye: Investigating imagery type,
18 direction, and outcome. *The Sport Psychologist*, 19, 1-17. Retrieved from
19 http://works.bepress.com/jennifer_cumming/4/
- 20 Olson, C. L. (1979). Practical considerations in choosing a MANOVA test statistic: A
21 rejoinder to Stevens. *Psychological Bulletin*, 86, 1350-1352. doi.org/10.1037/0033-
22 2909.86.6.1350
- 23 Roberts, R., Callow, N., Hardy, L., Markland, D., & Bringer, J. (2008). Movement imagery
24 ability: development and assessment of a revised version of the vividness of
25 movement imagery questionnaire. *Journal of Sport & Exercise Psychology*, 30, 200-

- 1 221. Retrieved from [http://journals.humankinetics.com/jsep-back-](http://journals.humankinetics.com/jsep-back-issues/JSEPVOLUME30Issue2April/MovementImageryAbilityDevelopmentandAssessmentofaRevisedVersionoftheVividnessofMovementImageryQuestionnaire)
2 [issues/JSEPVOLUME30Issue2April/MovementImageryAbilityDevelopmentandAssess-](http://journals.humankinetics.com/jsep-back-issues/JSEPVOLUME30Issue2April/MovementImageryAbilityDevelopmentandAssessmentofaRevisedVersionoftheVividnessofMovementImageryQuestionnaire)
3 [mentofaRevisedVersionoftheVividnessofMovementImageryQuestionnaire](http://journals.humankinetics.com/jsep-back-issues/JSEPVOLUME30Issue2April/MovementImageryAbilityDevelopmentandAssessmentofaRevisedVersionoftheVividnessofMovementImageryQuestionnaire)
- 4 Robin, N., Dominique, L., Toussaint, L., Blandin, Y., Guillot, A., & Her, M. L. (2007).
5 Effects of motor imagery training on service return accuracy in tennis: The role of
6 imagery ability. *International Journal of Sport and Exercise Psychology*, 5, 175-186.
7 doi: 10.1080/1612197X.2007.9671818
- 8 Uphill, M. A., Lane, A. M., & Jones, M. V. (2012). Emotion Regulation Questionnaire for
9 use with athletes. *Psychology of Sport and Exercise*, 13, 761-770.
10 doi:10.1016/j.psychsport.2012.05.001
- 11 White, A., & Hardy, L. (1998). An in-depth analysis of the uses of imagery by high-level
12 slalom canoeists and artistic gymnasts. *Sport Psychologist*, 12, 387-403. Retrieved
13 from
14 [http://www.humankinetics.com/acucustom/sitename/Documents/DocumentItem/1983](http://www.humankinetics.com/acucustom/sitename/Documents/DocumentItem/1983.pdf)
15 [.pdf](http://www.humankinetics.com/acucustom/sitename/Documents/DocumentItem/1983.pdf)
- 16 Williams, S. E., & Cumming, J. (2011). Measuring athlete imagery ability: the sport imagery
17 ability questionnaire. *Journal of Sport and Exercise Psychology*, 33, 416-440.
18 Retrieved from http://works.bepress.com/jennifer_cumming/17/
- 19 Williams, S. E., & Cumming, J. (2015): Athlete imagery ability: A predictor of confidence
20 and anxiety intensity and direction. *International Journal of Sport and Exercise*
21 *Psychology*. doi: 10.1080/1612197X.2015.1025809
- 22 Williams, S. E., Cooley, S. J., & Cumming, J. (2013). Layered stimulus response training
23 improves motor imagery ability and movement execution. *Journal of sport & exercise*
24 *psychology*, 35, 60-71. Retrieved from
25 http://works.bepress.com/jennifer_cumming/29/

1 Table 1

2

3 *Mean and standard deviations of imagery priming and imagery ability according to gender and competitive level*

	α	Total sample		Gender				Competitive Level			
		<i>M</i>	<i>SD</i>	Female		Male		Recreational		Competitive	
				<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Reappraisal	.83	4.89	0.96	4.95	0.94	4.81	0.98	4.92	0.98	4.84	0.93
Suppression	.75	4.00	1.03	3.95	1.01	4.08	1.06	3.98	1.06	4.04	0.99
Skill	.80	5.03	1.05	4.97	1.05	5.22	2.04	4.99	1.05	5.08	1.04
Strategy	.82	4.41	1.18	4.24	1.20	4.65**	1.11	4.34	1.24	4.51	1.10
Goal	.84	4.72	1.35	4.46	1.41	5.07**	1.20	4.57	1.46	4.92	1.18
Affect	.75	5.50	1.04	5.41	1.05	5.63**	1.01	5.49	1.05	5.52	1.02
Mastery	.70	4.64	1.04	4.51	1.07	4.81**	0.97	4.63	1.05	4.65	1.03

4 *Note.* ** = significantly higher than female at $p < .05$.

5

6

1 Figure 1.

2

3

4

5

6

7

8

9

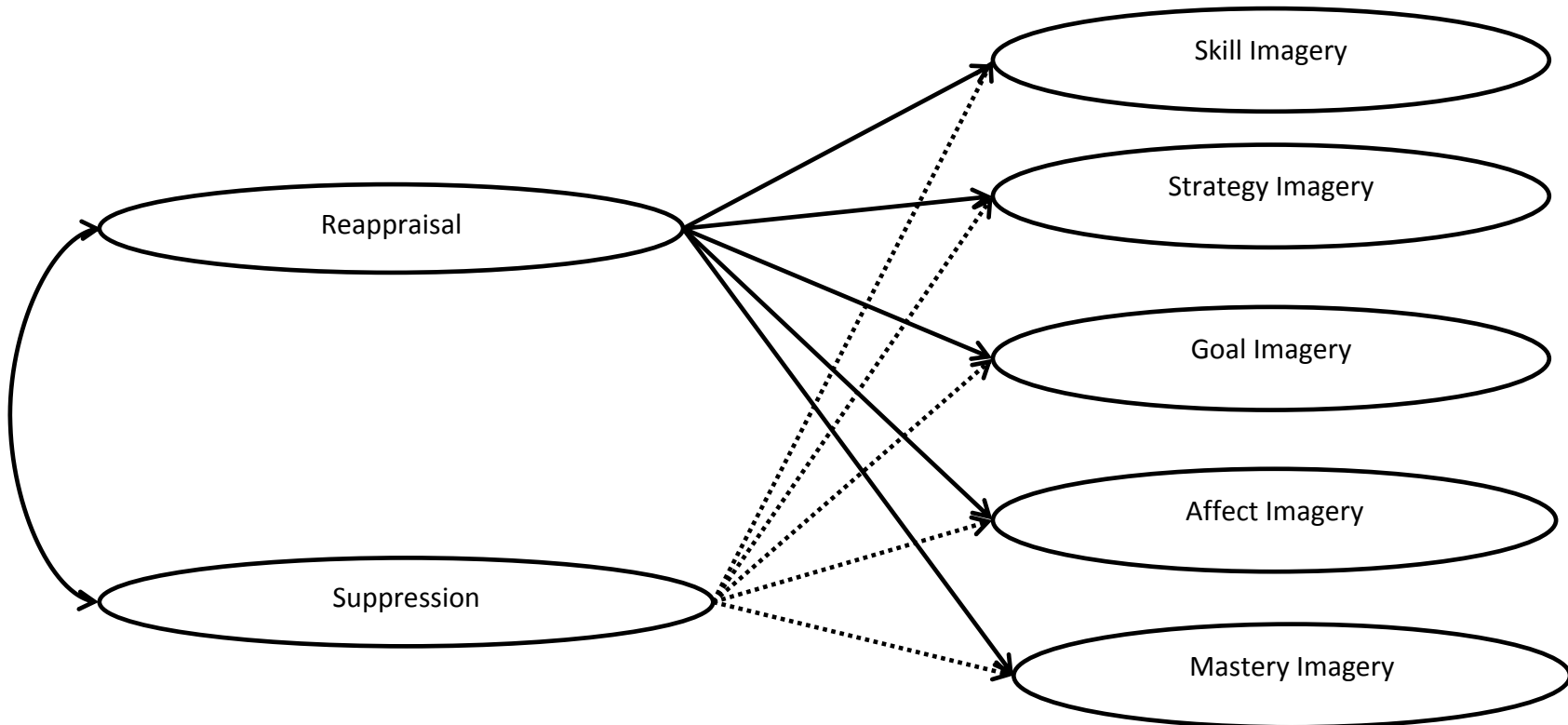
10

11

12

13

14



15 *Figure 1.* Hypothesized model of emotion regulation, reappraisal, predict imagery ability.

16 *Note.* Full lines indicate positively predicted and dashed lines indicate negatively predicted. For visual simplicity, variances between SIAQ
 17 subscales and gender controlled are not presented.

1 Figure 2.

2

3

4

5

6

7

8

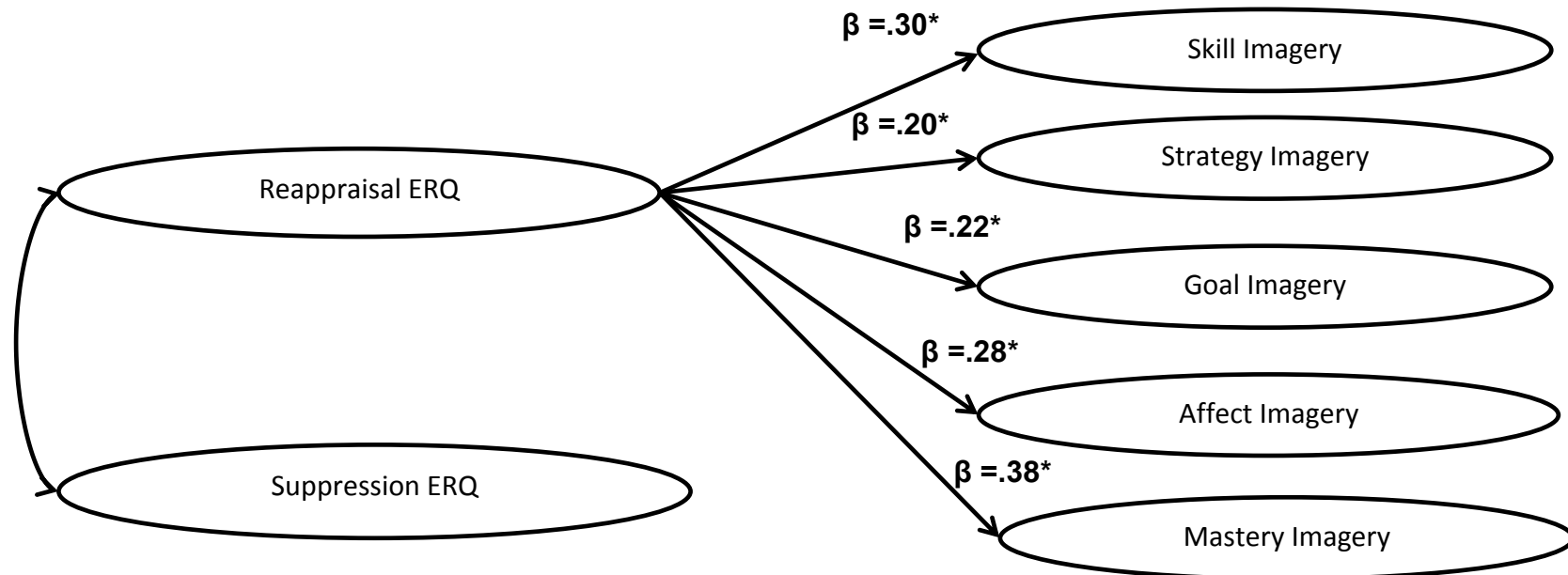
9

10

11

12

13



14 Figure 2. Final model of emotion regulation predicting ease of imaging skill, strategy, goal, affect and mastery.

15 *Note.* All coefficients are standardised and positive predictions. * = $p < .001$.

16 For visual simplicity, variances between SIAQ subscales and gender controlled are not presented.

17