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Individual propensity for reinvestment: field-based evidence for the predictive validity of three scales

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Two field-based studies were conducted to test the predictive validity of the Reinvestment Scale, the Movement Specific Reinvestment Scale and the Decision-Specific Reinvestment Scale. In Study 1, performance ratings were gathered for female university field hockey and netball players (N = 44) competing in low-pressure group games and high-pressure play-off games over the second half of a season. In Study 2, passing accuracy was assessed in a group of female university netball players (N = 15) over the course of a season. Analyses of variance using group data coupled with correlation and regression analyses revealed good support for the predictive validity of the Reinvestment Scale and Decision-Specific Reinvestment Scale, with high reinvesters being more prone to skill failure under pressure. The results are discussed in terms of task demands, the processes underlying skill failure, and the definition of choking.

KEY WORDS: Choking, Self-Focus.

The term 'choking' refers to performing significantly worse than expected in spite of high motivation and incentives for success (Jackson & Beilock, 2007). In examining this phenomenon in sport, many researchers have focused on the attentional processes underlying choking; in particular, how reinvestment of conscious control or explicit monitoring of a skill can disrupt performance (e.g., Baumeister, 1984; Beilock & Carr, 2001; Masters, 1992). This has yielded considerable support for reinvestment theory, notably in self-paced skills such as golf putting (Beilock, Carr, MacMahon, & Starkes, 2002; Hardy, Mullen, & Jones, 1996; Poolton, Maxwell, Masters, & Raab, 2006), basketball free-throws (Liao & Masters, 2002), soccer dribbling (Beilock et al., 2002; Jackson, Ashford, & Norsworthy, 2006) and climbing (Pijpers, Oudejans, & Bakker, 2005), and extends to account for poor per-

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formance in externally-paced perceptual-motor skills such as baseball (Gray, 2004), tennis (Liao & Masters, 2001; Smeeton, Williams, Hodges, & Ward, 2005), and driving (Maxwell, Masters, & Poolton, 2008).

Alongside evidence from studies of implicit motor learning (Masters, 1992; Maxwell, Masters, & Eves, 2000) attentional processes (Mullen, Hardy, & Tattersall, 2005), and qualitative research into performers' experiences (Hill, Hanton, Matthews, & Fleming, 2010), one line of evidence supporting reinvestment theory, and the focus of the present studies, comes from assessing individual differences in propensity for reinvesting conscious control processes under pressure. Research in this area initially focused on dispositional self-consciousness and researchers subsequently developed scales specifically designed to measure propensity for reinvestment. Indeed, Masters, Polman, and Hammond (1993) developed the Reinvestment Scale (RS) to measure individual differences in "purposefully endeavouring to run the skill with explicitly available knowledge of it" (p. 655). Masters, Eves, and Maxwell (2005) then developed a movement-specific version of the RS that explicitly focused on motor behaviour. The Movement-Specific Reinvestment Scale (MSRS) contains 10 items measuring movement self-consciousness and conscious motor processing. Subsequently, Kinrade, Jackson, Ashford, and Bishop (2010) argued that reinvestment theory might also account for skill failure in time-constrained decision making tasks and developed the Decision-Specific Reinvestment Scale (DSRS) to assess propensity for engaging in conscious decision making.

Dispositional Reinvestment and Skill Failure

Using the Self-Consciousness Scale (SCS), Baumeister (1984) found some evidence that low self-conscious participants were more prone to skill failure under pressure, supporting an 'acclimatization' hypothesis in which he argued that low self-conscious individuals would be less used to the heightened self-awareness brought about by high-pressure situations. The 'roll-up' task used in several of Baumeister's studies was a simple motor task that did not clearly lend itself to explicit instruction and the weight of evidence across a range of more complex, rule-based skills now supports the opposing position. For example, in developing the RS Masters et al. (1993) found significant positive correlations with skill failure on a golf putting task and with ratings of university tennis and squash players' tendency to experience choking in high-pressure situations. Subsequent experimental evidence supported Masters et al.'s findings. Chell, Graydon, Crowley, and Child

(2003) found that soccer players who were high reinvesters suffered a drop in performance under pressure on a soccer skill task whereas the performance of low reinvesters remained stable. In a study of skilled field-hockey players using a dribbling task, Jackson, Ashford, and Norsworthy (2006) similarly found that RS scores predicted choking, evidenced by slower task completion times. Returning to self-paced skills, the RS and SCS have also been found to correlate positively with choking in golf putting (Kinrade, Jackson, & Ashford, 2010; Maxwell, Masters, & Poolton, 2006) and basketball free-throw shooting (Wang, Marchant, Morris, & Gibbs, 2004), respectively. Poolton, Maxwell, and Masters (2004) further demonstrated that RS scores predicted how many explicit rules novice golfers used during the acquisition phase, which in turn predicted skill failure under pressure.

Evidence supporting the association between impaired motor performance and dispositional self-focus has recently been extended to movement-related disorders in the medical domain. For example, Masters, Pall, MacMahon, and Eves (2007) examined the relationship between the RS and Parkinson's disease duration and severity. They found that disease duration was a significant predictor of RS score while disease severity did not add significantly to the variance explained by the model. Assessing a sub-group using the MSRS, they found that Parkinson patients scored significantly higher than age-matched controls on both the movement self-consciousness and conscious motor processing subscales. Only conscious motor processing was a significant predictor of disease duration. These findings have since been extended to people who have suffered a stroke and to elderly patients who have suffered falls. Orrell, Masters, and Eves (2009) found higher MSRS scores for the stroke group than the control group, with the group difference being larger for the conscious motor processing than the movement self-consciousness subscale. In their study of fallers, Wong, Masters, Maxwell, and Abernethy (2009) similarly found that fallers scored higher than non-fallers on both MSRS subscales, with scores on the conscious motor processing subscale being a significant predictor of 'faller' or 'non-faller' status. All of these conditions or events are associated with the disruption of automatic movement execution so provide evidence that individual differences in propensity for reinvestment have relevance beyond competitive sport situations.

Kinrade et al. (2010) examined the relationship between RS scores and skill failure across a range of motor and cognitive tasks that differed in complexity. They found that RS scores significantly correlated with impaired performance in both simple (peg board) and complex (golf putting) motor tasks and also in both the simple and complex cognitive (modular arithmetic) tasks. The authors concluded that the association between dispositional rein-

vestment and skill failure extends beyond motor tasks to cognitive tasks that place greater demands on working memory, such as the decision making component of many sports. Initial work to test this hypothesis was conducted by Kinrade et al. (2010) who obtained coaches' ratings of basketball, netball, and korfball players' tendency to make poor decisions under pressure. They found a strong relationship ($r = .74$) between overall DSRS scores and coaches' ratings for the whole cohort, with both the decision reinvestment and decision rumination subscales being significantly related to poorer decision making under pressure.

To date, studies of skilled performance have used laboratory-based experiments to determine evidence for the predictive validity of the RS, MSRS and DSRS. While these are advantageous in terms of experimental control, there remains a need for field-based research to establish the predictive validity of the scales under competitive conditions. Accordingly, the purpose of the present studies was to focus on performance under different levels of competitive pressure. In Study 1, this centred on differences between the pressure associated with league games that served as qualifiers for the end-of-season play-offs, and 'knockout' play-off matches in which defeat resulted in the team being eliminated from the competition. In Study 2, we focused on individual perceptions of pressure, comparing performance in matches perceived as higher and lower pressure selected from a season-long league campaign. In both studies we hypothesized that dispositional reinvestment would moderate skill failure under pressure, with high reinvesters being more prone to choking.

Study 1

In Study 1, we aimed to examine the predictive validity of the RS using a broad performance measure and an objective manipulation of pressure defined in terms of match importance. Specifically, we assessed the performance of field-hockey and netball players over a series of matches in which pressure was operationally defined in terms of the objective and perceived importance of the match. This followed Baumeister and Steinhilber's (1984) reasoning that choking is most likely to occur when an individual or team has the chance to claim a desired identity through social, public performances. Accordingly, we measured participants' performance in both high-importance championship matches from the 'knockout' stage of the national intervarsity championship and the comparatively less-important 'regular season' league matches. Consistent with Masters et al. (1993), we predicted that high

reinvesters would demonstrate a greater propensity for skill failure than low reinvesters. More specifically, we predicted there would be no difference between high and low reinvesters' performance in low-pressure matches but that low reinvesters would outperform high reinvesters in high-pressure matches.

Method

Participants

Participants ($N = 44$) were female university hockey ($n = 24$) and netball players ($n = 20$) ranging in age from 18 to 23 years ($M = 19.64$, $SD = 1.14$). All participants had competed at county level or above and were representatives of their university's first and second teams. All four teams qualified for the 'knockout' phase of the annual varsity national championships at the end of the season. After obtaining institutional ethical approval, participants gave written consent and were informed that they could withdraw from the study at any stage without penalty.

Measures

Perceptions of match importance

Two objective levels of match importance were identified: high-importance matches from the varsity championship play-offs, in which the team had to win in order to stay in the tournament, and comparatively less-important matches from the 'regular season' league stage of the competition from which qualification for the play-offs was determined. As a manipulation check, participants rated the importance of each match on a 4-point scale from 1 (*not at all important*) to 4 (*extremely important*) using the statement "compared to a typical university league match" as a frame of reference.

Reinvestment Scale. The Reinvestment Scale contains 20 items, 12 of which are taken from the SCS (Fenigstein, Scheier, & Buss, 1975). These are divided equally between items measuring private self-consciousness (e.g., *I'm aware of the way my mind works when I work through a problem*) and items measuring public self-consciousness (e.g., *I'm concerned about my style of doing things*). A further seven items are taken from the rehearsal factor of the Emotional Control Questionnaire (Roger & Nesshoever, 1987; e.g., *I often find myself thinking over and over about things that have made me angry*) with the remaining item coming from the Cognitive Failures Questionnaire (Broadbent, Cooper, Fitzgerald, & Parkes, 1982; e.g., *Do you have trouble making up your mind?*). The RS has been found to have good internal reliability (Cronbach alpha = 0.86) and test-retest reliability over a four-month period ($r = .74$).

In the present study, each item was rated on a 5-point scale from 0 (*extremely uncharacteristic*) to 4 (*extremely characteristic*), resulting in a possible range of scores from 0 to 80. We used this scale as it is the one used in the SCS, from which the majority of items in the RS are drawn. Second, the RS items are statements respondents may feel are only somewhat charac-

teristic of them and Oppenheim (1992) states rating scales provide more precise information and are preferred by respondents. Furthermore, 5-point scales have been found to be advantageous both in terms of reliability and validity (Visser, Krosnick, & Lavrakas, 2000). To facilitate rating using the 5-point scale, the last item was written in the form of a statement: *I have trouble making up my mind.*

Performance

Using the statement "compared to how you usually play" as a frame of reference, participants were asked to rate their performance on a 4-point scale from 1 (*poor*) to 4 (*excellent*). A 4-point scale was chosen to force participants to categorise their performance as either above or below average in an effort to minimise the error of central tendency (Oppenheim, 1992). To test whether the relationship between RS scores and performance failure was confounded by perceptions of performance, we additionally obtained each team captain's ratings of other team members' performance using the same 4-point scale.

Procedure

Participants from the four teams were approached mid-season after being identified as likely to qualify for the play-offs. After giving written informed consent, participants completed a form containing questions about background information followed by the RS. To prevent social desirability bias, participants were told there were no right or wrong answers, and were informed their data would remain anonymous and be used by the researchers solely for the purpose of the present study. To standardise the time at which ratings were obtained, participants were instructed to rate the importance of each match approximately two hours before it was due to start and subsequently to rate their own performance approximately two hours after the match ended. Each team captain agreed to provide additional ratings for all team members, again approximately two hours after the end of each match

Results

Players were categorised as high or low reinvesters using the median split technique, with total RS score serving as the dependent variable. This created a group of 23 low reinvesters (RS score: $M = 38.70$, $SD = 5.68$) and 21 high reinvesters (RS score: $M = 51.00$, $SD = 6.63$). Using each individual player's and team captain's ratings, mean performance scores were calculated for each player in the high- and low-importance matches. For three of the four teams, mean performance ratings were calculated from eight low-importance and two high-importance matches. For the remaining team, mean ratings were calculated from seven low-importance and three high-importance matches. Differences between the performance ratings of high and low reinvesters were examined by analyses of variance (ANOVA), with follow-up pairwise comparisons made to determine the source of any differences as

appropriate. Effect sizes (partial eta squared: η_p^2) were calculated for all main effects and 95% confidence intervals (CI) were calculated for pairwise comparisons. Alpha was set at .05 unless otherwise stated.

Pressure Manipulation Check

To test whether players perceived the play-off matches to be more important than the regular season matches, mean ratings of match importance were calculated for each player in the two conditions. The play-off matches were rated as more important (M = 3.78, SE = 0.05) than the regular season matches (M = 2.52, SE = 0.11). In addition, ratings were slightly higher for high reinvesters (M = 3.30, SE = 0.09) than for low reinvesters (M = 3.00, SE = 0.09). These data were entered into a 2 x 2 (Reinvestment Group x Pressure) ANOVA, which revealed significant main effects for pressure, $F(1, 42) = 140.34$, $p < .05$, $\eta_p^2 = .77$, and reinvestment group, $F(1, 42) = 5.63$, $p < .05$, $\eta_p^2 = .12$, and a non-significant interaction between the two factors ($p = .10$, $\eta_p^2 = .06$).

Performance Ratings

Preliminary screening of the performance data for outliers, using the Mahalanobis distance method, revealed no outliers. To analyze performance ratings we entered the data into a 2 x 2 (Reinvestment Group x Pressure) MANOVA with pressure entered as a repeated factor and player ratings and captain ratings serving as the dependent variables. The multivariate output indicated a significant interaction between reinvestment group and pressure, Wilks' Lambda = .67, $F(2, 41) = 9.98$, $p < .05$, $\eta_p^2 = .33$.

For the players' self-ratings, the univariate analysis revealed a significant interaction between reinvestment group and pressure, $F(1, 42) = 8.49$, $p < .05$, $\eta_p^2 = .17$. As can be seen in Figure 1 (left panel), low reinvesters rated their performance as similar in low- and high-pressure matches, $t(22) = 1.00$, $p = .16$, 95% CI for difference: -0.10 to 0.28, whereas high reinvesters rated their performance significantly lower in the high-pressure matches, $t(20) = 2.71$, $p < .05$, 95% CI for difference: -0.76 to -0.10. For the team captains' ratings, the analysis again revealed a significant interaction between reinvestment group and pressure, $F(1, 42) = 20.29$, $p < .05$, $\eta_p^2 = .33$. This reflected significantly higher ratings for low reinvesters' performance in the high-pressure matches than in the low-pressure matches, $t(22) = 3.31$, $p < .05$, 95% CI for difference:

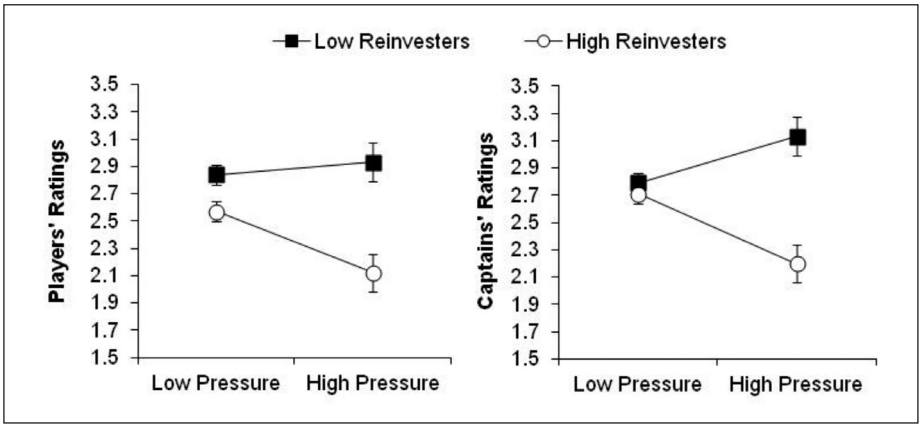

Figure 1. Mean performance ratings for low and high reinvesters in low-pressure and high-pressure matches.

0.13 to 0.55. By contrast, high reinvesters were rated as performing significantly worse in high-pressure than low-pressure matches, $t(20) = 3.12$, $p < .05$, 95% CI for difference: -0.79 to -0.16 (Figure 1, right panel).

Following the recommendation of Aiken and West (1991) we also computed the difference between mean ratings in high- and low-importance matches and calculated Pearson's product-moment correlation coefficients between this and total RS scores. This revealed significant relationships for both the player ratings, $r(44) = -.62$, $p < .05$, and captain ratings data, $r(44) = -.65$, $p < .05$

Discussion

The results of Study 1 indicate strong support for the predictive validity of the RS using differences in competitive pressure experienced during regular season league matches compared to end-of-season play-off matches. The primary source of the significant interaction between pressure and reinvestment group was high reinvesters' performing less well in high-pressure than in low-pressure matches. In the case of the team captains' ratings, low reinvesters not only maintained their level of performance in the critical play-off matches but were rated as performing better than in regular-season matches. Of course, these are simply perceptions of performance, albeit we sought ratings from both the players themselves and those of the team captain. This was important to address the possibility that any relationship between rein-

vestment and choking might be confounded by dispositional reinvestment influencing how individuals perceived their performance rather than how they actually performed. The fact that the pattern of results was so similar across the player and team captain data sets increases our confidence in both sets of ratings reflecting genuine differences in performance between the two groups. That said, we cannot rule out the possibility that either or both sets of ratings were influenced by other factors. For example, high reinvesters might appear less confident or more anxious under pressure or might react more negatively to mistakes during performance. In these instances, lower ratings might result from observer bias rather than the performance itself.

Study 2

In Masters' (1992) original conceptualisation, reinvestment theory targeted the breakdown of lower-order or motor elements of performance. The associated RS did not distinguish between processing at the motor level and a more general propensity for assuming conscious control over all elements of performance. With development of the MSRS and DSRS measures, individual propensity for reinvesting conscious control processes is measured with explicit reference to movements and decision making, respectively. Potentially, this will increase the predictive validity of the original RS and may be of particular use in sports for which success is underpinned by sound decision making as well as motor proficiency.

A limitation of Study 1 was that it relied upon subjective ratings of performance, namely the players' ratings and those of their team captains. Thus, while the results indicated that skill failure under pressure was moderated by dispositional reinvestment, the extent to which changes in perceived performance translated to objective measures of performance was unclear. In addition, in Study 1 we only used the original RS that does not distinguish between motor execution and decision making elements of performance. Accordingly, the purpose of Study 2 was to conduct a field test to assess the predictive validity of the MSRS and DSRS using an objective performance indicator.

Method

Participants

Participants were 15 female university netball players who were currently representing the first ($n = 9$) and second ($n = 6$) teams, competing in the top tiers of the national university

competition. They had a mean age of 20.07 years (SD = 1.22) and had additionally played representative netball at club (n = 7), regional (n = 4), and national (n = 4) level for a mean of 7.87 years (SD = 3.50). Institutional ethical approval was granted and all participants gave written consent prior to participating in the study. All participants were skilled performers with respect to netball and trained together to be selected for their respective teams.

Design and Measures

The design was a 2 (Group: low reinvesters, high reinvesters) x 2 (Pressure: low pressure, high pressure) mixed-factor design, in which participants' performances were observed over the course of a season. Taking into account injuries and squad selection each player was observed for between eight and 10 games. Using intra-individual calculations, the three games with the highest and lowest associated pressure ratings were selected for each player and grouped for analysis.

Pressure ratings

2006; Kinrade, Before each game, participants were asked to rate how much pressure they felt they were under on a 5-point Likert-type scale. The scale was anchored by 1 (*no pressure*) and 5 (*extreme pressure*; cf. Jackson, Ashford, & NorsworthyJackson, & Ashford, 2010).

Decision-Specific Reinvestment Scale

The DSRS (Kinrade, Jackson, Ashford, & Bishop, 2010) comprises 13 items that were adapted from the original RS in order to focus on the decision making process. The scale contains two factors: decision reinvestment and decision rumination. Six items assess decision reinvestment, the conscious monitoring of processes involved in making a decision (e.g., *I'm always trying to figure out how I make decisions*). The second factor, decision rumination, contains seven items assessing the tendency to focus on past inaccurate decisions they have made; (e.g., *I often find myself thinking over and over about poor decisions that I have made in the past*). Internal consistency estimates for the DSRS subscales using Cronbach's alpha coefficient were as follows: Factor 1 = .89, and Factor 2 = .91 (Kinrade et al.). Participants rated each item on the same 5-point scale used for the RS, giving a possible range of scores from 0 to 52.

Movement-Specific Reinvestment Scale. The MSRS is a 10-item scale constructed by modifying items in the RS to refer explicitly to movement. It contains five items assessing movement self-consciousness and five items assessing conscious motor processing. Participants rate items such as *I am concerned about my style of moving* (movement self-consciousness) and *I reflect about my movement a lot* (conscious motor processing) on a 5-point Likert scale from 0 (*extremely uncharacteristic*) to 4 (*extremely characteristic*), giving a possible range of scores from 0 to 40. The MSRS has good test-retest reliability for both the movement self-consciousness (r = .67, p < .05) and conscious motor processing (r = .76, p < .05) factors. Internal reliability was also acceptable for each factor (r = .78 and r = .71, respectively; Masters et al., 2005).

Procedure

Participants were informed that the purpose of the study was to examine psychological aspects of sport. They were further informed that the study required them to complete several questionnaires and have their match performances filmed over the course of the season. Participants were assured that the data gathered would remain confidential and be used solely for the purpose of the study. Each participant then completed a demographic information sheet and informed consent form followed by the MSRS and DSRS.

All games were recorded using a high-definition video camera mounted on a tripod positioned adjacent to the half-court line. Before each game, participants rated the degree of pressure they felt associated with the upcoming game. To assess passing accuracy, notational analysis was conducted on digitised footage of each match. An accurate pass was operationally defined as a pass that was successfully caught by the intended recipient. Defined in this way, an accurate pass partly relies on the recipient making a successful catch. We decided this was preferable to making subjective judgments about the cause of each incomplete pass due to its objectivity, simplicity, and the fact that the passer may be at fault in instances of dropped passes.

Data Analyses

As a manipulation check, 2 x 2 (Group x Pressure) ANOVAs were conducted with mean pressure ratings for low-pressure and high-pressure matches entered as the dependent variable. Two analyses were conducted to assess the predictive validity of the DSRS and MSRS measures. First, separate 2 x 2 (Group x Pressure) ANOVAs were conducted with participants categorised as either low or high reinvesters in each scale via a mean split. Total pass completion percentage across the two blocks of three games served as the dependent variable.

Aiken and West (1991) noted that creating dichotomous variables in this manner compromises statistical power because of the loss of information resulting from the grouping procedure. That is, categorising individuals simply as high or low reinvesters emphasises group membership over the strength or magnitude of their propensity for reinvestment. Given the relatively small sample size in the present study we therefore conducted an additional standard multiple regression analysis using global DSRS and MSRS scores as predictors of performance change under pressure. Alpha was set to .05 with effect size indicated by partial eta squared (η_p^2).—

Results

Preliminary screening of all data, using univariate z-scores (> ± 3.29) and Mahalanobis distance values, revealed no outliers. Descriptive statistics revealed that participants' DSRS scores ranged from 4 to 39 (M = 26.07, SD = 9.21) and MSRS scores ranged from 1 to 25 (M = 16.07, SD = 6.45). For the DSRS and MSRS the low reinvesters had means of 18.71 (SD = 7.57, n = 7) and 11.50 (SD = 4.93, n = 8), respectively; the high reinvesters had means of 32.50 (SD = 4.38, n = 8) and 21.29 (SD = 3.04, n = 7), respectively.

Pressure Manipulation Check. As expected, pressure ratings were lower for low-pressure matches (M = 1.89, SD = .51) than for high-pressure matches (M = 2.98, SD = .34). To examine perceptions of pressure by reinvestment group, the data were entered into two mixed-factor ANOVAs with pressure entered as the within-participants factor, DSRS or MSRS group entered as the between-participants factor and mean pressure ratings serving as the dependent variable. For the DSRS data, the analysis revealed a significant main effect of pressure, $F(1,13) = 119.80$, $p < .05$, $\eta_p^2 = .90$, a non-significant effect of DSRS group, $F(1,13) = 0.03$, $p = .86$, $\eta_p^2 = .002$, and a non-significant Pressure x DSRS group interaction, $F(1,13) = 3.08$, $p = .10$, $\eta_p^2 = .19$. Similarly, analysis using MSRS group as the between-participants factor showed a significant main effect of pressure, $F(1,13) = 101.24$, $p < .05$, $\eta_p^2 = .89$, a non-significant main effect of DSRS group, $F(1,13) = 3.57$, $p = .08$, $\eta_p^2 = .22$, and a non-significant Pressure x DSRS group interaction, $F(1,13) = .22$, $p = .65$, $\eta_p^2 = .02$.

Passing Accuracy and DSRS / MSRS Categorisation. As can be seen in both panels in Figure 2, the overall mean pass completion percentage of the participants was better in the low-pressure games (M = 93.50, SD = 4.70) than in the high-pressure games (M = 89.81, SD = 7.10).

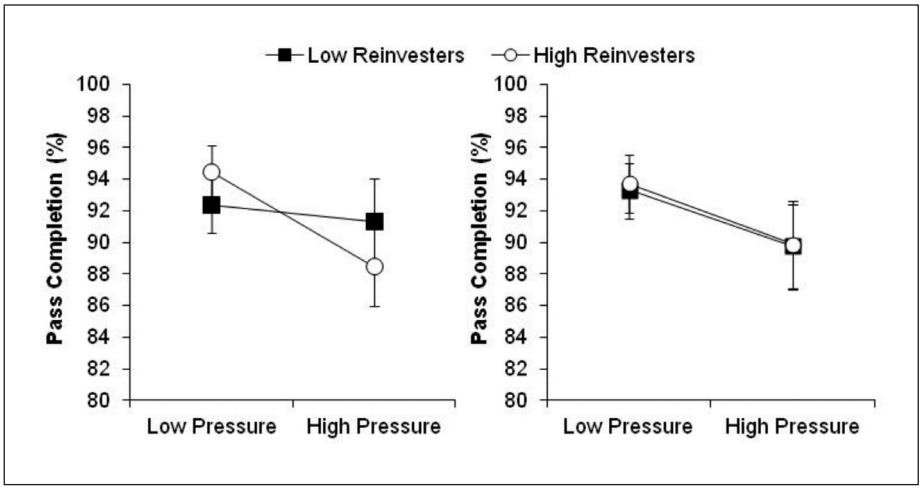

Figure 2. Mean pass completion percentage for low and high reinvesters in low-pressure and high-pressure matches, as classified by the DSRS (left panel) and MSRS (right panel).

DSRS group. Analysis of the pass completion percentage data revealed a significant effect of pressure, $F(1,13) = 7.13$, $p < .05$, $\eta_p^2 = .35$, and a non-significant effect of DSRS group, $F(1,13) = 0.02$, $p = .90$, $\eta_p^2 = .001$. As can be seen in the left panel of Figure 2, the difference in pass completion between low- and high-pressure games was greater in the high reinvester group; however, the Pressure x DSRS group interaction just failed to reach statistical significance, $F(1,13) = 3.51$, $p = .08$, $\eta_p^2 = .21$.

MSRS group

Analysis of the pass completion data by MSRS group again revealed a significant main effect of pressure, $F(1,13) = 6.19$, $p < .05$, $\eta_p^2 = .32$. The main effect of MSRS group was non-significant, $F(1,13) = 0.01$, $p = .93$, $\eta_p^2 = .001$, as was the Pressure x MSRS group interaction, $F(1,13) = 0.01$, $p = .92$, $\eta_p^2 = .001$ (Figure 2, right panel).

Regression analysis

To assess the extent to which DSRS and MSRS scores predicted skill failure under pressure, a standard multiple regression analysis was conducted. Global DSRS and MSRS scores were entered as predictor variables and the difference in pass completion percentage (a negative score indicated poorer performance in high-pressure matches) served as the dependent variable. The analysis revealed that the DSRS was a significant predictor of the difference in pass completion percentage ($\beta = -1.02$, $t = -3.07$, $p < .05$), while the MSRS was a non-significant predictor ($\beta = .50$, $t = 1.76$, $p = .10$; see Table I). MSRS and DSRS scores were significantly correlated ($r = .77$, $p < .05$) but

TABLE I
Multiple Regression Analysis of DSRS and MSRS Scores Predicting the Change in Pass Completion Percentage from Low-Pressure to High-Pressure Games.

	B	***SE***	***β***
Response Accuracy			
Constant	4.23	3.55	
Decision-Specific Reinvestment Scale	-.61	.20	-1.02*
Movement-Specific Reinvestment Scale	.50	.29	.59

Model Summary: $R^2 = .46$, Adjusted $R^2 = .37$; $F(2, 12) = 5.17$, $p < .05$.
*$p < .05$.

with an acceptable variance inflation factor (2.46) and associated tolerance statistic (0.41; Field, 2009). This was reflected in Pearson's correlation coefficients, which revealed a significant negative correlation between difference in pass completion percentage and DSRS score, (r = -.57, p < .05), but not MSRS score (r = -.20, p = .24).

Discussion

The purpose of Study 2 was to investigate the effect of pressure on an objective element of netball performance (pass completion percentage), and to examine the extent to which any evidence of choking was moderated by dispositional reinvestment using the MSRS and DSRS. We predicted that performance in the high-pressure games would be worse than in the low-pressure games and that this difference would be greater for those individuals scoring higher on the DSRS and MSRS. Participants were assessed for passing accuracy in the three games with the highest and three games with the lowest perceived pressure over the course of a season. The analysis revealed a significant difference in performance in the high- and low-pressure games and partial support for the moderating effect of dispositional reinvestment. Specifically, DSRS score, but not MSRS score was a significant predictor of performance decrements under pressure.

Results from the DSRS data were consistent with experimental research examining the role of reinvestment in skill breakdown (Masters et al., 1993; Maxwell et al., 2000) and with validation data from development of the scale (Kinrade et al., 2010). They support the hypothesis that a propensity for engaging in conscious control of, and ruminating about, past decisions is detrimental to performance under heightened pressure. With respect to passing accuracy, the fact that this finding did not extend to the MSRS is on the face of it somewhat surprising as the skill of passing involves both a decision making and skill execution component.

There are at least two possible explanations for this finding. The first links the nature of the passing task with thoughts on the role of working memory in choking. Masters and Maxwell (2008) suggested that reinvesting explicit knowledge, whether for consciously controlling one's actions or for performing a more cognitively-demanding task, draws upon working memory resources as information is manipulated (Baddeley, 1966). This in turn reduces working memory capacity available for performing the primary task, which can result in skill failure. In time-constrained tasks, for which success depends on both correct decision making and accurate skill execution, rein-

vesting explicit knowledge about the movement may be secondary to the decision making process. This would reflect the temporal sequence of a netball pass in which visual search and response selection precedes the pass. This means conscious attention is occupied in the period immediately preceding skill execution, the very moment when reinvestment of explicit knowledge is likely to occur in self-paced skills such as golf putting. If this is the case then the process of decision reinvestment may simultaneously impair decision making while suppressing movement reinvestment. By implication, the DSRS may be more predictive of skill failure in the many externally-paced sport skills in which decision making immediately precedes skill execution.

A more parsimonious explanation is that pass incompletions in our sample of netball players were predominantly caused by making poor decisions concerning when, whether and to whom to pass rather than by players failing to execute the motor action in making the pass itself. In the present study, the single camera position to the side of the court meant it was not possible to judge reliably the relative contributions of poor decision making and poor skill execution (on the part of the passer and recipient) from the video footage alone. In future, we recommend that researchers obtain match footage from more than one courtside position and / or a higher vantage point. We also recommend that researchers consider conducting a more formal analysis of errors with each participant to try to classify the nature of each error. This might be done using think-aloud protocols (Ericsson & Simon, 1984) and could be considered alongside evidence from coach assessments of the cause of each incomplete pass.

General Discussion

The Reinvestment Scale was devised as a means of measuring individual propensity for reinvesting conscious control under pressure (Masters et al., 1993). There is a growing body of literature supporting reinvestment theory and in the present studies we sought to assess the predictive validity RS, DSRS and MSRS in the competitive arena. To that end we conducted two field-based studies focusing on the RS (Study 1) and the decision-specific and movement-specific versions of the scale (Study 2). In Study 1, we assessed university players' overall performance in two team sports across a series of low- and high-pressure matches, defined by their objective importance. In Study 2, we focused on the specific skill of passing in netball, again comparing performance in low- and high-pressure matches.

Overall, strong support was found for the predictive validity of the RS and DSRS scales. In Study 1, both the group and correlation analyses indicated that the RS was strongly related to performance impairment under pressure. Specifically, whether using players' self-ratings or team captains' ratings of performance, high reinvesters performed more poorly than low reinvesters in the more important matches. Importantly, the similar findings from both data sets indicate that the observed relationship was unlikely to have been a result of dispositional reinvestment influencing performers' perceptions of their own performance. Nonetheless, it remains possible that the ratings of both players and team captains were subject to different biases that operated in the same direction. In Study 2, the DSRS was found to be a significant predictor of the difference in passing accuracy observed in low-pressure and higher-pressure games, with higher DSRS scores predicting lower pass completion percentages. We suggested that the nature of the passing task in Study 2 might have influenced how well the DSRS and MSRS predicted skill failure. This is an empirical question to be addressed by research that classifies skills both in terms of their nature (e.g., cognitive, motor) and the timeline of associated attentional demands.

There are two other limitations associated with the present studies. First, the number of participants was relatively small, particularly in Study 2. This compromises statistical power, especially when grouping participants. Caution must therefore be expressed when interpreting the analyses particularly when making inferences about the population from null effects observed in the sample group. Second, the scope of Study 1 was very broad inasmuch as the dependent variable was a rating of global perceptions of performance. By contrast, Study 2 was narrowly focused on a single skill (passing) so did not take into account other factors such as reactive agility that have been shown to discriminate between different skill levels (Farrow, Young, & Bruce, 2005). In addition, it is likely that high-pressure matches involved better opponents than did the low-pressure matches (e.g., better teams will qualify for the play-offs in Study 1). This may have affected overall performance; however, it does not affect the between-group comparisons of high and low reinvesters. There remains a need for further field-based assessments of predictive validity for both the DSRS and MSRS as well as the original RS, using a range of performance indicators in both interactive and non-interactive team and individual sports. In doing this, it would also be helpful to assess the attentional demands of the skills tested so that specific predictions associated with working memory accounts of skill failure may be assessed (Beilock & DeCaro, 2007).

Further research is required to corroborate and extend the present findings both within sport and to other domains. Larger scale and longitudinal studies will allow researchers to explore possible moderators, mediators, and boundary conditions associated with the relationship between dispositional reinvestment and skill failure. As this is done, the degree to which skill failure is predicted by different factors contained within the scales can be further assessed. For example, both rumination and conscious processing, whether directed towards movement or decision processes, are working-memory intensive activities. As such, skills that already place significant demands on working memory may be particularly vulnerable to failure in high reinvesters. Furley and Memmert (2012) found that basketball players with high working memory capacity were better than those with low working memory capacity at making tactical decisions from briefly presented images of basketball scenes. The authors also found a significant negative correlation between participants' working memory capacity (counting span task) and Cognitive Failures Questionnaire scores, indicating a possible link between working memory capacity and propensity for reinvestment. Set against this, Beilock and Carr (2005) found that individuals with lower working memory capacity were *less* prone to skill failure on highly demanding module arithmetic tasks because they relied on simpler solution strategies that could be successfully implemented under pressure. The interplay between individual differences in working memory capacity, dispositional reinvestment, and task demands is ripe for further investigation.

As a final, broader point, Mesagno and Hill (this issue) have argued that researchers should distinguish between 'underperformance' and 'choking' with the latter term reserved for greater declines in performance. Jackson (this issue) has debated elements of their proposed definition or re-conceptualization of choking; however, the extent to which 'moderate' and 'major' under-performance are caused by the same underlying mechanisms is presently unclear. The criterion for 'choking' in most empirical research, including the present study, is that of statistical significance and/or effect size. We feel the term 'choking' is an appropriate umbrella term for researching all levels of under-performance under competitive pressure. If future research establishes different processes underlying different magnitudes of performance decline the present study will need to be placed within a more refined delineation of skill failure.

In conclusion, the present studies highlight the importance of considering individual propensity for reinvestment in seeking a full understanding of skill failure under pressure. However, there remains a need for further validation data for all three reinvestment scales as well as research that unpicks

the relative contributions of rumination and conscious processing on different tasks at different times and in different situations. As a more complete picture of the interplay between dispositional reinvestment and skilled performance emerges, so a greater variety of more targeted interventions will follow.

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