The perceived stress reactivity scale for adolescent athletes

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Abstract

Individual differences play a significant role in the outcomes experienced by adolescent athletes, in what is a highly stressful period of their development. Stress reactivity is a stable individual difference underlying the broad variability in responses to stress, which has received very little attention within sport. Conventional physiological measures of reactivity can be time-consuming, costly, and invasive; therefore, this study aimed to adapt a self-report measure of perceived stress reactivity for use with adolescent athletes. 243 Adolescent athletes competing in various sports completed the perceived stress reactivity scale for adolescent athletes (PSRS-AA) along with measures of perceived stress, Big Five personality traits, and subjective well-being. The five-factor, 23 item structure of the original PSRS provided an adequate model fit for the PSRS-AA. There was good internal consistency and test retest reliability for the scale's measure of total reactivity. Total reactivity was positively associated with perceived stress, and negatively associated with emotional stability, extraversion, openness, and life satisfaction. Female adolescent athletes reported significantly higher stress reactivity than males. These findings provide good initial support for the use of PSRS-AA as a valid alternative to physiological measures of stress reactivity in youth sport contexts.

Keywords: stress reactivity; adolescence; sport; coping; wellbeing

1 Introduction

Adolescent athletes experience a great number of stressors, including competitions, regular social evaluation and criticism, family and peer influences, as well as academic commitments (Compas, Connor-Smith, Saltzman, Thomsen, & Wadsworth, 2001; Nicholls, Holt, Polman, & James, 2005; Reeves, Nicholls, & McKenna, 2009; van Rens, Borkoles, Farrow, Curran, & Polman, 2016). When faced with a stressor, an initial activation of the autonomic nervous system (ANS) and the hypothalamic-pituitary-adrenal (HPA) axis prepares an individual for action and facilitates a process of appraisal and coping responses. Lazarus and Folkman proposed in their transactional model of stress and coping that the appraisal of a stressor consists of numerous judgments regarding its threat or challenge to the individual, its potential benefit, harm or benignity, and the individual's perceived control (Lazarus & Folkman, 1987). This in turn influences the choice of coping strategy selected. Athletes have been found to use a vast variety of different coping strategies (Nicholls & Polman, 2007). A problem focussed strategy involves directly addressing the source of stress to nullify it whereas an emotion focussed strategy regulates one's own emotions in response to a stressor. Finally, an avoidance focussed strategy aims to physically or psychologically disengage or distance oneself from the source of stress and one's emotional response (Lazarus & Folkman, 1987). Being unable to cope adaptively with these stressors, and thus stem the activation of the ANS and HPA, can lead to athletes experiencing unpleasant emotions (e.g., anxiety, anger, shame, guilt) and reduced satisfaction with their performance (Lazarus, 2000; Nicholls, Polman, & Levy, 2012). Moreover, stress has been cited as a significant cause of both athlete burnout and dropout (Crane & Temple, 2015; Goodger, Gorely, Lavallee, & Harwood, 2007; Smith, 1986).

Lazarus and Folkman (1987) also proposed that numerous personal and situational factors can directly and indirectly influence the stress and coping process (see Figure 1). For

example, gender (Kaiseler, Polman, & Nicholls, 2012b), the Big Five personality traits (Kaiseler, Polman, & Nicholls, 2012a), mental toughness (Kaiseler, Polman, & Nicholls, 2009), and pubertal, cognitive, and emotional maturity (Nicholls, Levy, & Perry, 2015; Nicholls, Perry, Jones, Morley, & Carson, 2013; Nicholls, Polman, Morley, & Taylor, 2009) have all been associated with differences in appraisal and coping responses to stress in athletes. Therefore, individual differences can be examined to predict the likelihood of performance and well-being related outcomes in sport. This is of great importance in youth sport, given the vast number of stressors experienced by adolescent athletes during their development. However, little research within sporting contexts has examined the biological basis underpinning these individual differences, or considered differential sensitivity of the ANS and HPA as an individual difference in and of itself. In other words, individual differences in stress reactivity.

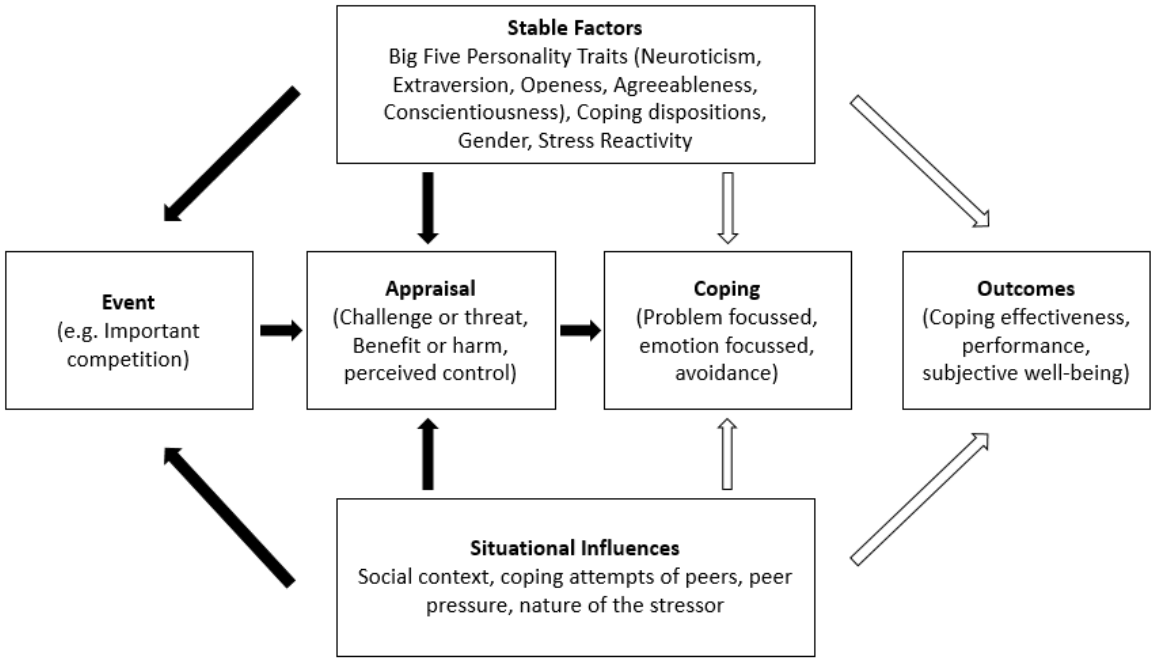

Figure 1: Conceptual framework illustrating how stable personal and situational factors can directly and indirectly influence the stress and coping process (Kerdijk, van der Kamp, & Polman, 2016) (Permission granted from corresponding author R. Polman).

1.1 Stress reactivity

Eysenck (1967) originally proposed that personality had a biological basis. (Eysenck, 1967)(Eysenck, 1967)(Eysenck, 1967)It was hypothesised that personality traits are a result of differential reactivity to stimulation, with neuroticism and introversion being the result of hyper-reactivity (Eysenck, 1967; Suls & Martin, 2005). Furthermore, gender differences in coping have been attributed to biological variations in reactivity between males and females (Tamres, Janicki, & Helgeson, 2002). More recently, stress reactivity (SR) has been operationalised as an individual difference underlying the broad variability in stress responses (Boyce & Ellis, 2005; Ellis, Essex, & Boyce, 2005; Schlotz, 2013; Schlotz, Hammerfald, Ehlert, & Gaab, 2011; Schlotz, Yim, Zoccola, Jansen, & Schulz, 2011). SR stems from an increased 'biological sensitivity to context' based on an evolutionary-developmental theory (see Boyce & Ellis, 2005). This predisposition is developed from exposure to both support and adversity in early childhood (Ellis et al., 2005). Exposure to acute stress during early childhood up regulates reactivity, increasing the individual's tendency to detect and respond to potential threats. Similarly, exposure to exceptionally high levels of support also creates the same effect, increasing the individual's sensitivity to their environment, and thus SR. Therefore, moderate exposure to stress in environments that are neither universally threatening nor safe, with moderate levels of support, down-regulates reactivity creating a buffering effect between the individual and stressors they experience. In summary, there is a curvilinear relationship between SR and early childhood exposure to stress (Boyce & Ellis, 2005; Ellis et al., 2005).

It has been argued that adolescence (12-22 years; Sullivan, 1953) is also a critical period where SR is developed, with the protracted maturation of the brain increasing sensitivity to stressors (Romeo, 2010). Hyper-reactivity in adolescents has been associated with internalising symptoms (negative emotionality, anxiety, and depression; Allwood,

Handwerger, Kivlighan, Granger, & Stroud, 2011; Granger, Weisz, & Kauneckis, 1994; Lopez-Duran et al., 2015). Therefore, SR could have a critical effect on whether adverse outcomes (such as anxiety and depression) are developed by young sportspeople in the face of this vast number of stressors they are known to experience. Adolescence may then be an ideal window of opportunity for providing interventions to young athletes, particularly those who can be identified as having high SR. This therefore raises the question of how SR should be measured in adolescent athletes.

1.2 Measuring stress reactivity

It has been commented that SR would be difficult to measure and assess in athletic contexts (Polman, Clough, & Levy, 2010). To date, SR in adolescents has been examined using various physiological (e.g., heart rate variability, cardiac output, blood pressure, skin conductance) and neuroendocrine measures (e.g., cortisol) in controlled lab-based procedures (Allwood et al., 2011; Colich, Kircanski, Foland-Ross, & Gotlib, 2015; Marceau, Dorn, & Susman, 2012; McLaughlin, Sheridan, Alves, & Mendes, 2014; Paysnick & Burt, 2015). However, in more ecologically-valid athletic situations, differences in an observed stress response may be influenced by several situational factors, not just personal factors related to SR. It may also be difficult to delineate between physiological arousal as a consequence of SR or of the physical demands of sport (Polman et al., 2010). Stressor specificity also affects the validity of one-time lab-based methods of measuring SR as a stable factor (Schlotz, Yim, et al., 2011). For example, HPA reactivity has been associated closer with responses to social stress, while ANS reactivity has been primarily related to arousal and effort (Schlotz, 2013; Schlotz, Yim, et al., 2011). Unless measurements are repeated extensively under different environmentally controlled conditions using multiple measures, which would be costly and

time-consuming (Schlotz, Yim, et al., 2011), a self-report measure would be more practical and ecologically valid.

Scholtz et al. (2011) developed the Perceived Stress Reactivity Scale (PSRS), a self-report questionnaire which measures a person's typical stress responses to different generalised situations, creating an aggregate score for an individual's 'total stress reactivity'. Perceived SR has been defined as 'a disposition that underlies individual differences in physiological and psychological stress responses' (Schlotz et al., 2011, p. 81). Scores from the PSRS have already been associated with self-efficacy, neuroticism, chronic stress, perceived stress, depressive symptoms, sleep quality, threat appraisals, and increased cortisol responses to social evaluation (Schlotz, Hammerfald, et al., 2011; Schlotz, Yim, et al., 2011). However, the PSRS would need to be adapted to represent stress response domains within the context of adolescent athletes and youth sport. For example, items referring to reactivity to social evaluation would need to refer to the socially evaluative situations experienced by adolescent athletes (e.g. performing in front of other people, their performance being evaluated by coaches).

The present study aimed to adapt the PSRS and validate it for measuring perceived SR in adolescent athletes (The Perceived Stress Reactivity Scale for Adolescent Athletes; PSRS-AA). This was to explore the validity of the PSRS-AA as a potential predictor of performance and well-being related outcomes for future research and applied practice in sport. The present study evaluated the relationship between the PSRS-AA and other self-report measures of perceived stress, personality, and subjective well-being, as well as the questionnaire's fit to its original five-factor model. It was predicted that the five-factor model structure of the original PSRS would fit that of the adapted scale for adolescent athletes (H1). It was hypothesised that the PSRS-AA would positively correlate with perceived stress, and would negatively correlate with subjective well-being on a measure of life satisfaction, and

emotional stability and extraversion on a personality inventory (H2). It was also hypothesised that adolescent girls would score higher on the PSRS-AA than adolescent boys (H3).

2 Method

2.1 Participants

243 Adolescent student athletes (in full time education and competing in one or more sports) were recruited from several schools, colleges, academies, and universities to complete a battery of self-report questionnaires either electronically or on paper (age 12-22 years, *M* age = 16.46, *SD* = 2.93). A university ethics board approved ethical clearance. Consent was obtained from a parent or guardian of all participants under the age of 16. 61.3% Of the recruit participants were male (*N* = 149), while 38.7% were female (*N* = 94).

Participants were asked to name their first sport (the sport they competed in the most), and identify their level of competition at both junior and senior level (see Table 1). 29 Sports were named as the participants' first choice activity. 37.9% of participants competed in a second sport at junior level (26 additional sports were named). 13 Participants completed the PSRS-AA again approximately 4 weeks later to examine its test re-test reliability (62% Male; 38% Female).

Table 1
Participants' Highest Levels of Competition at Junior and Senior Level (%)

Age Level		%
Junior Level (First sport)	Currently injured or suspended	9.9
	Local club or school	30.9
	County	25.9
	Regional	13.2
	National	16.5
	International	3.7
Junior Level (Second sport)	Do not compete in a second sport at junior level	62.1
	Currently injured or suspended	0.4
	Local club or school	19.8
	County	9.9
	Regional	5.3
	National	2.1
	International	0.4
Senior Level (First sport)	Do not compete in first sport at senior level	23.5
	Currently injured or suspended	1.6
	Local club	40.7
	County	11.1
	Regional	10.7
	National	11.1
	International	1.2
Senior Level (Second sport)	Do not compete in a second sport at senior level	80.6
	No competition	0.8
	Local club	12.8
	County	2.1
	Regional	2.5
	National	1.2

2.2 Measures

2.2.1 The perceived stress reactivity scale for adolescent athletes. The original PSRS consists of 23 items with five subscales (reactivity to social evaluation, reactivity to failure, reactivity to social conflicts, reactivity to work overload, and prolonged reactivity). Each item presents a potentially stressful stimulus (e.g. 'when I argue with other people') and offers a choice of three descriptive responses for the participant to choose from (e.g. 'I usually calm down quickly, 'I usually stay upset for some time' or 'It usually takes me a long time until I

calm down'). Responses are coded on a scale of zero to two, with the answer representing the least reactivity scoring zero, and the answer representing the most reactivity scoring two. The sum of the mean scores on each subscale indicates an individual's 'total reactivity'.

The instructions of the PSRS were adapted to instruct participants to reflect upon their reactions to stressful situations related to their participation in sport, rather than stressful situations in general. The wordings of the items in the PSRS were adapted to reflect sport-specific versions of the stress stimuli described in each item where appropriate. For example, "When I want to relax after a hard day at work" was re-worded to "when I want to relax after a hard training session". However, some items were not required to be re-worded, such as "when I make a mistake". Two external researchers with experience in questionnaire development and sport psychology firstly checked content validity. This was to assess both the scale's appropriateness for measuring perceived stress reactivity, and for its appropriateness to be administered to adolescent participants, with suggested changes being made to the scale. Two participants within the target sample were then recruited (with ethical clearance approved by a local ethics board) and asked to read the questionnaire. The participants were asked to feedback on any items or elements of the instructions which were unclear or difficult to understand. Finally, a Flesch-Kincaid grade level test was run to estimate the reading proficiency needed to understand the items. This uses a formula which considers sentence length and the average number of syllables per word, to calculate the school grade required to understand a selected text. Item wordings were adapted to require the minimum reading age of the target sample (12 years of age). This ensured that the PSRS-AA would be understood by the youngest of reading ages within the sample. After this process, the PSRS-AA retained its 23-item structure, with five factors (social evaluation, work overload, social conflict, failure, and prolonged).

2.2.2 Perceived stress scale. The perceived stress scale (PSS; Cohen, Kamarck, & Mermelstein, 1983) is a 10-item self-report questionnaire, designed to measure how much an individual perceives events in their life over the past month as being uncontrollable, overwhelming and unpredictable, thus indicating their level of perceived stress during that time (e.g., "In the last month, how often have you felt that you were unable to control the important things in your life?"). Participants rate the frequency of each item in their lives on a 5-point likert scale. The scale has demonstrated good internal consistency (α =.85) and validity through correlations with the impact of stressful life events and depressive symptomology (Cohen et al., 1983).

2.2.3 Ten item personality inventory. The ten item personality inventory (TIPI; Gosling, Rentfrow, & Swann, 2003) measures the "Big Five" personality traits (extraversion, agreeableness, conscientiousness, emotional stability, and openness). Each trait is measured with two items. Participants are asked to rate the extent to which a pair of words describes them on a 7-point likert scale. This measure was selected as a very brief alternative measure of the big five personality traits. The TIPI correlates strongly with the Big Five Inventory (r =.77) (Gosling et al., 2003).

2.2.4 Brief measure of student life satisfaction scale-PTPB version. The brief measure of student life satisfaction scale-PTPB version (BMSLSS; Athay, Kelley, & Dew-Reeves, 2012) is a measure of subjective well-being. Students rate the extent to which they are satisfied with their family life, friendships, school experience, themselves, where they live, and their life overall, on a 5-point likert scale. The mean score across these six domains indicates their total life satisfaction and thus their subjective well-being. The scale demonstrates adequate internal consistency (α =.77) and one factor model fit (CFA =.93) (Athay et al., 2012). For the present study, an additional life domain was added to the measure: "sport experience" (see van Rens et al. 2016). Participants rated on the same likert scale their satisfaction with their sport

experience. This score was summed along with the scores in the other life domains and divided by seven to give the mean life satisfaction score.

2.3 Analysis

Confirmatory factor analyses (CFAs) based on maximum likelihood estimation and a co-variance matrix were conducted using SPSS AMOS (v. 23). A second order model was used to test the data from the PSRS-AA's fit to the original five factor structure of the PSRS (Bryne, 2016). Lambda was set to 1 for each first observed indictor of the latent variables and the error weights, with all other parameters being freely estimated. The goodness-of-fit indices used to determine model fit were as follows: (1) Chi squared/degrees of freedom (CMIN/DF; greater than 1 indicating an adequate fit), (2) comparative fit index (CFI; greater than or equal to .95 indicating a good fit and .90 indicating an adequate fit; Hu & Bentler, 1999) and root mean square error of approximation (RMSEA; less than .60 indicating a good fit; Hu & Bentler. 1999), plus the *p* value testing the null RMSEA (PCLOSE; a non-significant result greater than .05 to reject the null), were all assessed to measure the model's fit (Hu & Bentler, 1999). Model modification was carried out using modification indices, factor loadings (with values greater than or equal to .34 being considered acceptable), and drawing of co-variances between correlated errors supported by a strong rationale, such as clear item content overlap, and the replication of error co-variances from previous research (Byrne, 2016). Cronbach's alpha scores were calculated to test the PSRS-AA's internal consistency within its subscales and its total reactivity scores (.60 to .69 being questionable, .70 to.79 being acceptable, and .80 and above being good; Kline, 1999). Test re-test reliability was calculated using intraclass correlation coefficients (ICCs) between scores approximately four weeks apart and the sub-sample of participants (ICCs greater than .81 classified as excellent, .60 to .80 as good, .41 to .60 as moderate, and less than .40 as poor;

Nunnally & Bernstein, 1994). Construct validity of the PSRS-AA was tested using Pearson's *r* correlations with the PSS, TIPI, and BMSLSS (*r* correlations from .10 to .29 being classified as small, .30 to .49 medium, and .50 and above large). Gender differences in scores on the subscales and total reactivity were also analysed using independent samples *t* tests with effect sizes (Cohen's *d*; .20 to .49 being classified as small, .50 to .79 medium, and .80 and above as large).

3 Results

3.1 Confirmatory factor analysis

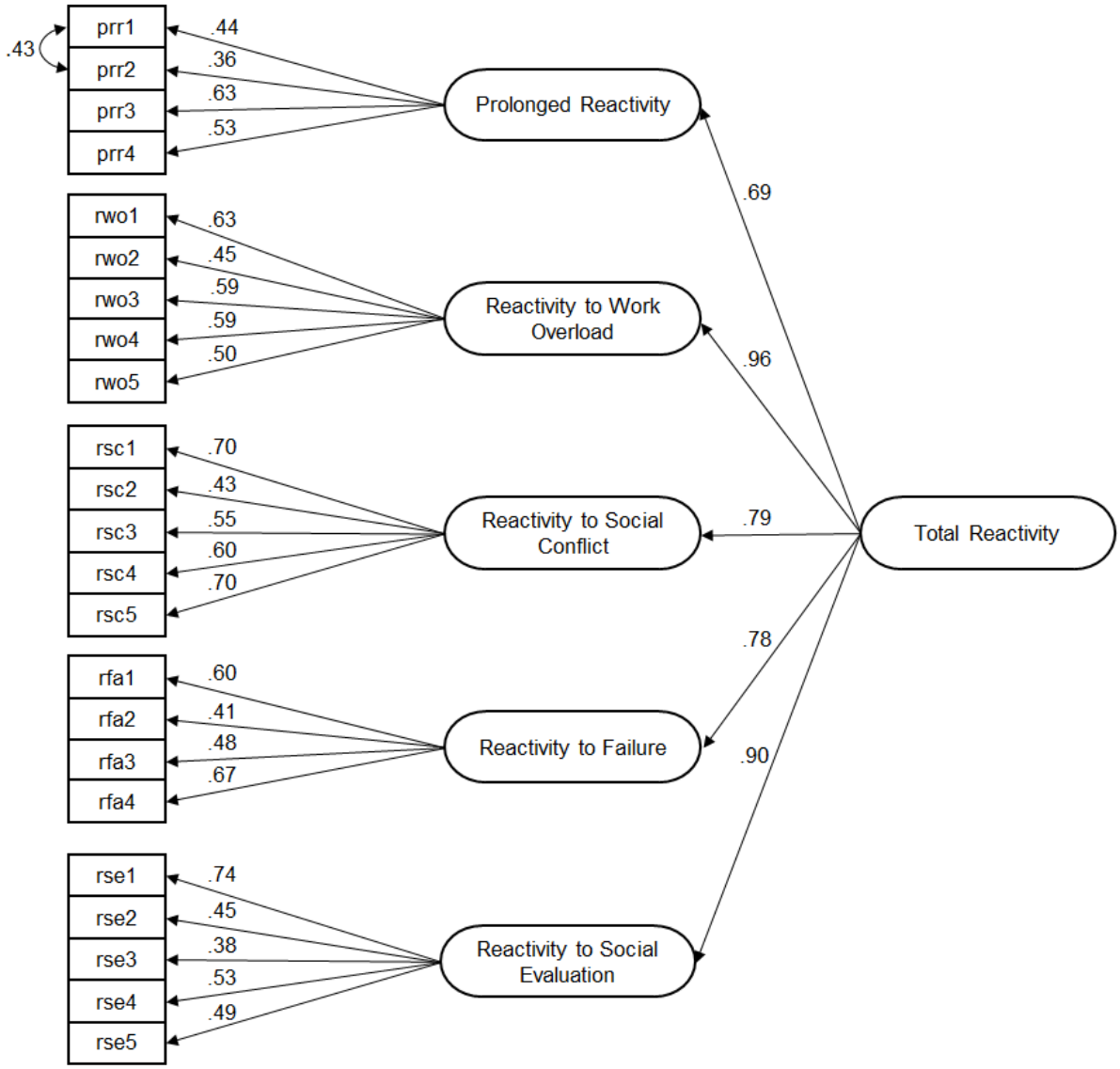

Figure 2: Confirmatory factor analysis of the PSRS-AA

Initial analysis using a five-factor second order model produced an unacceptable level of fit (CMIN/DF = 1.59; CFI = .89; RMSEA = .05; PCLOSE = .55). The modification indices provided by AMOS indicated that items 2 and 10 were highly correlated. The content of these two items shared clear content overlap (item 2: *When I want to relax after a hard training session or match: This is usually quite difficult for me; I usually succeed; I generally have no problem at all*; item 10: *When I have spare time after training or playing hard: It is often difficult for me to relax; I usually need some time to relax properly; I am usually able to relax well*) plus this was a replication of a same error co-variance featured in the confirmatory factor analysis of the original PSRS. Therefore, co-variances were drawn between these two items. The resulting analysis provided an acceptable fit to the five-factor structure (CMIN/DF = 1.43; CFI = .92; RMSEA = .04; PCLOSE = .90; see Figure 2).

3.2 Internal consistency and test re-test interclass correlation

Cronbach's alpha scores indicated good internal consistency for the measure of total reactivity, while scores for the individual subscales ranged from acceptable to questionable (see Table 2). ICCs indicated that the measure of total reactivity had good test re-test reliability. The reliability of the subscales ranged from good to moderate (see Table 2).

Table 2
Internal Consistency (Cronbach's α) and Test–Retest ICCs of Perceived Stress Reactivity scale for adolescent athletes

Scales	α	ICC
Prolonged Reactivity	.62	.40
Reactivity to Work Overload	.69	.50
Reactivity to Social Conflict	.73	.68
Reactivity to Social Evaluation	.65	.65
Reactivity to Failure	.63	.52
Total Reactivity	.87	.73

Table 3
Correlations between the Perceived Stress Reactivity Scales for Adolescent Athletes and other measures

Scales	Prolonged Reactivity	Reactivity to Work Overload	Reactivity to Social Conflict	Reactivity to Social Evaluation	Reactivity to Failure	Total Reactivity
Extraversion	-.11	-.13*	-.20**	-.25**	-.20**	-.24**
Agreeableness	-.10	-.10	-.03	.11	-.05	-.04
Conscientiousness	-.07	-.01	-.02	-.02	-.03	-.03
Emotional Stability	-.32**	-.43**	-.48**	-.43**	-.35**	-.54**
Openness	-.06	-.18**	-.18**	-.17**	-.18**	-.21**
Perceived Stress	.31**	.49**	.49**	.44**	.30**	.55**
LS Family	-.26**	-.17**	-.15*	-.16*	-.11	-.23**
LS Friendships	-.26**	-.19**	-.16*	-.20**	-.05	-.24**
LS Education	-.18**	-.23**	-.14*	-.11	-.16*	-.22**
LS Self	-.28**	-.37**	-.26**	-.34**	-.15*	-.38**
LS Location	-.29**	-.29**	-.24**	-.25**	-.20**	-.34**
LS Sport	-.15*	-.28**	-.20**	-.15*	-.16*	-.25**
LS Life	-.28**	-.28**	-.23**	-.26**	-.15*	-.32**
LS Total	-.35**	-.37**	-.29**	-.30**	-.21**	-.41**

Note. * $p < .05$. ** $p < .01$; LS = Life Satisfaction

3.3 Construct validity

3.3.1 Perceived stress. A large positive correlation was found between total reactivity and perceived stress experienced in the month prior to data collection. Medium positive correlations were observed between scores on the PSS and the PSRS-AA's five subscales (see Table 3).

3.3.2 Big five personality traits. A large negative correlation was observed between total reactivity and emotional stability. Emotional stability also had negative medium correlations with the PSRS-AA's subscales, although lower. There were also small but significant negative correlations between total reactivity and extraversion and openness. (see Table 3).

3.3.3 Life satisfaction. A medium negative correlation was observed between total reactivity and total life satisfaction. On the BMSLSS's individual items, only a small negative

correlation was observed between satisfaction with sport experience and scores on the PSRS-AA. Small correlations were also observed with the life domains of family and friendships. Medium correlations, however, were observed with the domains of self, location, and life overall (see Table 3).

3.3.4 Gender differences. Females reported greater total reactivity compared to males. An independent samples t-test revealed this difference to be significant, with a medium effect size. On the PSRS-AA's subscales, females also reported significantly higher reactivity to work overload, social conflict, and social evaluation. However, gender differences in reactivity to work overload and social conflict produced only small effect sizes. Only reactivity to social evaluation produced a medium effect size.

Table 4
Gender differences in Perceived Stress Reactivity for Adolescent Athletes

	Female		Male			
Scales	*M*	*SD*	*M*	*SD*	*t*	*d*
Prolonged Reactivity	.57	.49	.45	.41	1.88	.26
Reactivity to Work Overload	.63	.47	.43	.37	3.55**	.47
Reactivity to Social Conflict	.76	.48	.55	.43	3.45**	.46
Reactivity to Social Evaluation	.88	.50	.60	.38	4.53**	.63
Reactivity to Failure	.96	.40	.90	.43	1.19	.14
Total Reactivity	3.80	1.78	2.93	1.41	3.99**	.54

Note. * $p < .05$. ** $p < .01$

4 Discussion

This study provided initial support for the use of the PSRS-AA in youth sport contexts to measure individual differences in SR. The five-factor 23 item structure of the original PSRS provided acceptable model fit for the PSRS-AA (H1). There was adequate internal consistency and test retest reliability for the scale's measure of total reactivity. As predicted, total reactivity was positively associated with perceived stress, and negatively associated with the trait emotional stability, extraversion, openness, and with life satisfaction (H2). Gender

differences were also as expected, with females reporting higher levels of total reactivity than males (H3). The study provides a springboard for further research related to SR and individual differences in youth sport contexts. Furthermore, the PSRS-AA can be used as a less time-consuming, less costly, and more ecologically valid alternative to lab-based methods of assessing SR.

Confirmatory factor analysis of the PSRS-AA's model fit to the original scale's five factor structure demonstrated adequate results. This was achieved with one co-variance drawn between items 2 and 10 of the prolonged reactivity factor. There is a clear overlap of content between these two items (i.e. the ease of recovery from stress after training or matches) and this correlation of errors was also present in the original PSRS (Schlotz, Yim, et al., 2011). This therefore can be used to justify the co-variance drawn between these two items (Byrne, 2016). This provides support for collating perceived reactivity to different stress response domains to measure overall total reactivity as a broad stable trait, and that these stress response domains can be related to sport-specific contexts in youth sport.

The PSRS-AA's relationship with perceived stress indicates that adolescent athletes who are highly reactive experience greater levels of stress over time, feeling that their lives are uncontrollable and difficult to cope with. In other words, more reactive adolescent athletes experience more stress. Furthermore, the scale's relationship with the BMSLSS indicates that SR predicts subjective well-being, with highly reactive adolescent athletes experiencing lesser satisfaction across life domains. However, when examining the BMSLSS's individual measures of different life domains, sport experience did not demonstrate the strongest relationship with the PSRS-AA compared to other life domains (such as education, friendships, family, and location). This would lend support to the notion that SR is a broad stable trait (Schlotz, 2013), thus influencing satisfaction and well-being across all life domains irrespective of situational factors.

The scale's relationship with the Big Five personality traits indicates that high reactors are low in emotional stability. This supports previous research which has associated neuroticism with greater perceived stressor intensity, lower perceived control, and the use of emotion and avoidance focussed coping strategies in athletes and the wider population (Connor-Smith & Flachsbart, 2007; Kaiseler et al., 2012a). A significant relationship between reactivity and low levels of extraversion was also observed. This further supports prior findings which have associated extraversion with low stress reactivity (Connor-Smith & Flachsbart, 2007). Overall, the relationship of these two traits (Extraversion and Neuroticism) with perceived reactivity supports the assumption that personality is associated with reactivity and sensitivity to environmental signals (Eysenck, 1967; Suls & Martin, 2005).

Gender differences between scores on the PSRS-AA also supported its validity in its adapted form for adolescent athletes. This supports previous research which has reported greater physiological reactivity in adolescent females (Charbonneau, Mezulis, & Hyde, 2009; Hankin, Mermelstein, & Roesch, 2007). Furthermore, females reported higher levels of reactivity to work overload, social conflict, and social evaluation, but not prolonged reactivity or reactivity to failure. This suggests that adolescent females participating in sport experience more reactivity to social environments (such as performing in front of crowds, being evaluated by their coaches, or disagreements with teammates) and situations of high physical and psychological demand (having to manage multiple commitments in and outside of their sport). This puts greater emphasis on the management of stress in female youth sports in particular, notably in the face of stressors relating to criticism, self-presentation, inter-personal relationships with team-mates and coaches, and the management of workloads and commitments.

The internal consistency scores also indicate that the scales items reliably contribute to form an aggregated measure of an individual's perceived SR. The internal consistencies of

the individual subscales are somewhat lower however. One would therefore recommend that analysis which examines these subscales in isolation should be treated with caution. However, it is possible that the PSRS-AA's individual subscales relate to other specific traits, and thus may predict certain outcomes. For example, the reactivity to social evaluation subscale may relate to traits of self-consciousness, which have been linked to performance decrements under conditions of social evaluative threat (Geukes, Mesagno, Hanrahan, & Kellmann, 2013; Mesagno, Harvey, & Janelle, 2012). The reactivity to social evaluation subscale on the original PSRS has been associated with greater cortisol responses to a social stress test (Schlotz et al., 2011b). Future research may wish to explore this further. Overall though, the scale's measure of total reactivity, aggregating reactivity across response domains, demonstrates good validity, reliability, and consistency.

Future research is required to further establish the PSRS-AA for use within research and applied practice with adolescent athletes. Individual differences (Big Five personality traits and mental toughness) have been previously identified as influencing the stress appraisal and coping behaviour of athletes (Kaiseler et al., 2009; Kaiseler et al., 2012a). SR could influence how young athletes cope with stress, and their subsequent performance and well-being, by producing greater activations of the ANS and HPA systems in response to their environment. With stress being a significant cause of burnout and dropout from youth sport (Crane & Temple, 2015; Goodger et al., 2007), SR could predict the risk of both these outcomes. Future research could further validate the PSRS-AA by directly comparing it to physiological and neuroendocrine responses. Schlotz et al. (2011b) found the PSRS to predict cortisol reactivity to a social stress test. Cortisol reactivity and heart rate variability have both been associated with sports performance under pressure conditions (Laborde, Lautenbach, & Allen, 2015; Lautenbach, Laborde, Klämpfl, & Achtzehn, 2015). Validation via these

methods would confirm the PSRS-AA as a legitimate alternative to costly and time-consuming lab-based tests more commonly used to measure SR.

Future intervention studies aimed at stress management for adolescent athletes should consider individual differences in SR. The PSRS-AA could be used as a screening tool to identify adolescent athletes who are more sensitive to environmental signals and stress, and therefore at greater risk of negative emotionality and decreased life satisfaction. However, SR can be adapted and changed over-time, with adolescence having been identified as a window of opportunity for stress-based interventions (Romeo, 2010). The PSRS-AA could therefore be used as an outcome measure for interventions with youth athletes, aiming for stable long-term changes in adolescent athletes' reactivity and health.

5 Conclusions

The current study provides initial support for the use of the PSRS-AA for measuring individual differences in perceived stress reactivity in adolescent athletes. The PSRS-AA measures an individual difference yet to be examined in any great depth with adolescent athletes, and more specifically within sporting contexts for athletes of any age. It has the potential to predict several stress-related outcomes pertinent to the performance and well-being of young athletes during their development. Research and applied practice in the future can use the PSRS-AA to identify stable individual differences in adolescent athletes' total reactivity, without the use of time-consuming, costly, and less ecologically valid lab-based assessments.

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Appendix

The Perceived Stress Reactivity Scale for Adolescent Athletes

Instructions: This questionnaire asks about your reactions to situations **related to taking part in your sport** which you may have experienced in the past. Three answers are suggested. Please tick the answer that most closely describes your own reaction in general to these situations in your sport. Please don't skip any question, even if it may be hard to find the best answer.

1. When all my different training sessions and matches build up and become hard to manage.
    - I am generally untroubled.
    - I usually feel a little uneasy.
    - I normally get quite nervous.

2. When I want to relax after a hard training session or match.
    - This is usually quite difficult for me.
    - I usually succeed.
    - I generally have no problem at all.

3. If I have conflicts with team-mates, coaches or officials.
    - I generally shrug it off.
    - It usually affects me a little.
    - It usually affects me a lot.

4. When I make a mistake.
    - In general, I remain confident.
    - I sometimes feel unsure about my abilities.
    - I often have doubts about my abilities.

5. When I'm wrongly criticized by others.
    - I am normally annoyed for a long time.
    - I am normally annoyed for a short time.
    - In general, I am hardly annoyed at all.

6. If I argue with team-mates, coaches or officials.
    - I usually calm down quickly.
    - I usually stay upset for some time.
    - It usually takes me a long time until I calm down.

7. When I have little time to prepare for a match.
    - I usually stay calm.
    - I usually feel uneasy.
    - I usually get quite unsettled.

8. When I make a mistake.
    - I am normally annoyed for a long time.
    - I am normally annoyed for a while.
    - I generally get over it easily.

9. When I am unsure what to do or say in front of my team-mates or coaches.
    - I generally stay cool.
    - I often feel like I'm blushing.
    - I often begin to sweat.

10. When I have spare time after training or playing hard.
    - It is often difficult for me to relax.
    - I usually need some time to relax properly.
    - I am usually able to relax well.

11. When I am criticized by others.
    - I usually fail to find a reply to defend myself
    - I often have difficulty finding a good reply.
    - I usually think of a reply to defend myself.

12. When something does not go the way I expected.
    - I usually stay calm.
    - I often get uneasy.
    - I usually get very upset.

13. When I do not achieve a goal.
    - I usually remain annoyed for a long time.
    - I am usually disappointed, but recover soon.
    - In general, I am hardly concerned at all.

14. When others criticize me.
    - I generally don't lose confidence at all.
    - I generally lose a little confidence.
    - I generally feel very unconfident.

15. When I fail at something.
    - I usually find it hard to accept.
    - I usually accept it to some degree.
    - In general, I hardly think about it.

16. When there are too many things related to my sport that I have to do at the same time.
    - I generally stay calm and do one thing after the other.

- I usually get uneasy.
- Usually, even minor interruptions irritate me.

17. When others say something incorrect about me.
    - I usually get quite upset.
    - I normally get a little bit upset.
    - In general, I shrug it off.

18. When I fail at a task.
    - I usually feel very uncomfortable.
    - I usually feel somewhat uncomfortable.
    - In general, I don't mind.

19. If I have arguments with team-mates, coaches or officials.
    - I usually get very upset.
    - I usually get a little bit upset.
    - I usually don't get upset.

20. When I am under stress.
    - I usually don't enjoy playing my sport at all.
    - I usually have difficulty enjoying my sport.
    - I usually enjoy playing my sport.

21. When all my training sessions and matches accumulate and become hard to cope with.
    - My sleep is unaffected.
    - My sleep is slightly disturbed.
    - My sleep is very disturbed.

22. When I have to perform in front of other people.
    - I often get very nervous.
    - I often get somewhat nervous.
    - In general, I stay calm.

23. When I have to fulfil many tasks and duties related to my sport.
    - In general, I stay calm.
    - I usually get impatient.
    - I often get bad-tempered.

The first answer of each item is coded 0, the second 1, and the third 2. Items marked with "R" are to be reversed. Prolonged Reactivity (PrR): 2R, 10R, 20R, 21; Reactivity to Work Overload (RWO): 1, 7, 12, 16, 23; Reactivity to Social Conflict (RSC): 3, 5R, 6, 17R, 19R; Reactivity to Failure (RFa): 8R, 13R, 15R, 18R; Reactivity to Social Evaluation (RSE): 4, 9,

11R, 14, 22R; Perceived Stress Reactivity total score (PSRS-tot): sum of the five scale scores.