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The reinforcement sensitivity theory of personality in children: A new questionnaire

Andrew J. Cooper [a,*], Sarah Stirling [b], Sharon Dawe [b], Giulia Pugnaghi [a], Philip J. Corr [c]

[a] Department of Psychology, Goldsmiths, University of London, New Cross, SE14 6NW London, United Kingdom
[b] Griffith University, Menzies Health Institute Queensland, Brisbane, 4222, Queensland, Australia
[c] Department of Psychology, School of Arts and Social Sciences, City University of London, Northampton Square, EC1V 0HB London, United Kingdom

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ABSTRACT

We report the development of a self-report questionnaire of the reinforcement sensitivity theory (RST) of personality for use with children. Focus groups were held with children to sample their experiences of situations modelled on components of three RST systems: *fight-flight-freeze system* (FFFS, related to fear), *behavioural inhibition system* (BIS, related to anxiety), and *behavioural approach system* (BAS, related to approach). The thematic responses formed the conceptual anchors to the development of test items that were examined using exploratory factor analysis in a sample of 288 9–13 year olds. After eliminating items that did not load on their designated factor, or substantially cross-loaded over factors, the original 48 items were reduced to 21 items: 7 items for each of the BIS, FFFS and BAS factors. The separation of the BIS and FFFS items across two factors is consistent with the revised model of RST. We offer this new questionnaire as a RST measure of fundamental motivation and emotion traits in children.

1. Introduction

There has been extensive investigation of the measurement of personality in children, drawing largely from the work of Rothbart and colleagues. One of the most widely used measures of temperament in children, The Children's Behaviour Questionnaire (CBQ: Rothbart, Ahadi, Hershey, & Fisher, 2001), is a parent report measure for children aged 3 to 7 years that has demonstrated strong convergence with behavioural tasks (Rothbart, Sheese, & Conradt, 2009). Three factors have been reliably identified: Negative affectivity, surgency/extraversion, and effortful control (Rothbart et al., 2001). This, and related measures, have been shown to predict personality traits in children and later psychopathology (Biederman et al., 1990; Rothbart, Derryberry, & Hershey, 2000). For this reason, the measurement of personality in children is important as it may enable the prediction of clinical disorders and assist in treatment planning – it is also likely to permeate all areas of children's school, family, and social life.

It is widely believed that underlying human personality are neurobehavioural systems responsible for appetitive and aversive motivation (Corr, 2013; for a review, see DeYoung and Gray, 2009). These theories tend to group the most important classes of motivational stimuli into "rewards" and "punishments"; and leading theories (e.g., Carver & Scheier, 1998) assume they reflect the operation of cybernetic systems with attractors and repulsors (positive and negative goals) that have evolved to promote survival and reproduction. Individual differences in these systems give rise to differences in personality (e.g., extraversion and neuroticism) and behaviour (e.g., social interaction and performance), and shape the trajectory of adult personality and its effects, including the panoply of related behaviours, both normal and abnormal.

The revised 'reinforcement sensitivity theory' (RST) of personality (Gray & McNaughton, 2000; McNaughton & Corr, 2004, 2008; Corr & McNaughton, 2012) is one of the more prominent of such basic personality theories. In its most recent form, it assumes three major neuropsychological systems: the *behavioural approach system* (BAS), the *fight-flight-freeze system* (FFFS) and the *behavioural inhibition system* (BIS). The BAS is activated by appetitive stimuli of all kinds, including safety signals (i.e., associated with escape from threatening stimuli); the FFFS by all aversive stimuli (including frustrating 'rewarding' stimuli); and the BIS by all forms of conflicting goals (e.g., co-activation of FFFS and BAS; these may be explicit stimuli or more abstract cognitive goals, even of an existential nature giving rise to *angst*). A caveat here is that these stimuli are defined only after an initial valuation stage which categorizes stimuli as either indicating gain ('rewarding') or loss ('punishing') – these stimuli are then 'attractors' and 'repulsors', respectively – and it is then the contingencies of the situation that determine activation of the FFFS, BIS and BAS (Corr & McNaughton, 2012). This general theoretical framework increasingly is seen as offering an integrative model for the neurobiology of personality (e.g., Kennis, Rademaker, & Geuze, 2013). Summaries of this literature can be found in Corr (2013) and Corr, DeYoung and McNaughton (2013).

* Corresponding author.
E-mail address: a.cooper@gold.ac.uk (A.J. Cooper).

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The separation of FFFS/fear and BIS/anxiety is the most important alteration in revised RST. Emphasis is placed on their different, and often opposing, functional properties. Specifically, unlike the simpler FFFS which is concerned with active avoidance of, and escape from, stimuli evaluated as threatening and dangerous (that is *moving away* from aversive stimuli), the BIS has evolved to detect goal conflict and it attempts to resolve it by engaging processes entailing (a) the inhibition of prepotent conflicting behaviours, (b) the engagement of risk assessment processes, (c) scanning of memory and the environment to gather relevant information, (d) an increase in attention, and (e) an increase in arousal such that consequent behaviour has increased vigour. In typical animal learning situations, BIS activation allows entries to a dangerous situation (i.e., leading to cautious 'risk assessment' behaviour) or to the withholding of entrance (i.e., passive avoidance) – at high levels of the BIS, passive avoidance is so great that normally adaptive entrance is inhibited. There is extensive neuropsychopharmacological evidence to support the functional and neural separation of the FFFS and BIS (for summaries, see Corr & McNaughton, 2012; McNaughton & Corr, 2004, 2008). The evidential bases for the separation of the FFFS and BIS have been summarized in Corr and Cooper (2016).

As the FFFS, BIS and BAS have been implicated in psychopathology seen in childhood, these developments in RST are potentially of high importance (Bijttebier, Beck, Claes, & Vandereycken, 2009); however, the absence of appropriate self-report psychometric measures of the FFFS and BIS, not only in children but also adults, has been a significant obstacle to research progress (Sylvers, Lilienfeld, & LaPrairie, 2011). Recent efforts at questionnaire development in the adult RST literature, however, have redressed this issue to some extent (Corr & Cooper, 2016; Jackson, 2009; Reuter, Cooper, Smillie, Markett, & Montag, 2015; Smederevac, Mitrovic, Colovic, & Nikolasevic, 2014).

In the case of RST questionnaires specifically for children, efforts have largely involved the modification of existing adult RST scales for both child self-report (e.g., Muris, Meesters, de Kanter, & Eek Timmerman, 2005) and caregiver reports on children (e.g., Colder et al., 2011; Vervoort et al., 2015). The child version of the BIS/BAS scales have been widely used and validated, however these scales were developed in the context of unrevised RST and were originally shown to have a two factor structure (i.e., a BIS and BAS factor; Muris et al., 2005). Vervoort et al. (2010) showed a two factor structure in the BIS items from the child BIS/BAS scales, but the internal reliability of the putative FFFS factor was very low, as it was comprised of only two items. Thus, the usefulness of these scales is limited in the context of revised RST. Colder and O'Connor (2004) developed a caregiver-report RST measure for children based on the adult Sensitivity to Punishment and Sensitivity to Reward scales (SPSRQ; Torrubia, Ávila, Moltó, & Caseras, 2001). Colder et al. (2011) attempted further to develop this measure in line with revised RST. They extracted a separate fear/shyness and anxiety factor from the data, as well as three BAS-related factors (two additional factors extracted did not appear to be psychometrically robust). While the separation of the fear and anxiety factors is potentially consistent with revised RST, the fear factor appeared to only tap a relatively narrow spectrum of FFFS-related behaviour, with many of the items loading on the factor relating to shyness. Further, it is unclear to what extent the factor structure generated in caregiver reports will replicate to self-reporting by children.

Our aim in the current study was to develop a short self-report questionnaire for children consistent with revised RST. Rather than seek to modify an existing scale for adults, as previous studies have sought to do, we looked to develop a novel set of theoretically derived items. Our approach here was modelled on the process undertaken for the development of the reinforcement sensitivity theory of personality questionnaire (RST-PQ; Corr & Cooper, 2016), a recently developed RST self-report measure for adults. First, we used theoretically driven items to guide development, based on the most up-to-date version of RST (see Corr & Cooper, 2016). Secondly, we avoided the ambiguity associated with saturation of factors with specific emotion words. Thirdly, we used a variety of methods to generate test items, including focus groups with children to discover what they associate with specific defensive and approach situations. This structured approach ensured we remained faithful to the fundamental components of revised RST, as well as to the everyday experiences of children.

2. Method

2.1. Participants

Two hundred and eighty-eight school children were recruited from one public state school and seven independent schools in Brisbane, Australia. The number of children recruited from each school ranged from 22–72 ($M = 36.13$, $SD = 16.39$). The children's mean age was 11.01 ($SD = 0.92$), ranging from 9–13 years, and 159 (55.21%), were female (2 children did not report their gender). There was no significant difference in age across gender, $t\ (284) = 0.50$, $p = 0.62$.

2.2. Item development

The FFFS was designed to measure a child's propensity to engage in fear-related behaviours, specifically: Fight, Flight, Freeze, and Active Avoidance. The BIS was designed to measure a child's propensity to engage in anxiety-related behaviours, specifically: Risk Assessment, Goal Conflict Resolution, Behavioural Inhibition/Motor Inhibition, and Worry/Rumination. The BAS was designed to measure a child's propensity to engage in activities associated with reward, specifically: Incentive Interest/Reward Responsiveness, Appetitive Drive, and Active Approach. These facets were explored in the focus groups (see Supplementary Material), around which test items were written. Children responded to the 48 items on a 4 point Likert scale: 'Never', 'Sometimes', 'Often', 'Always'. (The full 48 items are shown in Supplementary Materials.)

Items were written using standard guidelines for clear and comprehensible self-report personality measures (e.g., Osterlind, 2009) that were unambiguous, short statements, without compound clauses and reflecting unipolar activity of the relevant system. The use of reverse worded items was avoided because these may cause spurious multi-dimensionality in responses by confusing participants (van Sonderen, Sanderman, & Coyne, 2013) – this is especially a concern with children.

2.3. Procedure

Primary schools in Brisbane, Australia, were approached. The schools which chose to participate were situated in areas of average to high socioeconomic status. The school distributed the consent forms to all children to obtain parental consent. Approximately 910 consent forms were distributed and 314 consent forms were returned (34.5% response rate).

Of the 314 consent forms returned, 26 children did not participate due to other school commitments. Schools set aside 45 min to 1 h for each group of children to complete the questionnaires – these were completed in groups of 15–30. The sessions were run in a spare classroom, library or art room. All children were given the same instructions and the researcher was present throughout these sessions. Children were instructed to answer all questions and to ask the researcher for assistance if they were unsure how to answer a specific question. They were told that there were no right or wrong answers and that they were to choose the answer that best described them. They were instructed to cross out an answer if they had made a mistake and circle the appropriate answer.

3. Results

The 48 test items were subjected to exploratory factor analysis using Principal Axis factoring with a direct oblimin rotation. Three

factors were extracted and items were retained that loaded on their designated *a priori* factor - items that initially loaded on different factors or cross-loaded were eliminated. This iterative process resulted in the removal of 27. A final exploratory factor analysis was run on the reduced set of 21 items. In the reduced solution, three factors (eigenvalues: 4.87, 2.53, 1.53; and the fourth 1.07) accounted for 33% of the total variance, and with seven items each showing a primary loading on the BIS, FFFS and BAS factors. The factor loadings of the items on their designated factors are shown in Table 1. There were no secondary loadings >|0.30| in the reduced solution.

Mean scores and their standard deviation for the three final scales for this sample are also shown in Table 1. Cronbach's alpha for the three scales (BIS = 0.80; FFFS = 0.76; BAS = 0.68) were adequate. Skewness and kurtosis values for the three scales were also acceptable. As predicted, the FFFS and BIS were positively, but only moderately, correlated ($r = 0.53$, $p < 0.001$ – Corr & Cooper, 2016, report a similar magnitude for their adult samples, 0.40/0.56) and the BAS was uncorrelated with both the FFFS ($r = -0.07$) and the BIS ($r = 0.07$). There were no significant correlations between age and the FFFS and BAS scales, and a modest negative correlation between age and the BIS ($r = -0.17$). Gender was uncorrelated with the three scales.

Table 1
Factor loadings for the reduced set of items defining the FFFS, BIS and BAS factors and descriptive statistics for the total scores.

Items	FFFS	BIS	BAS
FFFS			
I would be frozen to the spot if there was a snake or spider in the bathroom with me.	0.57		
I would be frozen to the spot if I saw a large shadow when swimming in the ocean.	0.57		
I would run away if I saw a spider or snake.	0.54		
I would freeze if I thought a bird was going to attack me.	0.52		
I would freeze if I heard strange noises when in bed at night time.	0.52		
I would run away from an animal if it was making me feel scared.	0.47		
I would run back upstairs if there were no lights on downstairs.	0.40		
BIS			
I am careful when doing something that might hurt me.		0.75	
I would be careful when playing a game or sport.		0.68	
I would stop what I was doing if I thought there was physical danger or I might hurt myself.		0.65	
I would stop what I was doing if I thought it was too risky to keep going.		0.64	
I worry about what would happen if I was hurt.		0.46	
I would stop and think before going down a hill on a skateboard, rollerblades, bike etc.		0.44	
I would think carefully about trying out for something (e.g., sports team, school captain etc.) in case I didn't make it in.		0.44	
BAS			
I am training to be better at sport/things I like doing.			0.54
I work hard to do well at the things I like doing.			0.54
I like to practise something I like doing so I can get better.			0.54
I put in lots of effort to achieve a goal (or get where I want).			0.54
I want to keep on improving (getting better) at my favourite things.			0.44
I am interested in exploring places.			0.43
I like to do new and exciting things.			0.41
Mean	9.44	12.25	17.89
SD	4.69	4.57	2.76
Skewness	0.16	−0.19	0.92
Kurtosis	−0.54	−0.64	0.65
Alpha	0.76	0.80	0.68

Note. Only factor loadings >0.30 are displayed in this table.

4. Discussion

Our aim was to develop a self-report measure appropriate for children that was consistent with revised RST. After generating an initial candidate pool of items, we used factor analysis to generate a final set of 21 items. The development of items was made on the basis of theoretical considerations of revised RST, as well as psychometric considerations. This final set of 21 items was shown to load on three separate factors: BIS, FFFS and BAS. The separation of the FFFS and BIS items across two factors is clearly important in the context of revised RST. Previous attempts to develop child RST measures have either potentially conflated items related to the BIS and FFFS within one factor (Muris et al., 2005), or have only shown separate BIS and FFFS factors in caregiver reports, rather than child self-reports (Colder et al., 2011). Previously developed RST measures for children have also focused on adapting existing adult RST scales. The strength of our approach is that we developed new items specifically for children, and used focus groups with children to help generate item content to gain a better understanding of emotions and behaviours relevant to RST in children.

Regarding the procedure to retain and delete items, it should be noted that it is difficult to write unambiguous FFFS items because even apparently straightforward ones may contain a significant degree of goal conflict and, thus, should relate to the BIS. It is notable that FFFS items that survived this culling process were specific fears, with animal fears prominent; however, these items also contained elements of freezing, flight, avoidance and so do not just reflect specific fears: This FFFS factor entails unambiguous and immediate threat. In contrast, the BIS is more concerned with the future and the possibility of harm that can be avoided from the exercise of caution, worry and rumination. The distinction between immediate unambiguous threat (FFFS-related) and abstract, more distant threat (BIS-related) is exactly the distinction made by the Blanchards' in their ethoexperimental analysis of defensive behaviour in the rodent (Blanchard, Hynd, Minke, Minemoto, & Blanchard, 2001; for a summary, see McNaughton & Corr, 2004, 2008) on which revised RST is based. The relevance of this fundamental ethoexperimental research has been confirmed in humans (e.g., Blanchard et al., 2001; Perkins, Cooper, Abdelall, Smillie, & Corr, 2010; Perkins & Corr, 2006) and it is not difficult to discern its presence in our three-factor solution.

Turning to the issue of defensive fight, none of these items survived our pruning process. This is less of a problem than might be thought. The position of a fight factor (in both its defensive and instrumental modes) is complex in RST (for more discussion, see Corr, 2013, and Corr & Cooper, 2016) . Empirical evidence confirms that it is more strongly associated with the BAS than the FFFS (Harmon-Jones, 2003; Smits & Kuppens, 2005), therefore its omission in the current RST-PQ does not undermine the FFFS scale. In the adult RST-PQ (Corr & Cooper, 2016), a separate scale of fight needed to be developed – even though designed to be largely defensive in nature this was strongly associated with the BAS. This correlation with BAS, rather than with other FFFS domains, is typical in adult RST measures (Corr, 2016).

In relation to the BAS, which tends to decompose into multiple factors in adult samples, the unitary scale we recovered seems to tap a combination of goal-drive persistence and achievement striving, but also the exploration of new places and the enjoyment of new things, which reflects some degree of reward interest. The child BIS/BAS scales also have a unitary BAS scale (Muris et al., 2005). In caregiver report measures, multiple BAS factors tend to be recovered, but some of these factors do not appear to be particularly robust or replicable (Colder et al., 2011; Luman, van Meel, Oosterlaan, & Guerts, 2012). It is possible that multi-factorial BAS structures are simply less stable in child samples. Impulsivity items were not represented in our final measure. In adults samples, both theoretically (e.g., Dawe & Loxton, 2004) and empirically (e.g., Quilty & Oakman, 2004; Smillie, Jackson, & Dalgleish, 2006), impulsivity is distinct from reward sensitivity/reactivity, and for this reason future studies should include a standard measure

of impulsivity to complement the reward-related BAS scale we have developed. This might be particularly important when considering the scales in relation to forms of externalising psychopathology.

The major limitation of the study is the lack of evidence for validation, but this is a tricky issue because comparing the measure with established measures of 'fear' and 'anxiety' relies upon the assumption that these emotion measures reflect their seemingly parallel constructs in RST. But there is considerable confusion over this issue. For example, the Fear Survey Schedule (Wolpe & Lang, 1977) has specific fears (animals and tissue damage, that should be expected to relate to the FFFS), but also social 'fear' which, as it entails goal conflict, in RST terms, is BIS-related social 'anxiety'. There is empirical evidence for these claims (Cooper, Perkins, & Corr, 2007). Thus, care needs to be taken when exploring the convergent and discriminant validity of these scales. Clearly, the next step in their development should involve establishing validity against appropriate self-report, behavioural and observational markers. Research on the developmental trajectory of these systems would also be useful. Of note, our scales had zero or very low correlations with both age and gender, and so would appear to be unconfounded by these factors.

In sum, we report the development of a new psychometric measure of the revised reinforcement sensitivity theory of personality for children. This new measure contains three scales, one each for the FFFS, BIS and BAS. The differentiation of the two defensive systems in a self-report measure for children is novel and should facilitate empirical investigation of their respective functions in a variety of behaviours, ranging from everyday social, academic and family to internalising and externalising disorders – there is evidence for the involvement of these constructs in such disorders (Corr & McNaughton, 2016). The child RST questionnaire is offered as an instrument to explore further the implications of approach and avoidance processes in children's personality.

Appendix A. Supplementary Material

Supplementary material to this article can be found online at http://dx.doi.org/10.1016/j.paid.2016.06.028.

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