RESEARCH ARTICLE

The Motivation for Special Interests in Individuals with Autism and Controls: Development and Validation of the Special Interest Motivation Scale

Rachel Grove, Ilona Roth and Rosa A. Hoekstra

Clinical observations and first person accounts of living with autism suggest that individuals with autism are highly motivated to engage in special interests, and that these interests remain important throughout life. Previous research assessing special interests has mainly focused on parental reports of children with autism spectrum conditions (ASC). To better understand the significance of and motivations for engaging in special interests it is essential to use self-report ratings. This paper aims to systematically explore the motivations for engagement in special interests, and whether these differ in adults with ASC, first-degree relatives and general population controls. The Special Interest Motivation Scale (SIMS) was developed to assess motivation to engage in special interests. The internal structure of this scale was evaluated using factor analysis, and mean scores on the SIMS factors were subsequently compared across individuals with autism, parents and general population controls. Factor analysis indicated a 20-item SIMS containing five factors assessing Personal life values and goals; Intrinsic interest and knowledge; Prestige; Engagement and "flow" and Achievement. Individuals with autism were more motivated by Intrinsic interest and knowledge and by Engagement and flow than controls. The 20-item SIMS is a quick to administer measure that provides a reliable description of motivation to engage in special interests. This study indicates that individuals with ASC are highly motivated to engage in their special interest, and are more motivated than controls by intrinsic motivational factors, some of which are associated with positive affect. This has implications for research and clinical practice. ***Autism Res*** *2015, 00: 000–000.* © 2015 International Society for Autism Research, Wiley Periodicals, Inc.

Keywords: autism; special interests; motivation; autistic disorder

Introduction

Autism spectrum conditions (ASC) are characterised by impairment in social interaction and communication, and by a range of repetitive behaviours and restricted interests (RRBI) [American Psychiatric Association, 2013]. Diagnostic criteria for Autism Spectrum Disorder, as published in the fifth edition of the Diagnostic and Statistical Manual, highlight two domains. The social communication domain includes impairments in social and emotional reciprocity, difficulty understanding nonverbal communication and establishing and maintaining relationships. The RRBI domain consists of four criteria assessing stereotyped movement, insistence on sameness, sensory reactivity and restricted or intense interests [American Psychiatric Association, 2013].

While the social symptoms of autism have been studied extensively, the nonsocial traits relating to the autism spectrum are less well researched. There is some evidence to suggest that the nonsocial symptoms of ASC are heterogeneous, consisting of three distinct factors including repetitive motor behaviours, insistence on sameness and circumscribed interests [Lam, Bodfish, & Piven, 2008; Smith et al., 2009]. Furthermore, it has been proposed that circumscribed or special interests are qualitatively different from repetitive behaviours [Jordan & Caldwell-Harris, 2012]. Given that special interests appear to be a somewhat independent factor of the RRBI symptom domain, systematic assessment of special interests is essential to fully understand autism.

Special interests were first described in Kanner's seminal paper in the 1940s [Kanner, 1943]. Since then, special interests have been recognised as being common across individuals with autism, with estimates of approximately 75–90% developing one or more special interests early in life [Klin, Danovitch, Merz, & Volkmar, 2007]. Reports suggest that common interests involve mechanical systems, vehicles, dinosaurs, animals, factual information,

From the Centre for Emotional Health, Department of Psychology, Macquarie University, Sydney, NSW, Australia (R.G.); Department of Life, Health & Chemical Sciences, The Open University, Milton Keynes, UK (I.R., R.A.H.)
Conflict of interest: The authors declare that they have no conflicts of interest.
Received November 24, 2014; accepted for publication August 15, 2015
Address for correspondence and reprints: Rachel Grove, Department of Psychology, Centre for Emotional Health, Macquarie University, NSW 2109 Australia. Email: rachel.grove@mq.edu.au
Published online 00 Month 2015 in Wiley Online Library (wileyonlinelibrary.com)
DOI: 10.1002/aur.1560

timetables, technology, and numbers [Anthony et al., 2013; South, Ozonoff, & McMahon, 2005].

Some previous studies suggest that special interests are associated with increased functional impairment in individuals with ASC [Turner-Brown, Lam, Holtzclaw, Dichter, & Bodfish, 2011]. For example, special interests have been shown to be predictive of difficulties with social interaction and communication amongst a clinical group of children and adolescents with autism [Klin et al., 2007]. Others have also argued that the persistence of special interests is problematic, and that they can be quite resistant to change [Mercier, Mottron, & Belleville, 2000]. However, there is also research indicating that special interests can have a positive impact on individuals with ASC. Winter-Messiers [2007] reports that special interests are associated with self-confidence. Mercier et al. [2000] also argue that individuals with ASC and their families see their special interests as an area of great strength and skill. Moreover, there is evidence to suggest that special interests can increase socialisation and peer interaction when incorporated into treatment programs [Boyd, Conroy, Mancil, Nakao, & Alter, 2007; Koegel, Vernon, Koegel, Koegel, & Paullin, 2012, 2013]. This highlights that apart from an association with functional impairment, there are also a number of positive aspects associated with special interests for individuals with autism.

The majority of research into special interests in ASC has been conducted with children. Thus, the positive or negative aspects of special interests have mostly been measured via parent report. However to get a proper understanding of the role special interests play in the lives of people with autism, and their motivations for pursuing these interests, self-report measures are essential. Clinical observations and first person accounts of autism suggest that special interests are of significant importance to individuals with autism [Attwood, 2007]. For instance, John Simpson, a man with ASC and regular conference speaker, asserts that "to an autistic individual they [special interests] are the most wonderful and important things in the world" (http://www.inspirationalautismtraining.com). Characterising the motivation to engage in special interests using self-report provides an opportunity for understanding part of the nonsocial domain associated with the autism spectrum.

Previous family studies suggest that some first-degree relatives display subthreshold levels of autistic traits, also referred to as the broader autism phenotype [BAP; Piven, Palmer, Jacobi, Childress, & Arndt, 1997; Sucksmith, Roth, & Hoekstra, 2011]. It is therefore important to assess motivation for special interests across samples containing varying levels of genetic risk for autism. This article aims to systematically explore the motivations for engagement in special interests, by developing a scale based on well-established motivational theories. Second, it aims to determine whether these motivations differ in individuals with autism, first-degree relatives (parents, of intermediate genetic risk) and general population controls (low genetic risk).

Development of the Special Interest Motivation Scale

Self-determination theory posits that behaviour can be intrinsically motivated, extrinsically motivated or amotivated [Deci & Ryan, 1985, 2002]. Intrinsic motivation describes motivation derived from the pleasure and satisfaction that occurs through engaging in an activity [Deci, 1975]. This engagement is not dependent on external rewards or reinforcement but purely on an individual's enjoyment of the task [Deci & Ryan, 1985]. It has been proposed that intrinsic motivation can be split into three specific goals or motives including "to know," "to accomplish" and "to experience stimulation" [Vallerand et al., 1992]. The first motive "to know" encompasses gaining satisfaction or pleasure from learning or understanding something new [Pelletier et al., 1995]. "To accomplish" describes engaging in an activity to derive a feeling of satisfaction or mastery [Pelletier et al., 1995]. Finally, "to experience stimulation" involves engaging in an activity in order to experience stimulating sensations or excitement [Pelletier et al., 1995].

In contrast to intrinsic motivation, extrinsic motivation describes engagement that is contingent on external factors or rewards [Ryan, Connell, & Grolnick, 1990]. Three different aspects of extrinsic motivation have been described, including "external regulation," "introjection" and "identification." External regulation refers to behaviour that is motivated by the expectation of external rewards or praise from others [Deci & Ryan, 1985]. "Introjection" applies to motivation that no longer requires the source of the external motivation to be present [Pelletier et al., 1995]. For example, an individual may engage in a behaviour motivated by feelings of guilt or anxiety originally evoked by external factors. By contrast, identification relates to behavior that is judged to be important and therefore performed by choice [Pelletier et al., 1995]. However, the activity is still performed for extrinsic reasons, for example, in order to achieve an external goal. Finally, amotivation describes behaviour that is neither intrinsically nor extrinsically motivated. Individuals who are amotivated find it difficult to identify any reasons why they should continue to pursue an activity, and often give up [Pelletier et al., 1995]. These three facets of motivation, and their subtypes, are all important in understanding motivation to engage in special interests.

The Special Interests Motivation Scale (SIMS) forms part of a comprehensive survey of special interests conducted by Roth, Roelfsema, and Hoekstra [2013]. The SIMS was developed by Hoekstra and Roth based on the Sports Motivation Scale [Mallet, Kawabata, Newcombe,

Otero-Forero, & Jackson, 2007; Pelletier et al., 1995], the Motivation at Work Scale [Gagné et al., 2010] and the Academic Motivation Scale [Fairchild, Horst, Finney, & Barron, 2005; Vallerand et al., 1992]. The Sports Motivation Scale [Mallet et al., 2007; Pelletier et al., 1995] assesses seven factors related to intrinsic motivation, extrinsic motivation, and amotivation. The SIMS was developed to follow this same structure. Four items for each intrinsic and extrinsic motivation factor and two items assessing amotivation were included. Three items were taken from the Motivation at Work Scale [Gagné et al., 2010] and converted to reflect special interests. For example, "I chose this job because it allows me to reach my life goals" was converted to "I chose this special interest because it allows me to reach my life goals." Twelve items were also directly converted from the Sports Motivation Scale [Mallet et al., 2007; Pelletier et al., 1995]. A number of further items were included, based on the definitions of the relevant motivational facets measured. Examples include, "Because I enjoy broadening my knowledge about my special interest" assessing intrinsic motivation "to know," "Because when I do well at my special interest I feel important" assessing extrinsic motivation "introjected" and "I can't really give any good reason for doing my special interest" reflecting amotivation.

Altogether, the SIMS comprised 26 items, assessing a range of motivations described in well-known motivational theories to engage in special interests. A large sample of participants, spanning individuals with ASC, parents of a child with autism and general population controls were asked to complete a survey that included the SIMS. This article aims to validate the SIMS as well as to assess and compare the motivation for special interests in individuals with autism, parents and controls.

Methods

Participants and Measures

Participants included individuals with autism, parents of a child with autism and general population controls. Two modes of recruitment were utilised. First, students of The Open University in the United Kingdom taking a range of first and second level modules spanning arts, health and science topics were approached via email to participate in the study. The Open University is a distance learning university and is therefore attractive to individuals who have carer responsibilities or have special needs themselves. Therefore, although most students fell into the control group, the sample also included some individuals with ASC and some parents. Secondly, registered research volunteers at the Autism Research Centre at Cambridge University received an invitation via email to take part in the study, including a link to the survey. All participants completed the survey online, hosted at the Open University's Biomedical Online Research Network (www.open.ac.uk/born).

Only individuals with complete data on all items of the SIMS were included in the analyses ($n = 610$). The ASC group consisted of 158 individuals (Males = 86, Females = 72, Mean age = 41, sd = 13) who had received a formal diagnosis of ASC made by a qualified clinician. Individuals who reported a self-diagnosis of ASC were excluded from the sample. The parent group comprised 185 individuals (Males = 35, Females = 150, Mean age = 44, sd = 7) who reported having a child with a formal clinical diagnosis of ASC but no diagnosis themselves. The control group consisted of 267 individuals (Males = 193, Females = 74, Mean age = 42, sd = 15). The control group was restricted to individuals who reported no previous psychiatric history. The parent group was significantly older than the ASC group ($P < 0.01$). 64% of the ASC group had completed education above high school level, along with 69% and 52% of parents and controls, respectively. There was a significant difference in education level between the parent and control groups ($P < 0.05$), most likely due to sampling methods.

Participants were administered an online version of the SIMS outlined above. The SIMS was part of a larger set of questions, together comprising a comprehensive survey of special interests [Roth et al., 2013]. Prior to completing the SIMS items, participants were asked to describe their "most important" special interest, given that they may have more than one. After this description and some other questions the participants were presented with the 26 SIMS items scored on a 7-point Likert scale assessing how well each statement describes why individuals engage in their special interest. The scale ranged from "not at all" through to "exactly," with "moderately" as a midpoint. All items were summed, with higher scores reflecting increased motivation to engage in special interests.

The Autism Spectrum Quotient [AQ; Baron-Cohen, Wheelwright, Skinner, Martin, & Clubley, 2001] was also administered in order to assess quantitative autistic traits. The AQ is a 50-item self-report measure rated on a 4-point scale with response options "definitely agree," "slightly agree," "definitely disagree" and "slightly disagree." Hoekstra, Bartels, Cath, and Boomsma, [2008] outline a raw scoring method that was implemented in the current study. Previous research has split the AQ into a broad social interaction factor and an attention to detail subscale [Hoekstra et al., 2008]. These two subscales were used in all analyses.

Analytic Strategy

Exploratory factor analyses (EFA) were conducted on the 26 items of the SIMS in order to evaluate the factor structure of the measure. Model fit indices including

the Akaike information criterion (AIC) [Akaike, 1987], Bayesian information criterion (BIC) [Schwarz, 1978], Sample size adjusted BIC (SSABIC) [Sclove, 1987], Comparative fit index (CFI) [Bentler, 1987], Tucker-Lewis index [Tucker & Lewis, 1973] and the Root mean square error of approximation (RMSEA) [Steiger & Lind, 1980] were estimated. Smaller AIC, BIC and SSABIC values are indicative of better model fit. CFI and TLI values $\geq$0.95 are indicative of very good fit to the data, with values $\geq$0.90 indicating adequate fit [Brown, 2006; Hu & Bentler, 1999]. RMSEA values $\leq$0.08 are indicative of good fit, with values $\leq$0.05 indicating excellent fit to the data [Browne & Cudeck, 1993].

The overall fit of the EFA models was evaluated by the statistics outlined above. In addition, the evaluation of how many items and factors to retain in the EFA was based on a range of different methods. Decisions regarding the removal of specific items followed the procedure outlined by Costello and Osborne [2005]. This procedure recommends removing items containing cross loadings $\geq$0.32 and factors measured by less than three items. In order to determine the number of factors to retain in each EFA model, a parallel analysis was conducted [Glorfeld, 1995; Horn, 1965]. Parallel analysis generates 95% confidence intervals from random sets of data with the same sample size and number of variables as the original data. Eigenvalues from the EFA models that are larger than the values produced within the parallel analysis determine the number of factors retained [Glorfeld, 1995]. Lastly, the interpretability of the various models was also taken into account when deciding which model provided the best description of the data.

Following scale development with EFA models, the factor structure of the SIMS was confirmed via confirmatory factor analysis (CFA), allowing for greater model specification and comparison of specific group differences. Measurement invariance [Meredith, 1993] determines whether a scale assesses the same construct in a consistent way across different populations. Invariance was assessed by fitting a series of models that placed increasing levels of restrictions on the parameter estimates across each group to determine whether the SIMS is invariant for individuals with autism, parents and controls.

Analyses were estimated in Mplus version 7 [Muthén and Muthén, 2012]. Once the best fitting model was identified, further analyses were implemented in SPSS 21 [IBM Corp, 2012]. Cronbach's alpha [1951] was calculated to estimate the reliability of the SIMS and any associated factors. Alpha scores between 0.6 and 0.7 are indicative of acceptable internal consistency, with scores ranging from 0.7 to 0.9 indicating good to excellent internal consistency [George & Mallery, 2003]. Mean scores on the SIMS were estimated and compared for individuals with autism, parents and controls and for males and females. The relationship between the SIMS and the AQ was also evaluated.

Results

Exploratory Factor Analysis

EFA models were implemented to estimate the factor structure of the SIMS (see Table 1). An evaluation of the model fit indices highlighted that a model with six factors provided the best fit to the data (Model 1). Parallel analysis also indicated a six-factor structure. However, the extrinsic motivation item "Because I would feel guilty or lazy if I didn't spend time doing my special interest" contained a loading >0.32 on three factors. Following the recommendations set by Costello and Osborne [2005], this item was dropped from the subsequent analysis. A second EFA model (Model 2) identified a six-factor structure in which two items contained cross loadings >0.32 on a number of factors. These two items "Because my special interest allows me to learn about many things that interest me" and "Because it is one of the best ways to develop myself" were therefore dropped from the subsequent EFA model.

A further EFA was implemented including the 23 remaining items (Model 3). One item "Because people around me think it is important to engage in this activity" was the only item with substantial cross loadings on another factor. A subsequent EFA (Model 4) was therefore conducted with 22 items, revealing a six-factor model containing no cross loadings. However, based on recommendations concerning minimum item numbers [Costello & Osborne, 2005], Factor 6, including the two items assessing amotivation was removed from the model. A final EFA model (Model 5) contained fit indices within the recommended thresholds. Results from the parallel analysis also indicated a 20-item five-factor structure provided the best fit. Moreover, this structure represented a model that is easy to interpret based on what is known from the literature on intrinsic and extrinsic motivation.

Confirmatory Factor Analysis

CFA models confirming the fit of the five-factor model identified in the exploratory analyses were then implemented (Table 1). First, a model assessing a five-factor structure in the total sample was estimated, indicating an adequate fit to the data (Model 6). Modification indices indicated correlated residual variances between similar items. Following the recommendations of Cole, Ciesla, & Steiger [2007], items containing similar wording or meaning with large residual variances were allowed to correlate in all subsequent models. Three CFA models were estimated separately for controls (Model 7), parents (Model 8) and individuals with ASC (Model 9), all providing an adequate fit to the data.

Multiple group CFA models were then estimated in order to assess measurement invariance across the three groups (see Table 1). First, a multiple group CFA was

Table 1. Fit Indices and Model Comparisons of Exploratory and Confirmatory Factor Analysis of the Special Interest Motivation Scale

		Fit indices							
Model	Description	AIC	BIC	SSABIC	RMSEA	CFI	TLI	χ^2	$\Delta\chi^2$ (*df*)
Exploratory Factor Analysis (EFA)									
1	EFA (26 items)								
	1f total sample ($n = 610$)	59857.389	60201.639	59954.006	0.146	0.525	0.484	4173.101[a]	
	2f total sample ($n = 610$)	58230.310	58684.896	58357.893	0.115	0.728	0.677	2496.022[a]	
	3f total sample ($n = 610$)	57574.835	58135.345	57732.148	0.101	0.811	0.754	1792.548[a]	
	4f total sample ($n = 610$)	57223.144	57885.163	57408.945	0.092	0.857	0.795	1394.856[a]	
	5f total sample ($n = 610$)	56795.885	57555.000	57008.937	0.076	0.912	0.860	923.597[a]	
	6f total sample ($n = 610$)	56409.114	57260.912	56648.179	0.053	0.962	0.933	494.827[a]	
2	EFA (25 items)								
	6f total sample ($n = 610$)	54032.899	54849.389	54262.055	0.051	0.966	0.939	431.713[a]	
3	EFA (23 items)								
	6f total sample ($n = 610$)	49852.049	50597.924	50061.386	0.048	0.974	0.949	313.761[a]	
4	EFA (22 items)								
	6f total sample ($n = 610$)	47747.499	48458.066	47946.926	0.051	0.973	0.946	293.530[a]	
5	EFA (20 items)								
	5f total sample ($n = 610$)	43237.563	43811.313	43398.591	0.054	0.972	0.947	277.540[a]	
Confirmatory Factor Analysis (CFA)									
6	5f total sample ($n = 610$)	43489.975	43820.985	43582.876	0.072	0.923	0.906	639.953[a]	
7	5f controls ($n = 267$)	18759.443	19028.487	18790.693	0.072	0.923	0.905	372.391[a]	
8	5f parents ($n = 185$)	13239.568	13481.095	13243.547	0.078	0.916	0.897	330.704[a]	
9	5f ASC ($n = 158$)	11547.959	11777.654	11540.243	0.072	0.913	0.894	281.520[a]	
Measurement invariance analyses									
10	5f total sample ($n = 610$) free	43546.970	44539.999	43825.673	0.074	0.918	0.900	984.616[a]	
11	5f total sample ($n = 610$) factor loadings invariant only	43517.645	44334.135	43746.800	0.072	0.916	0.906	1035.290[a]	50.67 (40) $P > 0.05$
12	5f total sample ($n = 610$) intercepts invariant only	43521.314	44386.352	43764.095	0.072	0.918	0.905	1016.959[a]	32.34 (29) $P > 0.05$
13	5f total sample ($n = 610$) factor loadings and intercepts invariant	43493.317	44181.817	43686.551	0.070	0.916	0.910	1068.963[a]	83.63 (69) $P > 0.05$
14	5f total sample ($n = 610$) factor loadings, intercepts and residual variances invariant	43491.494	44003.455	43635.180	0.070	0.910	0.910	1147.139[a]	162.52 (109) $P < 0.001$

AIC, Akaike information criteria; BIC, Bayesian information criteria; SSABIC, Sample size adjusted BIC; RMSEA, Root mean square error of approximation; CFI, Comparative fit index; TLI, Tucker-Lewis index.

χ^2= chi square; $\Delta\chi^2$ (*df*)=chi square difference test; df=degrees of freedom.

[a] $P<0.001$.

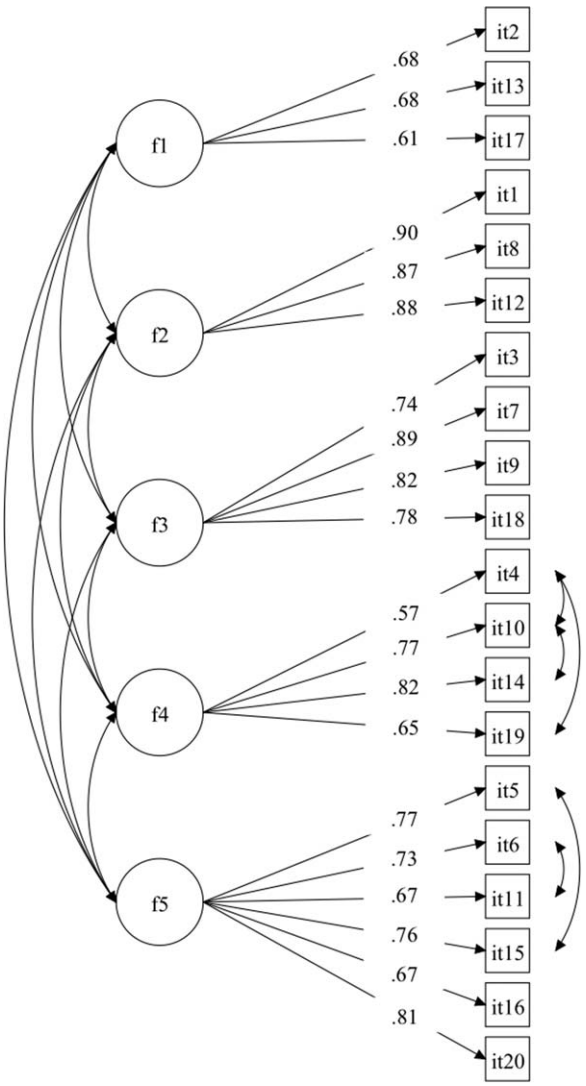

Figure 1. SIMS factor structure

implemented, assessing the factor structure of the SIMS for all three groups concurrently, allowing all structural parameter estimates to be freely estimated for each group (Model 10). Further models with varying restrictions were then fit to the data, in which the factor loadings (Model 11), intercepts (Model 12), loadings and intercepts (Model 13) and loadings, intercepts and residual variances (Model 14) were restricted across individuals with autism, parents and controls. Chi square difference tests were computed to assess the relative fit of the more restrictive models. Initial examination of the data indicated that one of the item intercepts (item 19) was not invariant within the ASC group. Based on previous recommendations [Byrne, Shavelson, & Muthén, 1989; Steenkamp & Baumgartner, 1998], the equality restraint on the intercept of item 19 in the ASC group was released in Models 11 to 14. Model 13, a five-factor model with invariant factor loadings and intercepts across individuals with autism, parents and general population controls provided the best description of the data. This indicates that the 20 items in the SIMS are measured and interpreted in the same way in each of these three groups, allowing for mean comparisons in subsequent analyses.

Factor Structure of the SIMS

Exploratory and confirmatory methods suggested a 20-item five-factor structure for the SIMS (see Fig. 1). Note that items were relabelled to reflect the new 20-item scale (see Table 2 and Appendix). Factor one contained three items assessing motivation based on Personal life values and goals. Factor two consisted of three items assessing Intrinsic interest and knowledge, while factor three included four items assessing the feeling of Prestige associated with engaging in special interests. Factor four contained four items assessing Engagement and "flow," or the satisfaction experienced while completely absorbed in an activity [Csikszentmihalyi, 1990; Csikszentmihalyi & Csikszentmihalyi, 1988]. Factor five included six items assessing motivation relating to experiencing a sense of Achievement. Cronbach's alpha estimates for each factor are presented in Table 3, indicating that all factors had good to excellent internal consistency.

Additional Analyses

Mean comparisons for the SIMS are given in Table 3. Individuals with autism scored significantly higher on Intrinsic interest and knowledge and Engagement and flow factors than the other two groups ($P < 0.01$). The control group also scored significantly higher than the parent group on Intrinsic interest and knowledge and Engagement and flow factors ($P < 0.05$). Individuals with ASC had higher scores than parents but not controls on motivation due to Achievement ($P < 0.01$). There were no overall sex differences on any of the five factors of the SIMS ($P > 0.05$). However, control females scored significantly higher than control males on the Values and goals factor ($P < 0.01$), while ASC females obtained significantly higher scores than ASC males on the Engagement and Flow factor ($P < 0.05$).

Correlations between the five factors of the SIMS are given in Table 4. The factor correlations were not significantly different between the three groups and are therefore presented together. All factors were significantly correlated ($p < 0.01$), ranging from 0.29 to 0.78. Correlations between the SIMS and the social interaction and attention to detail factors of the AQ are also given in Table 4. Similar to the correlations between the SIMS factors, all correlations between the AQ and SIMS subscales were comparable between the three groups (with overlapping confidence intervals) and are therefore presented together in Table 4, with one

Table 2. Factor Structure and Items of the Special Interest Motivation Scale

Factor 1	Personal life values & goals
2	I chose this special interest because it allows me to reach my life goals.
13	Because it is a good way to learn lots of things that could be useful in other areas of my life.
17	Because my special interest fits my personal values.
Factor 2	Intrinsic interest & knowledge
1	Because it is satisfying to learn new things about my special interest.
8	Because I enjoy discovering new aspects about my special interest.
12	Because I enjoy broadening my knowledge about my special interest.
Factor 3	Prestige
3	Because it enables me to be well regarded by people I know.
7	For the prestige that comes with doing my special interest.
9	Because when I do well at my special interest I feel important.
18	To prove to others that I am good at my special interest.
Factor 4	Engagement & "flow"
4	For the sense of sheer enjoyment I experience doing my special interest.
10	Because I love being engaged in my special interest.
14	For the excitement I feel when I am really involved in my special interest.
19	Because I like the feeling of being totally immersed in my special interest.
Factor 5	Achievement
5	Because I love bettering myself at my special interest.
6	To prove to myself that I am capable of achieving something special.
11	For the sense of achievement I feel after accomplishing difficult aspects of my special interest.
15	Because I enjoy improving my special interest abilities.
16	Because I don't want to fail in pursuing my special interest.
20	Because it is satisfying to aim for excellence in my special interest.

exception. The Prestige factor correlated more strongly with the attention to detail subscale of the AQ in individuals with ASC ($r = -0.34$, $P < 0.01$) compared to the other two groups. This appears to be driven by a subgroup of individuals in the ASC group with very high AQ scores (>120) who show very limited motivation due to prestige (as indicated by minimal scores on factor three). In all three groups there was a significant correlation between the Intrinsic interest and knowledge factor and the Engagement and flow factor and both subscales of the AQ, although all associations were modest (ranging between 0.11 and 0.19). There was also a significant association between the SIMS Achievement factor and the attention to detail factor of the AQ ($r = 0.12$).

Discussion

This study presented the first systematic exploration of the motivation to engage in special interests, using a scale assessing well-established universal motivational factors, collected in a large sample of individuals with a clinical ASC diagnosis, parents of a child with autism, and general population controls. Results of an extensive factor analysis indicated that a 20-item version of the SIMS reliably assesses five dimensions of motivations to engage in special interests, including Personal life values and goals, Intrinsic interest and knowledge, Prestige, Engagement and "flow" and Achievement. This five-factor structure was invariant across controls, parents and ASC groups, indicating that the SIMS assesses the same construct within different populations.

The Personal life values and goals, Intrinsic interest and knowledge, and Engagement and flow factors map well onto three of the seven factors previously identified on the Sports Motivation Scale [Mallet et al., 2007; Pelletier et al.,

Table 3. Mean Scores on the Special Interest Motivation Scale and Reliability Estimates

	Values & Goals (F1)	Intrinsic (F2)	Prestige (F3)	Flow (F4)	Achievement (F5)
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Controls	11.4 (5.0)	15.4 (5.1)	10.9 (6.4)	22.3 (5.2)	26.6 (9.9)
Male	10.9 (4.9)	15.3 (5.1)	10.8 (6.2)	22.2 (5.3)	27.0 (9.8)
Female	12.8 (4.9)$^{\#}$	15.8 (5.1)	11.2 (6.7)	22.8 (4.8)	25.7 (10.1)
Parents	**11.9 (5.2)**	**14.4* (5.4)**	**10.9 (6.7)**	**21.3* (5.6)**	**25.1 (10.4)**
Male	11.7 (5.6)	15.1 (5.3)	11.8 (6.9)	21.5 (5.6)	26.6 (10.4)
Female	11.9 (5.1)	14.3 (5.4)	10.7 (6.7)	21.2 (5.5)	24.8 (10.4)
ASC	**12.1 (4.9)**	**16.8** (4.1)**	**11.4 (7.1)**	**23.6** (4.7)**	**27.9 (9.2)**
Male	12.4 (4.6)	17.0 (4.0)	11.7 (7.2)	22.7 (4.9)	28.1 (8.9)
Female	11.8 (5.3)	16.6 (4.1)	11.2 (6.9)	24.7 (4.0)$^{\#\#}$	27.8 (9.6)
Cronbach's alpha	**0.68**	**0.91**	**0.87**	**0.78**	**0.87**

*$P < 0.05$, **$P < 0.01$ denotes significant group difference from controls.
$^{\#\#}$ $P < 0.01$, $^{\#}P < 0.05$, denotes significant sex difference within each group.

Table 4. Correlation between the Five Factors of the SIMS and the AQ

	Values & Goals (F1)	Intrinsic (F2)	Prestige (F3)	Flow (F4)	Achievement (F5)
FI	**1**				
F2	0.66** (0.61–0.70)	**1**			
F3	0.61** (0.56–0.66)	0.29** (0.22–0.36)	**1**		
F4	0.34** (0.27–0.41)	0.57** (0.51–0.62)	0.29** (0.22–0.36)	**1**	
F5	0.72** (0.68–0.76)	0.63** (0.58–0.68)	0.78** (0.75–0.81)	0.59** (0.54–0.64)	**1**
AQ_soc	−0.01 (−0.09–0.07)	0.11* (0.03–0.19)	−0.02 (−0.10–0.06)	0.14* (0.06–0.22)	0.06 (−0.02 to 0.14)
AQ_att	0.08 (0.0–0.16)	0.19* (0.11–0.27)	0.09* (0.01–0.17)	0.17* (0.09–0.25)	0.12* (0.04–0.20)

Note. Factor correlations did not differ between groups (with one exception, see text) and are therefore presented together.
AQ_att = attention to detail factor of the Autism Spectrum Quotient; AQ_soc = social interaction factor of the Autism Spectrum Quotient.
*$P < 0.05$, **$P < 0.01$; () = 95% confidence interval.

1995]; the extrinsic motivation "identified" scale and intrinsic motivation "to know" and "to experience stimulation" scales, respectively. The latter two factors thus provide clear assessment of intrinsic motivational factors or motivations purely based on the individuals' enjoyment, unrelated to external rewards or reinforcement. The Prestige factor assessed extrinsic motivations, mostly overlapping with the original extrinsic motivation "external regulation" scale. There were also some differences between the factor structure of the SIMS and the original scales it was based upon. The fifth factor, Achievement, was found to consist of items designed to measure both extrinsic (item numbers 6, 16) and intrinsic (item numbers 5, 11, 15, 20) motivation. On closer evaluation, these items all appear to tap into a drive to better oneself and achieve something related to the special interest. Therefore, although the factor includes both intrinsic and extrinsic motivation, the strong overarching theme of this factor relates to achievement.

Individuals with ASC scored higher than controls and parents of a child with autism on factors assessing Intrinsic interest and knowledge and engagement and flow, indicating that this group is more strongly motivated by intrinsic factors. The finding that individuals with ASC are particularly motivated to engage in their special interest due to sheer enjoyment and excitement (as measured by the engagement and flow factor) is consistent with previous research highlighting that special interests are associated with feelings of enthusiasm, pride and happiness [Winter-Messiers, 2007]. This highlights the important role special interests can play in positive outcomes for individuals with autism.

There were no differences between the groups on two extrinsic motivation factors assessing personal values and goals and prestige. Given the clinical symptoms that characterise autism, including impaired social communicative functioning, it might be expected that individuals with autism would be less motivated by extrinsic factors such as prestige than general population controls. Interestingly, this was not reflected in the results of the current study. There were no differences between the groups on both factors assessing achievement and prestige, suggesting that individuals on the autism spectrum, parents and controls are equally motivated by extrinsic factors. Furthermore, factor mean scores indicated that all three groups showed relatively higher intrinsic than extrinsic motivations. This indicates that extrinsic motivation does not appear to play a major role in engaging in special interests, at least not in engaging with one's most important special interest.

Results indicated that parents scored lower than both the ASC group and controls on Intrinsic interest and knowledge and Engagement and flow factors of the SIMS. Parents also scored lower than the ASC group on motivation due to Achievement. Previous research has suggested that special interests may form part of the BAP, and that relatives of individuals with autism may also display intense interests or preoccupations [Smith et al., 2009]. However, the current study assessed the motivations for engaging in special interests, rather than the intensity of the special interest itself. Moreover, parents of a child with autism are likely to be engaged for a significant amount of time in the care of a child with special needs, and these caring responsibilities may shape their motivations. This group may therefore not be representative of the wider BAP, for example, in siblings of a child with autism, or second-degree relatives who do not have significant caring responsibilities. Further research is needed in order to fully understand the relationship between special interests and the BAP.

It has been suggested that individuals with autism engage in special interests in order to reduce anxiety or negative affect [Attwood, 2003; Spiker, Lin, Van Dyke, & Wood, 2012]. Conversely, the results obtained in the current study indicate that individuals with autism are motivated to engage in special interests in order to obtain knowledge, experience engagement, flow and an overall sense of achievement. Special interests therefore

appear to be strongly related to positive affect and intrinsic engagement, rather than merely the alleviation of negative emotion. This has implications for treatment practices, indicating that special interests should be included in intervention and where possible should not be discouraged. Previous research has highlighted the benefit of incorporating special interests into intervention programs for individuals with autism. For example, the inclusion of special interests in peer activities has been associated with increased socialisation, social engagement, and peer interaction in adolescents [Koegel et al., 2013] and an increase in social behaviour in children with autism [Boyd et al., 2007; Koegel et al., 2012]. Incorporating special interests has also been shown to increase pretend play and joint attention in children with ASC [Kryzak, Bauer, Jones, & Sturmey, 2013; Porter, 2012] and predict positive change in language, social communication, emotion regulation and motor skills [Winter-Messiers, 2007]. Importantly, special interests are associated with a positive sense of self and an increase in self-confidence for individuals with autism and are vital for wellbeing [Winter-Messiers, 2007]. The inclusion of special interests into case formulation and intervention programming therefore has the potential to significantly influence both behavioural and affective outcomes for individuals on the autism spectrum. As Winter-Messiers [2007] states, special interests capture the heart and mind of individuals with autism and provide a "lens through which they view the world" (p. 142). Future research evaluating the efficacy of incorporating special interests into intervention strategies is vital to improve quality of life and wellbeing for individuals with autism.

Results indicated an association between special interests and autistic traits. Motivation due to Intrinsic interest and knowledge and Engagement and flow was associated with higher levels of traits on both the Social interaction and Attention to detail subscales of the AQ. This suggests that the motivation to engage in special interests due to these factors is not only associated with nonsocial traits on the autism spectrum, but also with higher levels of social and communication difficulties. However, the associations between the AQ and the SIMS were small, indicating that while there is some association between motivation, special interests and the autism spectrum, there are substantial individual differences in the relationship between these constructs.

Limitations

The study included self-report measures of special interests and motivation and was therefore restricted to the inclusion of high functioning individuals with autism. This limits the generalisability of the results across the full autism spectrum, particularly in relation to individuals with associated intellectual disability. However, self-report measures are vital in assessing special interests given the differences in how special interests are regarded by individuals and caregivers, and are especially valuable when researching motivations to engage in special interests. Another limitation of this study is that the parent group was somewhat older than the ASC group and a slightly higher percentage of parents had completed education above high school level than controls. Future research would benefit from the inclusion of more specifically matched samples.

This study aimed to provide a systematic exploration of motivational factors related to special interests, using measures based on established motivational theories. It did not aim to maximise differences between groups by selectively including items that may be especially relevant to people with autism. Such autism-specific reasons for engagement will be explored in a separate paper [Roth, Grove, Roelfsema, & Hoekstra, 2015].

Conclusions

The SIMS is a 20-item scale providing a reliable assessment of five dimensions of motivations to engage in special interests, spanning personal life values and goals, intrinsic interest and knowledge, prestige, engagement and "flow" and achievement. Individuals with ASC were more strongly motivated than controls and parents of a child with autism by intrinsic motivational factors related to the pursuit of knowledge and the sense of engagement and flow. This highlights that engagement in special interests is strongly related to positive effect, and not merely to a reduction of negative emotions. There was a significant relationship between autistic traits and motivation to engage in special interests, indicating that these interests are important in understanding the phenotype associated with ASC. This has significant implications for diagnosis, intervention and clinical practice. The SIMS is a reliable measure that is quick to administer, and can thus be useful in future research or in clinical practice.

Acknowledgments

The authors are indebted to all participants for their generous time and efforts completing our survey. We would like to thank Prof Martin Hagger for his helpful suggestions in constructing the Special Interest Motivation Scale, and Prof Simon Baron-Cohen and Dr Carrie Alison for inviting Cambridge University's Autism Research Centre research volunteers to take part in this study.

Appendix: Special Interest Motivation Scale (SIMS)

Using the scale of 1 (Not at all) to 7 (Exactly) below, please indicate to what extent each of the following statements explains why you engage in your most important special interest. For example, if a statement in no way explains why you engage with your special interest, click "Not at all"; if a statement explains really well why you engage with your special interest, click "Exactly."

Not at all			Moderately						Exactly
1	**2**	**3**	**4**	**5**			**6**		**7**
1.	Because it is satisfying to learn new things about my special interest.	1	2	3	4	5	6	7	
2.	I chose this special interest because it allows me to reach my life goals.	1	2	3	4	5	6	7	
3.	Because it enables me to be well regarded by people I know.	1	2	3	4	5	6	7	
4.	For the sense of sheer enjoyment I experience doing my special interest.	1	2	3	4	5	6	7	
5.	Because I love bettering myself at my special interest.	1	2	3	4	5	6	7	
6.	To prove to myself that I am capable of achieving something special.	1	2	3	4	5	6	7	
7.	For the prestige that comes with doing my special interest.	1	2	3	4	5	6	7	
8.	Because I enjoy discovering new aspects about my special interest.	1	2	3	4	5	6	7	
9.	Because when I do well at my special interest I feel important.	1	2	3	4	5	6	7	
10.	Because I love being engaged in my special interest.	1	2	3	4	5	6	7	
11.	For the sense of achievement I feel after accomplishing difficult aspects of my special interest.	1	2	3	4	5	6	7	
12.	Because I enjoy broadening my knowledge about my special interest.	1	2	3	4	5	6	7	
13.	Because it is a good way to learn lots of things that could be useful in other areas of my life.	1	2	3	4	5	6	7	
14.	For the excitement I feel when I am really involved in my special interest.	1	2	3	4	5	6	7	
15.	Because I enjoy improving my special interest abilities.	1	2	3	4	5	6	7	
16.	Because I don't want to fail in pursuing my special interest.	1	2	3	4	5	6	7	
17.	Because my special interest fits my personal values.	1	2	3	4	5	6	7	
18.	To prove to others that I am good at my special interest.	1	2	3	4	5	6	7	
19.	Because I like the feeling of being totally immersed in my special interest.	1	2	3	4	5	6	7	
20.	Because it is satisfying to aim for excellence in my special interest.	1	2	3	4	5	6	7	

References

Akaike, H. (1987). Factor analysis and AIC. Psychometrika, 52, 317–322.

American Psychiatric Association. (2013). Diagnostic and Statistical Manual of Mental Disorders DSM-5. Washington DC: American Psychiatric Publishing.

Anthony, L.G., Kenworthy, L., Yerys, B.E., Jankowski, K.F., James, J.D., Harms, M.B., et al. (2013). Interests in high-functioning autism are more intense, interfering, and idiosyncratic than those in neurotypical development. Development and Psychopathology, 25, 643–652.

Attwood, T. (2003). Understanding and managing circumscribed interests. In: Prior, M. editor., Learning and behaviour problems in Asperger syndrome (pp 126–147). New York: Guilford Press.

Attwood, T. (2007). The complete guide to Asperger's syndrome. London: Jessica Kingsley Publishers.

Baron-Cohen, S., Wheelwright, S., Skinner, R., Martin, J., & Clubley, E. (2001). The Autism-Spectrum Quotient (AQ): Evidence from Asperger syndrome/high-functioning autism, males and females, scientists and mathematicians. Journal of Autism and Developmental Disorders, 31, 5–17.

Bentler, P.M. (1987). Comparative fit indices in structural models. Psychological Bulletin, 107, 238–246.

Boyd, B.A., Conroy, M.A., Mancil, G.R., Nakao, T., & Alter, P.J. (2007). Effects of circumscribed interests on the social behaviors of children with autism spectrum disorders. Journal of Autism and Developmental Disorders, 37, 1550–1561.

Brown, T.A. (2006). Confirmatory factor analysis for applied research. New York: The Guildford Press.

Browne, M.W., & Cudeck, R. (1993). Alternate ways of assessing model fit. In: Bollen, K.A. & Long, J.S. editors., Testing structural equation models (pp. 136–162). Newbury Park, CA: Sage.

Byrne, B.M., Shavelson, R.J., & Muthén, B. (1989). Testing for the equivalence of factor covariance and mean structures: The issue of partial measurement invariance. Psychological Bulletin, 105, 456–466.

Cole, D.A., Ciesla, J.A., & Steiger, J.H. (2007). The insidious effects of failing to include design-driven correlated residuals in latent-variable covariance structure analysis. Psychological Methods, 12, 381–398.

Costello, A.B., & Osborne, J.W. (2005). Best practices in exploratory factor analysis: Four recommendations for getting the most from your analysis. Practical Assessment, Research and Evaluation, 10, 1–9.

Cronbach, L.J. (1951). Coefficient alpha and the internal structure of tests. Psychometrika, 16, 297–334.

Csikszentmihalyi, M. (1990). Flow: The psychology of optimal experience. New York: Harper and Row.

Csikszentmihalyi, M., & Csikzsentmihalyi, I.S. (1988). Optimal experience: Psychological studies of flow in consciousness. Cambridge, UK: Cambridge University Press.

Deci, E.L. (1975). Intrinsic motivation. New York: Plenum Press.

Deci, E.L., & Ryan, R.M. (1985). Intrinsic motivation and self-determination in human behaviour. New York: Plenum Press.

Deci, E.L., & Ryan, R.M. (2002). Handbook of self-determination research. Rochester, NY: The University of Rochester Press.

Fairchild, A.J., Horst, S.J., Finney, S.J., & Barron, K.E. (2005). Evaluating existing and new validity evidence for the Academic Motivation Scale. Contemporary Educational Psychology, 30, 331–358.

Gagné, M., Forest, J., Gilbert, M.-H., Aubé, C., Morin, E., & Malorni, A. (2010). The Motivation at Work Scale: Validation evidence in two languages. Educational and Psychological Measurement, 70, 628–646.

George, D., & Mallery, P. (2003). SPSS for Windows step by step: A simple guide and reference. Boston: Allyn & Bacon.

Glorfeld, L.W. (1995). An improvement on Horn's parallel analysis methodology for selecting the correct number of factors to retain. Educational and Psychological Measurement, 55, 377–393.

Hoekstra, R.A., Bartels, M., Cath, D.C., & Boomsma, D.I. (2008). Factor structure, reliability and criterion validity of the Autism-Spectrum Quotient (AQ): A study in Dutch population and patient groups. Journal of Autism and Developmental Disorders, 38, 1555–1566.

Horn, J.L. (1965). A rationale and test for the number of factors in factor analysis. Psychometrika, 30, 179–185.

Hu, L., & Bentler, P.M. (1999). Cutoff criterion for fit indices in covariance structure analysis: Conventional criteria versus new alternatives. Structural Equation Modeling, 6, 1–55.

IBM Corp. (2012). IBM SPSS Statistics for windows (Version 21.0). Armonk, NY: IBM Corp.

Jordan, C.J., & Caldwell-Harris, C.L. (2012). Understanding differences in neurotypical and autism spectrum special interests through internet forums. Intellectual and Developmental Disabilities, 50, 391–402.

Kanner, L. (1943). Autistic disturbances of affective contact. Nervous Child, 2, 217–250.

Klin, A., Danovitch, J.H., Merz, A.B., & Volkmar, F.R. (2007). Circumscribed interests in higher functioning individuals with autism spectrum disorders: An exploratory study. Research and Practice for Persons with Severe Disabilities, 32, 89–100.

Koegel, L.K., Vernon, T.W., Koegel, R.L., Koegel, B.L., & Paullin, A.W. (2012). Improving social engagement and initiations between children with autism spectrum disorder and their peers in inclusive settings. Journal of Positive Behavior Interventions, 14, 220–227.

Koegel, R., Kim, S., Koegel, L., & Schwartzman, B. (2013). Improving socialization for high school students with ASD by using their preferred interests. Journal of Autism and Developmental Disorders, 43, 2121–2134.

Kryzak, L.A., Bauer, S., Jones, E.A., & Sturmey, P. (2013). Increasing responding to others' joint attention directives using circumscribed interests. Journal of Applied Behavior Analysis, 46, 674–679.

Lam, K.S.L., Bodfish, J.W., & Piven, J. (2008). Evidence for three subtypes of repetitive behavior in autism that differ in familiality and association with other symptoms. Journal of Child Psychology and Psychiatry and Allied Disciplines, 49, 1193–1200.

Mallet, C., Kawabata, M., Newcombe, P., Otero-Forero, A., & Jackson, S. (2007). Sport Motivation Scale-6 (SMS-6): A revised six-factor sport motivation scale. Psychology of Sport and Exercise, 8, 600–614.

Mercier, C., Mottron, L., & Belleville, S. (2000). A psychosocial study on restricted interests in high-functioning persons with pervasive developmental disorders. Autism, 4, 406–425.

Meredith, W. (1993). Measurement invariance, factor analysis and factorial invariance. Psychometrika, 58, 525–543.

Muthén, L.K., & Muthén, B.O. (2012). Mplus (Version 7). Los Angeles: Muthén & Muthén.

Pelletier, L.G., Fortier, M.S., Vallerand, R.J., Tuson, K.M., Briere, N.M., & Blais, M.R. (1995). Toward a new measure of intrinsic motivation, extrinsic motivation and amotivation in sports: The Sport Motivation Scale (SMS). Journal of Sport and Exercise Psychology, 17, 35–53.

Piven, J., Palmer, P., Jacobi, D., Childress, D., & Arndt, S. (1997). Broader autism phenotype: Evidence from a family history study of multiple-incidence autism families. American Journal of Psychiatry, 154, 185–190.

Porter, N. (2012). Promotion of pretend play for children with high-functioning autism through the use of circumscribed interests. Early Childhood Education Journal, 40, 161–167.

Roth, I., Grove, R., Roelfsema, M., & Hoekstra, R.A. (2015, 13–16 May). Measuring commitment to special interests in adults on the autism spectrum. Paper presented at the International Meeting for Autism Research, Salt Lake City, USA.

Roth, I., Roelfsema, M., & Hoekstra, R.A. (2013, 26–28 September). The role of special interests in the lives of adults on the autism spectrum. Paper presented at the International Autism-Europe Congress, Budapest.

Ryan, R.M., Connell, J.P., & Grolnick, W.S. (1990). When achievement is not intrinsically motivated: A theory of self-regulation in school. In: Boggiano, A.K. & Pittman, T.S. editors., Achievement and motivation: A social-developmental perspective (pp 167–188). New York: Cambridge University Press.

Schwarz, G. (1978). Estimating the dimension of a model. Annals of Statistics, 6, 461–464.

Sclove, S.L. (1987). Application of model-selection criteria to some problems in multivariate-analysis. Psychometrika, 52, 333–343.

Smith, C.J., Lang, C.M., Kryzak, L., Reichenberg, A., Hollander, E., & Silverman, J.M. (2009). Familial associations of intense preoccupations, an empirical factor of the restricted, repetitive behaviors and interests domain of autism. Journal of Child Psychology and Psychiatry and Allied Disciplines, 50, 982–990.

South, M., Ozonoff, S., & McMahon, W.M. (2005). Repetitive behavior profiles in Asperger syndrome and high-functioning

autism. Journal of Autism and Developmental Disorders, 35, 145–158.
Spiker, M.A., Lin, C.E., Van Dyke, M., & Wood, J.J. (2012). Restricted interests and anxiety in children with autism. Autism, 16, 306–320.
Steenkamp, J.E.M., & Baumgartner, H. (1998). Assessing measurement invariance in cross-national consumer research. Journal of Consumer Research, 25, 78–107.
Steiger, J.H., & Lind, J.M. (1980). *Statistically based tests for the number of common factors*. Paper presented at the Meeting of the Psychometric Society, Iowa City, IA.
Sucksmith, E., Roth, I., & Hoekstra, R.A. (2011). Autistic traits below the clinical threshold: Re-examining the broader autism phenotype in the 21st century. Neuropsychology Review, 21, 360–389.
Tucker, L.R., & Lewis, C. (1973). A reliability coefficient for maximum likelihood factor analysis. Psychometrika, 15, 149–162.
Turner-Brown, L.M., Lam, K.S.L., Holtzclaw, T.N., Dichter, G.S., & Bodfish, J.W. (2011). Phenomenology and measurement of circumscribed interests in autism spectrum disorders. Autism, 15, 437–456.
Vallerand, R.J., Pelletier, L.G., Blais, M.R., Brière, N.M., Senécal, C., & Vallières, E.F. (1992). The Academic Motivation Scale: A measure of intrinsic, extrinsic, and amotivation in education. Educational and Psychological Measurement, 53, 1003–1017.
Winter-Messiers, M. (2007). From tarantulas to toilet brushes: Understanding the special interest areas of children and youth with Asperger's syndrome. Remedial and Special Education, 28, 140–152.