



Factor structure of the Strengths and Difficulties Questionnaire (SDQ)
in preschool aged children

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Þakkarorð

Ég vil þakka Urði Njarðvík fyrir frábæra leiðsögn og samstarf. Bestu þakkir til minnar kæru fjölskyldu. Sérstaklega vil ég þakka börnum mínum þeim Ríkarði Flóka, Guðbjörgu Elísu og Þorsteini Hilmari fyrir þolinmæðina síðastliðin tvö ár. Einnig vil ég þakka eiginmanni mínum Bjarka Þór Elvarssyni fyrir hvatninguna og að vera ávallt með mér í liði í lífinu. Foreldrum og tengdaforeldrum vil ég þakka ómetanlegan stuðning og alla þössunina, þetta hefði náttúrulega aldrei gengið upp án ykkar!

Abstract

Factor analytic studies assessing the construct validity of the Strengths and Difficulties Questionnaire (SDQ) have shown mixed findings in the past. Given the thirteen year age range of the questionnaire and all the developmental changes children undergo during that time, an accurate assessment of the questionnaire's construct validity across age is crucial. Research on the developmental trajectories of pathology indicate that internalizing and externalizing psychosocial maladaptation as well as normative development is heterogeneous during the preschool years. An especially important time for the identification, prevention and intervention of psychosocial maladaptation. In the present study, the construct validity of the SDQ is assessed, by comparing the three models that have been hypothesized to represent the latent factors of the SDQ. Since development during the preschool years is especially capricious, age effects are further inspected in the model that shows the best fit. The sample under study is a fairly large, representative community sample of 851 Icelandic children, four to six years old, attending preschool. The original five-factor structure of the SDQ showed a good fit on the selected indices, and a better fit of the two proposed models. The five-factor model also showed good fit on the fit indices in a multigroup CFA across age, showing desirable psychometric properties pertaining to measurement invariance, but indicated population heterogeneity through different means on the latent variables. Together, these results support that the SDQ has similar psychometric properties for preschoolers as for older children, nevertheless narrower age gaps might be needed for clinical cut-off scores due to population heterogeneity at least for the youngest subjects.

** Strengths and difficulties questionnaire; Preschool age; Confirmatory factor analysis; Construct validity; Factor structure

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As is increasingly becoming clear, a substantial proportion of all psychopathology begins quite early in childhood (Egger & Angold, 2006) and persists in one form or another throughout life (Carter, Briggs-Gowan, & David, 2004; Leventhal, 2013). This entails both a diminished quality of life for the person affected and a significant added cost for the whole of society (Costello, Egger, & Angold, 2005). On the other hand, preventive strategies like evidence-based treatment for young children with internalizing and/or externalizing behaviour problems antecedent to psychopathology could prevent their manifestation during the life course (Basten et al., 2015). Thus, a prevention strategy where children most likely to develop psychopathology are located and treated could both result in an improved life trajectory for each individual and likewise a lowered cost for society.

But in order for a prevention strategy to work, early screening is needed. One such screening instrument is the Strengths and Difficulties Questionnaire (SDQ) (Robert Goodman, 1997), which is meant to measure the psychological adaption of children and adolescents with the age span of 4-17 years. The SDQ has a number of attractive aspects with regards to screening: it is brief (only 25 questions), widely used, both for research and in practice (Stone, Otten, Engels, Vermulst, & Janssens, 2010), free (<http://www.sdqinfo.com>) and easy to use. The questionnaire was designed so that both questions of strengths and difficulties would be well represented and employs positive worded items, making it more acceptable to parents. These aforementioned aspects make its use especially suitable for screening in the general population where a large portion of the children under study are not affected by behaviour problems.

The SDQ has also been found to complement the Child Behavior checklist (CBCL), a very solid instrument for doing an assessment of childhood psychopathology (Stone et al., 2010). For instance, it correlates highly with the CBCL (R. Goodman & Scoot, 1999; Klasen et al., 2000; Koskelainen, Sourander, & Kaljonen, 2000), and both batteries have been demonstrated to equally discriminate between disorders, both for samples of children and adolescents drawn from psychiatric clinics and from community samples (Klasen et al., 2000), as well as to display other similar psychometric properties such as concurrent validity (Van Widenfelt, Goedhart, Treffers, & Goodman, 2003).

Studies for the SDQ have generally shown good psychometric properties overall (Becker, Woerner, Hasselhorn, Banaschewski, & Rothenberger, 2004; R Goodman, 2001; Muris, Meesters, & van den Berg, 2003; Rothenberger, Becker, Erhart, Wille, & Ravens-Sieberer, 2008). In a review of psychometric properties of the SDQ, Stone et al. (2010) notes that these properties have not been as extensively studied in the youngest and oldest children as in those in primary and secondary school, and that research on psychometric properties conducted on lower primary school-aged children shows mixed findings. Thus, conclusions about the suitability of the SDQ for younger children are in need of further verification. This is especially relevant for estimation efforts of construct validity, such as examining factor structure, measurement invariance and population heterogeneity between subgroups of the SDQ, to see if meaningful unbiased group comparisons are indeed possible for such a wide age span. Given the thirteen year age range of the questionnaire and all the developmental changes children undergo during that time, an accurate assessment of the questionnaire's construct validity across different subgroups of age is crucial.

Factor analytic studies of the SDQ have been conducted for different age groups, both clinical and community samples and they have shown mixed findings (Caci, Morin, & Tran, 2015). Some authors have suggested an alternative three-factor structure of internalizing, externalizing and pro-social factors (Caci et al., 2015; Dickey & Blumberg, 2004; A. Goodman, Lamping, & Ploubidis, 2010), over the original five-factor structure proposed and substantiated by Goodman (2001). Furthermore, in one study where the five-factor model did hold, the factor loadings differed between age-subgroups of adolescents (Van Roy, Veenstra, & Clench-Aas, 2008). When Niclasen, Skovgaard, Andersen, Sørhøvd, & Obel (2013) conducted confirmatory factor analysis (CFA) between different age groups of 5-7 and 10-12 year olds (and across gender) they also found rather large intergroup differences where data for the older group showed better model fit. In light of their findings they noted that previous factor analytic studies, such as the one conducted by A. Goodman et al. (2010), may have masked potential variance in measurement between subgroups by aggregating such a large age span (5–16-year-old children) in one analysis.

Developmental considerations during the pre-school years

In light of the mixed psychometric findings found for the youngest intended subjects of the SDQ (Stone et al., 2010) and the rapid developmental changes that characterize the early

childhood period (Carter et al., 2004) questions arise as to whether outcomes of children in the youngest age group of the SDQ might differ from that of older children. In terms of screening for and identifying, preventing or intervening psychological maladaptation, the optimal time for identification and detection of early signs of psychological problems is said to be in the preschool period (Poulou, 2015), making an accurate picture of the psychopathology of children in this age group critically valuable.

One factor that can interrupt such a process during the preschool years is that many symptoms of disorders are often still a part of children's developmentally normative behavior at this young age (Carter et al., 2004), making it developmentally imprecise and sometimes even impossible to distinguish psychopathology from developmentally appropriate behaviour in young children using psychometric measures that were developed with older children in mind (Bufferd, Dougherty, Carlson, Rose, & Klein, 2012; Wakschlag et al., 2007). Another factor is the documented heterogeneity sometimes found in the expression of both externalizing and internalizing symptoms across age (Basten et al., 2015; Carter et al., 2004; Chacko, Wakschlag, Hill, Danis, & Espy, 2009). For example, Basten et al. (2015) showed that although children with co-occurring internalizing and externalizing problems were most likely to show persisting problems, the presentation of problem behaviour changed in such a way across the preschool period that it was difficult to predict the problem profile of either internalizing or externalizing problems from a previously mapped profile. Bufferd et al. (2012) also found an equal likelihood for meeting the criteria for a different DSM diagnosis as for the same DSM diagnosis for children from the ages of 3 to 6 years. The relations between internalizing and externalizing symptoms may thus be different for preschooler than for older children or adolescents (Stone, Otten, Engels, Kuijpers, & Janssens, 2015). A third factor possibly confounding the identification and treatment for preschool aged children is the high rates of comorbidity in childhood psychopathology (Dougherty et al., 2015), both within internalizing or externalizing disorders and also between the two groupings. The interplay between these factors is best illustrated by the example of the symptom of chronic irritability. Irritability, common in typical development is often classified as a symptom of externalizing disorders, but as Dougherty et al. (2013) found this symptom among preschoolers predicted the emergence of new cases of both internalizing depressive disorders and externalizing oppositional defiant disorder at age 6. This suggests that there are differences in the

trajectories of irritability-psychopathology associations at different developmental points across the lifespan.

Thus, considering that the SDQ has not been as extensively studied for its youngest age group, variance has been found for age in the SDQ and since the preschool years are especially capricious in terms of possible age effects a comprehensive assessment of the factor structure for preschool aged children is needed. The advantage of the structural confirmatory method is that it provides a comprehensive means for assessing the latent structure of the hypothesized models in this age group and therefore has the potential for furthering theory development.

The objective of this study was to evaluate the construct validity of both the five-factor SDQ as proposed by Goodman (2001) and the three-factor SDQ A. Goodman et al. (2010) suggested might be more suitable for community samples, in a fairly large community sample of Icelandic preschoolers, aged 4-6 years. This involves a confirmatory factor analysis of both of the hypothesized latent structures of the SDQ and an assessment of the effect of age on those latent structures, as neither the measurement invariance nor the factor structure of the SDQ for this particular age group have been extensively examined. Therefore, the measurement invariance and population heterogeneity of the SDQ was tested by means of a multigroup CFA for younger (born in 2009) and older (born in 2008) children in the sample.

Methods

Sample

Parents or other primary guardians of 2610 children attending 57 preschools in Iceland were invited to participate in a study. The preschools selected for study were conveniently sampled and their location was stratified in terms of population density in order to attain a sample representative of the country as a whole, seeing as in 2014, 96% of children living both in urban and rural areas in Iceland and born in the years 2008 and 2009 attended preschool (Iceland, 2014). The parents received questionnaires at their children's local preschool, completed the survey at home and returned the materials in a sealed envelope to the preschool. Participation in the study was voluntary. Parents of 916 children (mean age:

5.27 years, range 4-6 years; boys: 48.88%, girls: 51.12%) participated (response rate= 35.10%; mean age: 35.60 years) and were 89.96% of the respondents mothers.

Since a relatively few respondents (7.10%) did not have valid answers on all 25 items of the SDQ and did not differ from respondents with answers valid on all items (N=851) in terms of any of the demographic variables available (e.g. age or gender of the respondent, the age or gender of the child and residency), they were not included in the analysis (*listwise deletion*).

The two subgroups of children across age were children born in 2008 (N=380, mean age: 5.78 years, SD=0.28 years) and in 2009 (N=392, mean age: 4.77 years, SD=0.28 years).

Material

The Icelandic version of the SDQ parent report, obtained by translation, back-translation and validation, was used in the study. The SDQ is comprised of five dimensions, each consisting of five of the questionnaire's 25 questions. Four of the dimensions relate to psychopathology (emotional symptoms, conduct problems, symptoms of hyperactivity/inattention and peer problems) and the fifth one relates to strengths (pro-social behaviour). The items are all marked on a three point Likert style scale and rated 0-2 points where a higher score signifies increased difficulty (positively worded items pertaining to difficulties are rated inversely).

Data analysis

Confirmatory factor analysis (CFA) was used, first for the entire age group and secondly a multiple groups model contrasting younger (born in the year 2009) and older (born 2008) children. Ingrained in CFA is an explicit modeling of the hypothesized constructs, taking measurement error into account. The analyses test if the items of the SDQ load onto the five hypothesized latent factors in the same manner independent of age.

All data handling and statistical analyses were carried out using R (R Core Team, 2015, version 3.2.3), in particular the 0.5 release of the lavaan package for CFA which includes support for non-normal and categorical data (Rosseel, 2012). Based on the size of the sample, the ordinal nature and extreme non-normality inherent in the SDQ, model fit was evaluated with diagonally weighted least squares (DWLS) (Brown, 2015). The fit of both models was tested using the DWLS Chi-square statistic (χ^2), the Comparative Fit Index (CFI), the Tucker-Lewis Index (TLI) and the Root Mean Square Error of Approximation (RMSEA). For

categorical data, values greater than 0.96 for CFI and TLI are considered to be indicative of good model fit and for RMSEA values less than 0.08 or 0.06, respectively, indicative for acceptable and good model fit (Schreiber, Nora, Stage, Barlow, & King, 2006).

The fit of the *a priori* SDQ five-factor model (Model 1) and the three-factor model (Model 2) was examined for the entire age group of four - six year olds. The model with the best fit is split in two age groups of older (Model 3: born in 2008) and younger (Model 4: born in 2009) children. First, the fit for both model 3 and 4 is assessed individually. For the different age groups, the variability in answers was in some cases too small causing empty cells to appear in the pairwise cross-tables. To counter this, the value 0.01 was added to the empty cells in order for Models 3 and 4 to converge (See the Lavaan discussion on <https://groups.google.com/forum/#!forum/lavaan>). After the posited model is found to be acceptable in both age groups, a multiple-groups CFA is conducted. One key advantage of multiple-groups CFA is that measurement invariance can be examined through the factor loadings, intercepts, residual and factor variances, factor covariances and latent means for the model (Brown, 2015).

Results

The results of the CFA are presented in Table 1. They show that of the two hypothesized *a priori* models, Model 1 (M1) reaches good fit on all three indices of comparative fit (CFI, TLI and RMSEA), whereas for Model 2 (M2) only the RMSEA estimator indicates a good fit. Fit indicators for both explications of the five-factor model in older (M3) and younger (M4) age groups also show acceptable fit. One indicator, TLI, is marginal for the older (M3) children. The results suggest that the five-factor model fits the data well, both for the whole sample and for either age group.

Table 1. Fit indices for the different models

	χ^2	<i>df</i>	CFI	TLI	RMSEA
M1: Five-factor model - full sample	613.20*	265	.96	.96	.039
M2: Three-factor model - full sample	892.34*	272	.94	.93	.052
M3: Five-factor older	422.82*	265	.96	.95	.041
M4: Five-factor younger	421.40*	265	.96	.96	.040

* $p < .05$

Standardized factor loadings for the full sample and both age groups are shown in table two. All items presented satisfactory to high factor loadings on their main factors ($\lambda = .33-.89$; $M = .63$) except item 3 (*Somatic complaints*) in the older age group ($\lambda = .26$). All score

Table 2. Standardized factor loadings based on confirmatory factor analyses for the five-factor model

SDQ	M1: Full sample	M3: Older	M4: Younger
Emotional symptoms			
Somatic complaints (3)	0.35	0.26	0.50
Worries (8)	0.75	0.76	0.76
Unhappy (13)	0.72	0.81	0.63
Clingy (16)	0.58	0.57	0.63
Fears (24)	0.65	0.61	0.69
Conduct problems			
Tempers (5)	0.60	0.60	0.58
Obedient (7)	0.72	0.63	0.76
Fights (12)	0.39	0.53	0.41
Lies, cheats (18)	0.49	0.57	0.36
Steals (22)	0.66	0.68	0.73
Hyperactivity/Inattention			
Restless (2)	0.89	0.87	0.89
Fidgety (10)	0.81	0.83	0.79
Distractible (15)	0.76	0.76	0.76
Reflective (21)	0.57	0.52	0.60
Persistent (25)	0.77	0.78	0.76
Peer problems			
Solitary (6)	0.47	0.55	0.47
Good friend (11)	0.67	0.65	0.77
Popular (14)	0.78	0.71	0.82
Picked on, bullied (19)	0.46	0.57	0.33
Best with adults (23)	0.48	0.44	0.54
Prosocial behavior			
Considerate (1)	0.76	0.75	0.72
Shares (4)	0.54	0.58	0.56
Caring (9)	0.55	0.57	0.53
Kind to kids (17)	0.57	0.40	0.70
Helps out (20)	0.66	0.61	0.69

reliability coefficients for the scale proved satisfactory (Cronbach's $\alpha=.63-.86$). In the sample as a whole and both age groups, inter-correlations between the five latent variables were often strong, indicating considerable conceptual overlap among some of the constructs. Strongest correlations were found between conduct problems and both hyperactivity/inattention ($r=.72-.75$) and pro-social behaviour ($r=-.76-.65$). Inter correlations were also moderate to strong for peer problems and pro-social behaviour ($r=-.62-.51$) and conduct problems ($r=.51-.70$), respectively. Lowest correlations among the latent variables were found between pro-social behaviour and emotional problems ($r=-.29-.14$).

The findings in Table 2 indicated that the factor loadings might differ across the two age groups, especially on items 3 (*Somatic complaints*), 17 (*Kind to kids*), 18 (*Lies, cheats*) and 19 (*Picked on, bullied*). Pairwise comparisons as well as chi-squared difference tests (as seen in table 3) comparing both the age groups simultaneously ($\Delta\chi^2$), did not show support for difference in factor loadings across the age groups. Further, other chi-squared difference tests of measurement invariance did not find measurements to vary across the age groups. Comparisons between the two age groups on latent variable means, however, indicate population heterogeneity.

Table 3. Fit indices for multiple group CFA comparing younger and older children

	χ^2	<i>df</i>	CFI	TLI	RMSEA	$\Delta\chi^2$
Configural invariance	844*	530	.96	.96	.041	-
Weak factorial invariance	917*	550	.95	.95	.043	20.04
Strong factorial invariance	907*	570	.96	.96	.041	-5.07
Variance invariance	917*	575	.96	.96	.041	4.03
Covariance invariance	938*	585	.96	.95	.041	5.84
Mean invariance	977*	590	.95	.95	.043	8.47*

* $p<.05$

Discussion

The results of the present study support the hypothesized five-factor model of the SDQ (Robert Goodman, 1997) for children in the general population aged four to six years and attending preschool. The five-factor model showed a good fit both for the whole sample and for both age groups, but the three-factor model did not reach acceptable fit. The SDQ's

indicators for measurement were invariant across the two years, but the means on the latent variables differed between groups indicating population heterogeneity.

Although the model showed good fit to the data without any modifications, substantial latent variable inter-correlations and differences in latent variable means across age warrant closer inspection. First, strong inter-correlations among the latent variables indicate noticeable conceptual overlap. Some of the strong correlations found were in line with the conceptualization of internalizing and externalizing latent variables found in the literature for the SDQ. For instance, conduct problems and hyperactivity/inattention, that constitute the externalizing factor in the three-factor model correlated strongly. Peer problems, that are conjectured to make up the internalizing factor with emotional problems did however show moderate inter-correlations with both conduct and emotional problems, indicating that these subscales share the same underlying trait to some extent. This finding contrasts those that support the distinction between the internalizing and externalizing dimensions of the SDQ (Dickey & Blumberg, 2004; R Goodman, 2001; Koskelainen et al., 2000; Van Roy et al., 2008), but is similar to the outcome reported by Caci et al. (2015). The suggested conceptual overlap between latent variables of both internalizing and externalizing dimensions is not surprising with regard to the heterogeneity reported for this age group at least (e.g. Basten et al., 2015). This finding is in line with the higher rates of comorbidity during the preschool years (Dougherty et al., 2015) as well as the often heterogeneous expression of both normative development and psychopathology during those years (Basten et al., 2015; Carter et al., 2004; Chacko et al., 2009).

Second, differences in latent variable means found across the two years also indicate some degree of population heterogeneity in the youngest intended age group of the SDQ. This result implies that narrower age bands might be needed for the SDQ than are currently being used, at least for this age group. Using the same criteria or cut-points on one instrument across different ages, the researcher or clinician are both in danger of not accurately separating normal developmental shifts from deviance from typical development (Basten et al., 2015; Carter et al., 2004).

The strengths of the current study include that it entails a community sample that includes a relatively large number of children that are representative of the population in terms of the country as a whole. There were also limitations. The participation rate in the

present study was low (35.10%) hinting to the possibility of a selection bias. Also, as both Elberling, Linneberg, Olsen, Goodman, & Skovgaard (2010) and Niclasen et al. (2013) point out there is a possibility of cultural effects confounding the findings of CFA for SDQ. In this instance though, the similar inter-correlation profiles of this study and that of Caci et al. (2015) reflects that similar findings have now been found across different cultures.

Continuing inspection of the youngest age group of the SDQ in term of measurement invariance and population heterogeneity is needed, especially in comparison to older age groups, as well as a further inspection of the latent classes of the SDQ apart from those found in the five-factor model.

In conclusion, this study on the whole shows that the five-factor model of the SDQ holds for preschool aged children, but the inter-correlation between the factors of the SDQ here and in other CFA studies suggests that the grouping of items exclusively as either internalizing or externalizing, at least for this age group, is in danger of missing out on conceptual connections between items that show heterogeneous connections to both dimensions and might be developmentally important for the understanding of the evolution of psychopathology in children.

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