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Psychometric Properties of the Strengths and Difficulties Questionnaire and Mental Health Problems Among Children With Hearing Loss

Janni Niclasen and Jesper Dammeyer

University of Copenhagen

Correspondence should be sent to Janni Niclasen, Department of Psychology, University of Copenhagen, Øster Farimagsgade 2A, 1353 København K, Denmark (e-mail: janni.niclasen@psy.ku.dk).

Abstract

More knowledge is needed about the characteristics of mental health problems among deaf or hard of hearing (D/HH) children. This study investigates the factor structure of one of the most widely used screening tools, the Strengths and Difficulties Questionnaire (SDQ), and the prevalence of mental health problems among D/HH children. Our data were derived from two independent samples of D/HH children, one from 2007 of children ($N = 334$) in bilingual/bicultural educational programs and another from 2014 of children ($N = 233$) in mostly mainstream oral educational programs with cochlear implants. Teacher-SDQs were collected for the 2007 sample and parent-SDQs for the 2014 sample. The factor structure of the SDQ was examined from both Exploratory Factor Analytic (EFA) and Confirmatory Factor Analytic (CFA) perspectives and internal consistency was examined. Mean problem scores were presented. The five-factor structure of the SDQ was overall found for both the 2007 and the 2014 samples using EFA. However, problems with the Conduct scale and the reversed items loading onto the Prosocial scale were observed. The five-factor model was superior to a one- and a two-factor model from a CFA perspective in both samples. Better internal consistency was observed for the 2007 sample rated by teachers. Both samples showed higher mean scores on all SDQ problem subscales compared to a cohort of Danish children without hearing loss. The five-factor structure of the SDQ is recommended to be used among D/HH children.

Fellinger, Holzinger, and Pollard (2012) summarize in their review that deafness may have far reaching consequences for children's social, emotional, and cognitive development. Across numerous studies, an elevated prevalence of mental health problems among deaf or hard of hearing (D/HH) children has been reported. Overall, the prevalence of mental health problems among D/HH children is estimated to be 20–40% higher than for peers without hearing loss (Bøttcher & Dammeyer, 2013; Fellinger et al., 2012; Hindley, 2000). Fellinger et al. (2012) reported point and lifetime prevalence rates of mental health problems of 32.6% and 45.3%, respectively, in a sample of D/HH children (Fellinger, Holzinger, Beitel, Laucht, & Goldberg, 2009). The higher prevalence rates have been reported for most subtypes of psychopathology, including attentional and behavioral disorders (Hindley, 2000), depression (Theunissen et al., 2011), and peer problems (Stevenson, Kreppner, Pimperton, Worsfold, & Kennedy, 2015). In a recently completed meta-analysis, Stevenson et al. (2015) reported that elevated rates of peer problems were consistent across a number of studies using the Strengths and Difficulties Questionnaire (SDQ).

Strengths and Difficulties Questionnaire

The SDQ is a screening tool developed to assess behaviors, emotions, and relationships in young children and adolescents. It consists of 25 items that are grouped into five scales (*Hyperactivity-inattention*, *Conduct disorder*, *Emotional problems*, *Peer problems*, and *Prosocial skills*) of five items each. Of

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the 25 items, 14 are generally thought of as difficulties, 10 as strengths, and 1 as a neutral question (Goodman, 2001). It is one of the most widely used brief screening instruments of its kind and it is used in both community and clinical samples (Niclasen et al., 2012; Niclasen, Skovgaard, Andersen, Sømhovd, & Obel, 2013). The factor structure of the SDQ has been investigated in numerous studies of children without a hearing loss. From an Exploratory Factor Analytic (EFA) perspective, several studies, including one large-scale Danish study, have found support for a five-factor structure (Goodman, 2001; Niclasen et al., 2012). Fewer studies have investigated the factor structure from a Confirmatory Factor Analytic (CFA) perspective. Most of these studies have investigated the five-factor model, whereas others have tested a two-factor solution combining the *Hyperactivity* and *Conduct scales* into an *Externalizing scale*, the *Peer problem* and *Emotional scales* into an *Internalizing scale* along with the *Prosocial scale* (Dickey & Blumberg, 2004; Goodman, Lamping, & Ploubidis, 2010). Another study including data from custodial grandmothers found that a model which contained a positive construct factor fitted the data better than the three- and the five-factor models (Palmieri & Smith, 2007). Finally, a model combining the four problem scales into a *Total difficulties* factor has been tested. Overall, the results of these studies have been somewhat mixed. Some studies have found support for the originally proposed five-factor model (Goodman, 2001), whereas others have opted for the two-factor solution (Goodman et al., 2010). Even other studies have found support for a model that includes a hypothesized *positive construct factor* in addition to the four problem scales (Palmieri & Smith, 2007). A study among a large Danish community sample concluded that a five-factor and a two-factor model worked equally well and are both superior to a model using the *Total difficulties* scale (Niclasen et al., 2013). Another CFA study looking separately at low- and high-risk children without hearing impairment concluded that there are advantages to using the broader *Internalizing/Externalizing* scales for analyses in low-risk samples, whereas the five subscales should be retained in high-risk samples (Goodman et al., 2010).

The SDQ has also been used to measure levels of mental health problems among D/HH children. Stevenson et al. (2015) reported on 45 studies in a review, including 12 studies using the SDQ to measure emotional and behavioral problems among D/HH children. Of these, only one study has looked specifically at the psychometric properties of the SDQ in a sample of deaf and hard of hearing children (Hintermair, 2007). The study investigated the five-factor structure from an EFA perspective and concluded that the factor structure was satisfactory. However, the *Conduct* scale could not be identified.

Differences in factor structure have not only been observed between clinical and normative samples, but also between parent and teacher raters. Generally, a clearer factor structure has been observed for parent raters as compared to teacher raters from an EFA perspective (Niclasen et al., 2012). For example, parents seem to be more likely to observe the different constructs (i.e., *Hyperactivity* and *Conduct*) as separate, whereas teachers are generally found to be more likely to perceive the constructs (i.e., *Hyperactivity* and *Conduct*) as overlapping (i.e., *Externalizing disorder*) (Niclasen et al., 2013). However, in EFA testing, the factor loadings, that is, the correlations between a given factor and a specific item have been found to be higher for teachers. Likewise, the model fits for parent ratings in CFA testing are also superior to those from teacher ratings (Niclasen et al., 2013).

Factors Explaining Mental Health Problems Among D/HH Children

In order to explain the higher prevalence rates of mental health problems among D/HH children, a number of factors have been investigated. One of the key factors is language delays leading to language difficulties (Dammeyer, 2010; Stevenson, McCann, Watkin, Worsfold, & Kennedy, 2010). The suggested pathway is that congenital hearing impairment may cause language delay, which in turn leads to a higher risk of mental health problems. Related to the risk of language delay and language difficulties are two other protective factors, sign-language and cochlear implantation (CI). Some studies have reported that good sign-language ability is an important protective factor for mental health problems among D/HH children (Dammeyer, 2010). Other studies have found that use of sign-language compared to oral language use is associated with an increased risk of mental health problems (Theunissen et al., 2014). However, the negative association may not be linked to sign-language use per se. Instead, sign-language may be introduced as a consequence of the fact that the child experienced oral language difficulties. CI has significantly improved the opportunities over the last two decades for children with severe to profound hearing losses to develop oral language. It appears that the overall psychosocial well-being of children with hearing loss and CI lies somewhere between that of children with hearing loss but without CI and children without hearing loss (Huber & Kipman, 2011). These authors compared 32 deaf adolescents with CI and 212 hearing peers using the SDQ. No significant mean differences were overall reported between the two groups, but teachers rated more peer problems and total difficulties among the children with CI compared to the hearing children. Improvements of oral language abilities may be the main reason for the decrease of mental health problems among D/HH children with CI. In this respect, age of the implantation has been found to be one of the most important factors for the oral language outcome following CI (Cosetti & Waltzman, 2012).

Another debated factor of importance for the mental health conditions of D/HH children is the use of deaf/special versus mainstream schooling. In Scandinavia, there was, until a decade ago, a focus on a bicultural (i.e., deaf and hearing) and bilingual (i.e., signed and oral) education (Swanwick, Dammeyer, Hendar, Kristoffersen, & Salter, 2014). There is now a controversy as to whether this in fact is positive for the psychosocial and cognitive development of the D/HH child. A bicultural and bilingual perspective has on the one hand been found to be positive for deaf children's psychosocial and cognitive development because it supposedly gives the children a greater ability to communicate naturally from early life and an ability to develop a self-image and self-esteem as a deaf person (Heiling, 1995; Hindley, 2000; Preisler, 1999). By contrast, other studies report that mainstream (and oral schooling) predicts a better mental health outcome for children with cochlear implantation (for a review, see Theunissen et al., 2014). Again, it might not be the mainstream enrolment per se. The negative association between deaf school enrolment and mental health may be a consequence of the fact that the children attending the deaf schools were referred there in the first place because of mental health problems, language, and other difficulties (Knoors & Marschark, 2014).

In Denmark, education and support for children with hearing loss has changed during the last decade from an almost solely bilingual/bicultural approach to an oral and mainstream approach after the introduction of CI. Use of sign-language in

Denmark is not recommended to children after they have had CI (Danish Health and Medicine Authority, 2010).

Study Aims

The first aim of the present study has been to investigate the psychometric properties of the Danish version of the SDQ among children and youths with a hearing loss. On the basis of previous studies of high-risk samples, it was hypothesized that there would be some overlap in the factor structure between the Conduct and the Hyperactivity items (i.e., the Externalizing items). It was further hypothesized that there would be an overlap between the Prosocial items and the five reversed, positively worded items. The second aim was to compare mean scores among D/HH children and children in a community sample. It was hypothesized that the mean scores among the D/HH children would be higher than those of the sample of community children.

Methods

Samples

Included in the present study were data from two independently collected samples of D/HH children (Table 1). The data for Sample 1 were collected in 2007 (denoted the "2007 sample") and comprised 328 children (55% boys). The mean age of the 2007 sample was 12.8 (*SD* = 2.9). A total of 91 of these children had a CI on one or both ears and the mean age of the cochlear implantation was 6.1 (*SD* = 3.2). The data were originally collected in connection with a study investigating psychosocial well-being among Danish children at deaf schools and hearing impaired units adopting the bilingual/bicultural approach (Dammeyer, 2010). In 2007, almost all children with severe to profound hearing loss attended these deaf schools or hearing impaired units. The participation rate of this sample was 97%.

The data for Sample 2 were collected in 2014 (denoted the "2014 sample") and comprised a total of 233 children (Table 1). Their mean age was 9.8 (*SD* = 3.3) and 50% were boys. The data were collected as part of a national survey on life conditions for children with severe to profound hearing loss, conducted by the Danish National Centre for Social Research (Bengtsson, Larsen, & Sommer, 2014). By 2014, the number of children at the deaf schools or hearing impaired units had decreased to a minimum, and the bilingual/bicultural approach was now only partly applied at these schools. According to the national guidelines, sign language was no longer recommended to children with CI (Danish Health and Medicine Authority, 2010). A total of 44% of the children had never attended a deaf school or a hearing impaired unit. The mean age of the cochlear implantation for the 194 children with CI was 3.1 (*SD* = 3.1). The data were collected by sending out invitations via parent organizations, health centers, schools, and social media websites. Due to this approach, it was not possible to estimate a participation rate for this sample.

Data from the Aarhus birth cohort (ABC) was used as a comparison group in the present study. The ABC is an ongoing cohort including all births taking place at Aarhus University Hospital from 1990 and onwards (Obel, 2003). The SDQ was distributed to a subsample of the cohort (n = 8,244) in 2002, when the children were between 10 and 12 years of age. The participation rate for the parent and teacher SDQ follow-ups were 88% and 86%, respectively, of those invited for the follow-up.

For all three samples, the procedures followed were in accordance with the ethical standards of the Helsinki Declaration.

Strengths and Difficulties Questionnaire

The SDQ teacher version was used in the 2007 sample, whereas the SDQ parent version was applied in the 2014 sample. In the ABC sample, both the parent and teacher versions of the SDQ were administered to the full sample of children.

Statistical Analyses

The methods of EFA and CFA were chosen as the appropriate procedures to investigate the factor structure of the SDQ among D/HH children. EFA is a descriptive approach to factor analyses where the goal is to identify factors based on the data and to maximize the total amount of variance explained (Field, 2009). EFA should be used if one is to understand the structure of a set of variables. It is applied in the present study because the factor structure of the SDQ among deaf and hard of hearing populations has yet to be established. The aim of CFA on the other hand is to test how well the data fit a hypothesized, a priori, theory-based measurement model. CFA can be used when the aim is to test two or more competing theoretical models (Byrne, 2013). It was thus included in the present study because the aim was to test three competing theoretical models.

We initially investigated the factor structure from an EFA perspective. The EFAs were carried out in the statistical package SPSS version 21. The method of Principal Component Analysis (PCA) with Varimax rotation was applied. Although PCA strictly speaking is not a method of EFA, the two methods are often treated as though they are, and PCA is thus denoted at EFA in the present study (Field, 2009). In PCA, testing the results of the analyses cannot be generalized to other samples, unless they are replicated in other samples. However, because two independent samples are included in the present study, it is assumed that

Table 1. Characteristics of the samples providing data for the present study

Sample	2007	2014	ABC	ABC
N	328 (55% boys)	233 (50% boys)	5,595 (50% boys)	6,559 (51% boys)
Data collected	2007	2014	2002	2002
SDQ rater	Teachers	Parents	Teachers	Parents
Age	Mean: 12.8 (*SD*: 2.9); range: 6–19	Mean: 9.8 (*SD*: 3.3); range: 4–16	10–12-year olds	10–12-years old
CI	91 (27.7%)	194 (83%)	≈0%	≈0%
Mean age of CI (*SD*)	6.1 (3.2)	3.1 (3.1)	—	–
Has never attended deaf schools	≈0%	44%	≈0%	≈0%

Note. ABC = Aarhus birth cohort; CI = cochlear implantation; SDQ = Strengths and Difficulties Questionnaire.

the results of the present study can be extrapolated to other D/HH samples.

We decided on the number of factors based on both the so-called Kaiser principle as well as the Scree plot. The idea of the Kaiser principle is to retain the number of factors in further analyses with an initial Eigenvalue greater than 1 (Field, 2009). The Scree plot on the other hand graphically depicts the value of each Eigenvalue against the factor with which it is associated. The cutoff point for selecting the number of factors to retain should be at the point of inflexion, that is, where the slope of the line changes dramatically (Field, 2009).

All CFAs were carried out by means of the statistical package MPlus version 6. We used the Weighted Least Squares Means and Variance (WLSMV) estimator which is designed specifically for use with small and medium sample sizes (Byrne, 2013). Because most of the SDQ items had skewed or very skewed distributions, the data were treated on a categorical level. Model fits were evaluated by means of Chi Square Test of Model Fit where 0 indicates a perfect fit; Steiger-Lind Root Mean Square Error of Approximation (RMSEA) where a RMSEA <0.08 indicates an acceptable model fit and <0.05 a good model fit; We also calculated the Bentler Comparative Fit Index (CFI) and the Tucker-Lewis Fit Index (TLI). For both of these, values >0.90 signify acceptable fits and >0.95 good fits (Schreiber, Nora, Stage, Barlow, & King, 2006). When certain parts of the model did not show acceptable fits, loadings between specific indicators were allowed for on the basis of modification indices if they were considered theoretically meaningful.

The factor analyses were followed by scale reliability analyses (Cronbach's alpha) and by computing descriptive statistics including means and *SD*s for the individual SDQ scales. These analyses were carried out in SPSS version 21.

Results

Missing Values

Goodman (2001) suggests that cases should be included only when a minimum of three answers are given on a single scale. Six children in the 2007 sample did not fulfill this criterion and were excluded from all analyses leaving a total sample of 328 for the analyses. Furthermore, one child had missing values for both gender and age and was excluded from the descriptive statistics, thus leaving a total of 327 children for these analyses. In the 2014 sample, a total of 28 had missing values on gender. These were likewise retained in the analyses that were not run

Table 2. Principal Component Analysis with Varimax rotation for teacher ratings of the Strengths and Difficulties Questionnaire for the 2007 sample of children with hearing impairment

2007 Sample of 6–19-year-old children with hearing impairment					
Principal component	1	2	3	4	5
Initial Eigenvalue	7.76	2.67	2.24	1.42	1.19
Initial variance explained (%)	31.04	10.69	8.96	5.70	4.74
Extracted factors	Positive	Hyperactive	Peer	Emotional	Conduct
Hyperactivity items					
2. Restless		0.81			
10. Fidgety		0.78			
15. Distracted		0.83			
21. Reflects		0.63			
25. Attends		0.75			
Emotional items					
3. Somatic				0.74	
8. Worries				0.72	
13. Unhappy				0.73	
16. Clingy			0.54		
24. Afraid			0.57	0.40	
Conduct items					
5. Tantrum	0.52			0.44	
7. Obedient	0.50	0.41			
12. Fights	0.54				
18. Lies					0.69
22. Steals					0.82
Peer items					
6. Loner			0.75		
11. Friend			0.65		
14. Popular	0.51		0.40		
19. Bullied			0.50		
23. Oldbest			0.73		
Prosocial items					
1. Considerate	0.76				
4. Shares	0.73				
9. Caring	0.73				
17. Kind	0.70				
20. Helpout	0.64				

Note. Only factor loadings > 0.40 are shown.

on gender-specific subsamples, that is, the factor analyses and reliability analyses. However, they were excluded from the gender-specific descriptive statistics analyses leaving a total of 205 (102 girls and 103 boys) children for these analyses.

Exploratory Factor Analyses

The dimensionality of the SDQ was investigated separately for the 2007 and 2014 samples. In the 2007 sample, all items showed high initial communalities of >0.50. Six factors proved to have an Eigenvalue >1. However, based on the Scree plot, only four factors should be retained. Because the sixth factor had an Eigenvalue of only 1.016, and because only two items (both from the *Emotional scale*) had loadings >0.40 on the sixth factor, we decided to rerun two EFAs, fixing the number of factors to four and five, respectively. Neither of these two solutions were optimal, nor were they clear. Because the five-factor model was established in samples of children without hearing loss, we decided to present the data from such a five-factor solution (Table 2) and thereafter to test this model in a CFA.

In the five-factor model, the individual items fitted acceptably with their proposed scales and the factor structure was overall established (Table 2). However, the first factor, explaining 31% of the total variance, comprised the five expected Prosocial items as well as two of the five reversed items (7 and 14). However, two of the "negative" conduct items (5 and 12) also showed the highest loadings on this scale. The second factor was a *Hyperactivity* scale and the third factor comprised of the five proposed Peer problem items as well as two Emotional items. High factor loadings (>0.40) were observed for four of the five emotional items on the fourth factor. The fifth factor consisted of only two of the conduct items. The remaining three conduct items loaded highly onto the *Prosocial* scale.

For the 2014 sample, all items also showed high communalities >0.50. A total of eight factors had initial Eigenvalues greater than one. Based on the Scree plot, however, only either four or five factors should be retained for further analyses. Because factors six, seven, and eight comprised of only one or two items with factor loadings >0.40, and because they only had initial Eigenvalues between 1.002 and 1.178, it was decided to rerun the analysis twice specifying the number of factors to be four and five, respectively. Because no clear factor structure emerged from either of the analyses, it was decided to proceed with the five-factor structure, as this is already a well-established model in community samples. The five-factor structure somewhat resembled the factor structure observed in samples of children without hearing loss (Table 3). However, similarly to the 2007 sample, some overlap was observed for two of the reversed, positive items, including one of the conduct items, which loaded

Table 3. Principal Component Analysis with Varimax rotation for parent ratings of the Strengths and Difficulties Questionnaire of the 2014 sample of children with hearing impairment

2014 Sample of 4–16-year-old children with hearing impairment					
Principal component	1	2	3	4	5
Initial Eigenvalue	5.78	2.62	1.94	1.40	1.32
Initial variance explained	22.31	10.49	7.75	5.61	5.29
Extracted factors	Prosocial	Hyperactivity	Emotional	Peer problems	Conduct
Hyperactivity					
2. Restless		0.82			
10. Fidgety		0.74			
15. Distracted		0.72			
21. Reflects	0.46	0.50			
25. Attends		0.62			
Emotional					
3. Somatic			0.41		
8. Worries			0.82		
13. Unhappy			0.59		
16. Clingy			0.63		
24. Afraid			0.63		
Conduct					
5. Tantrum					0.57
7. Obedient	0.41				
12. Fights					0.61
18. Lies		0.42			
22. Steals					0.48
Peer					
6. Loner	–0.44			0.48	
11. Friend	0.63				
14. Popular				–0.85	
19. Bullied				0.65	
23. Oldbest				0.54	
Prosocial					
1. Considerate	0.64				
4. Shares	0.57				
9. Caring	0.77				
17. Kind	0.57				
20. Helpout	0.68				

Note. Only factor loadings > 0.40 are shown.

highly onto the *Prosocial* scale, and one conduct items which loaded highly onto the *Hyperactivity* scale.

Confirmatory Factor Analyses

Partly on the basis of previous research using diagnostic criteria from the ICD-10, partly on the basis of models tested in samples of children without hearing loss, and partly on the basis of the results of the EFAs, it was decided to test three measurement models using CFA. Firstly, we tested a five-factor (*hyperactivity*, *conduct*, *peer problems*, *emotional problems*, and *prosocial* scales) first-order model (Figure 1). Secondly, we decided to test a model adding two second-order *Internalizing* and *Externalizing* factors to Model 1 (Figure 2). We decided to

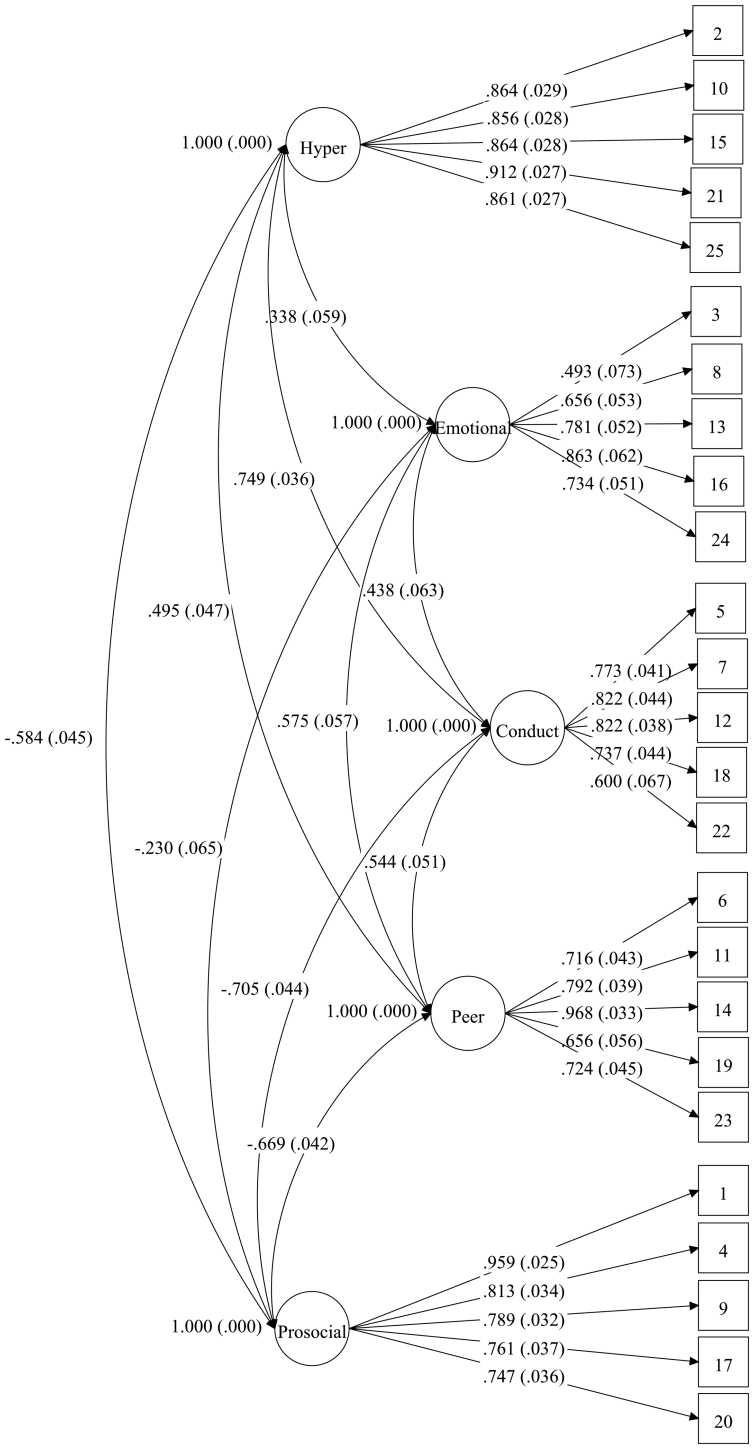

Figure 1. The three theoretical models tested with Confirmatory Factor Analysis for the two samples of children with hearing impairment. Model 1: Five-factor first-order model.

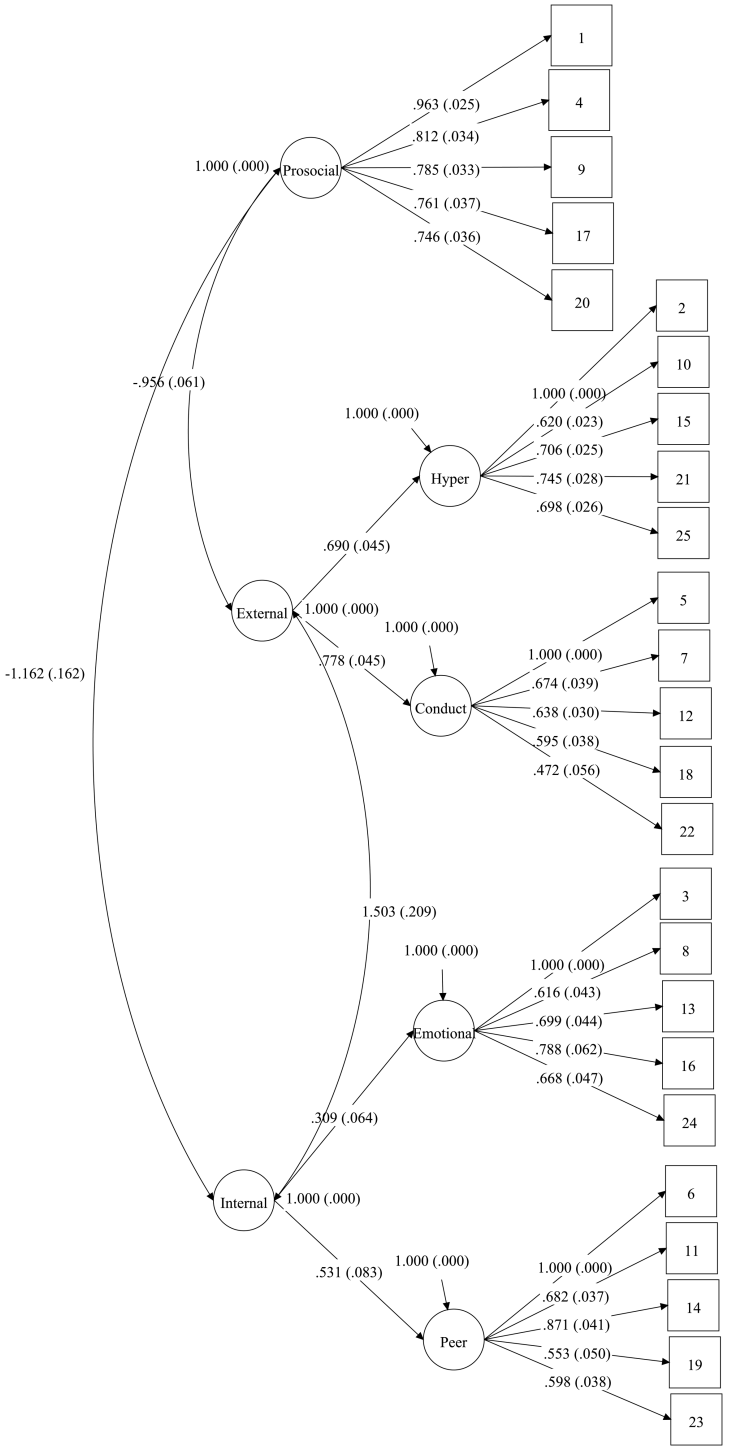

Figure 1. *Continued*
Model 2: Two-factor Externalizing/Internalizing second-order model.

test these two models in part because they have previously been found to show superior model fits in a large-scale sample of Danish normally hearing children and because they were considered theoretically meaningful (Niclasen et al., 2013). The third model adds a *Total Difficulties* second-order factor to Model 1 (Figure 3). This model has been found to be inferior to Models 1 and 2 in a study among Danish children without hearing loss. However, it was tested here because it is the model that is most often applied for research purposes.

For the 2007 sample, Model 1 initially showed acceptable model fits (Table 4). In order to improve the model, we allowed for two cross-loadings between item 14 and the *Conduct* factor, and item 21 and the *Prosocial* factor. These cross-loadings were based on the modification indices and were included because they were considered theoretically meaningful. These resulted in slightly improved model fits (Table 4). Model 2 and Model 3 initially showed unacceptable overall model fits and several factor loadings were >1. We

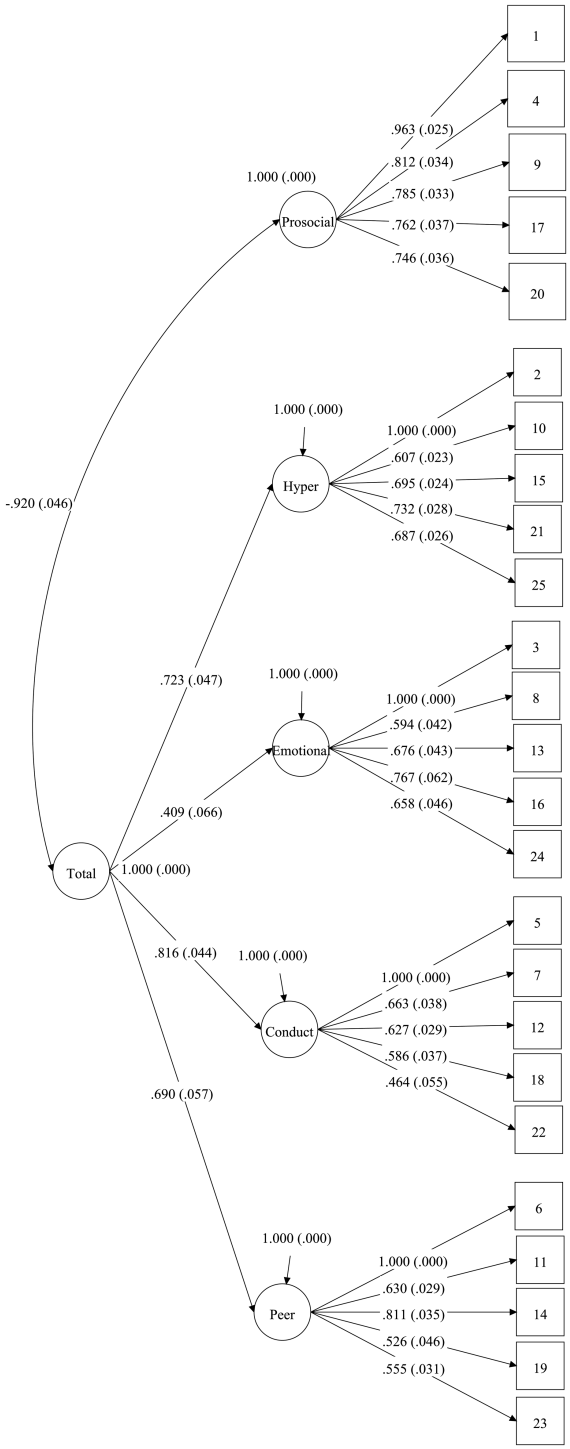

Figure 1. *Continued*
Model 3: One-factor total difficulties second-order model.

allowed for modifications of both models, which resulted in somewhat better model fits. However, we were not able to fully fix the models, that is, the model was nonidentified/nonconvergent models.

For the 2014 sample, Model 1 initially showed unacceptable fits (Table 4). In order to improve the model, we only allowed for one modification because allowing for more modifications lead to problems with the residual covariance matrix. Model 2 and Model 3 both showed very poor, unacceptable fits with several factor loadings >1. Allowing modifications to the models slightly improved them, but we were not able to fully fix the models.

Scale Reliability

Scale reliability was tested by means of Cronbach's alpha (Table 5). These were calculated separately for the two samples for the

Table 4. Confirmatory Factor Analytic model fits for the Strengths and Difficulties Questionnaire teacher ratings for the 2007 sample and parent ratings for the 2014 sample

Sample	Model	Chi square	*df*	RMSEA (90% CI)	CFI	TLI
2007 sample (*N* = 327)	Model 1	760	265	0.076 (0.069–0.082)	0.928	0.919
	Model 2[a]	1,929	272	0.136 (0.131–0.142)	0.761	0.736
	Model 3[a]	1,840	274	0.132 (0.127–0.138)	0.774	0.752
2014 sample (*N* = 233)	Model 1	742	265	0.088 (0.080–0.095)	0.776	0.746
	Model 2[a]	1,036	272	0.110 (0.103–0.117)	0.641	0.604
	Model 3[a]	1,016	274	0.108 (0.101–0.115)	0.651	0.618

Note. CFI = Comparative Fit Index; CI = confidence interval; *df* = degrees of freedom; RMSEA = root mean square error of approximation; TLI = Tucker-Lewis Fit Index.
[a]Model fits after fixing the internalizing/externalizing and total difficulties factors to 1.

Table 5. Cronbach's alpha reliability testing

	2007 sample (*N* = 328)	2014 sample (*N* = 233)
Rater	Teacher	Parent
Hyperactivity	.88	.80
Conduct	.76	.52
Emotional	.74	.67
Peer problems	.80	.50
Prosocial	.85	.73
Externalizing	.87	.79
Internalizing	.82	.69
Total difficulties	.88	.80

Note. Teacher-rated Strengths and Difficulties Questionnaire (SDQ) score for the 2007 sample and parent-rated SDQ score for the 2014 sample.

Hyperactivity, *Conduct*, *Emotional*, *Peer problems*, *Prosocial*, *Externalizing*, *Internalizing*, and *Total Difficulties* scales. Notwithstanding the fact that the individual SDQ scales only comprised five items, all scale reliabilities were considered satisfactory to good (ranging from 0.50 to 0.88 for the individual subscales). Reliabilities were in general observed to be higher for the 2007 sample compared to the 2014 sample.

Mean Scores

The mean scores of the samples of D/HH children were compared to data from the ABC comprising SDQ information from both parents and teachers. The exact mean age of the community sample was not known but consisted of 10–12-year-old children. The mean age of the 2014 sample (9.8 years) was thus presumably marginally lower than that for the hearing sample, whereas the mean age of the 2007 sample (12.9 years) was a little higher than the hearing sample (Niclasen, 2013).

Table 6 shows that the mean scores for the four individual *problem* scales for the full 2007 sample and for boys and girls alike were approximately twice the mean scores for the comparable cohort of children without hearing loss (all significantly different at $p < .001$ level). Likewise, large significant differences in mean scores between boys and girls were observed on all scales except for the *Emotional* and *Internalizing* scales (data not shown).

All *problem* scale scores for the full 2014 sample and for boys and girls were also significantly different ($p < .05$) from the mean scores for the comparable cohort sample of children without hearing loss (Table 7). However, no significant differences were observed for boys and girls in independent samples *t* tests (data not shown). Because of the different informants (teacher and parent), the mean scores of the 2007 and the 2014 samples were not directly comparable.

Discussion

The first aim of the present study was to investigate the psychometric properties of the Danish parent and teacher versions of the SDQ in a sample of children with severe to profound hearing loss. The second aim was to compare mean SDQ scale scores of the two samples of children with hearing loss with mean SDQ scores in a community sample. With respect to the psychometric properties of the SDQ, a five-factor model was found to be superior in both samples of children with hearing loss. However, the factor structure was more solid and fitted data better for the 2007 sample that were rated by teachers than for the 2014 sample rated by parents. Confirming the results from previous studies (Stevenson et al., 2015), the two samples of D/HH children showed significantly higher mean scores compared to the community sample of children without hearing loss.

Factor Structure of the SDQ Among D/HH Children

In relation to the factor structure it was, in accordance with Hintermair (2007), concluded that the SDQ overall works acceptably, but not well, from an EFA perspective. Based on the Kaiser principle and the Scree plot criterion, we tested both a four- and a five-factor model for both samples. None of these models was entirely convincing. Problems were observed for the *Conduct* scale and for the reversed items loading onto the *Prosocial* scale. One explanation for this may in part be the relatively large age range (6–19 and 4–16, respectively) of children included in the two samples. Behaviors change during childhood and adolescence and this will in turn have an impact on the factor structure. As children become older an increase in mean *Internalizing* scores is observed, whereas the opposite is true for *Externalizing* behaviors (Dickey & Blumberg, 2004). For the teacher-rated 2007 sample, only two of the five Conduct items loaded highly onto the *Conduct* scale, whereas the remaining three items loaded highly onto the *Prosocial* and *Hyperactivity* scales. This finding is similar to the results from hearing samples where a greater overlap between the Hyperactivity and Conduct items has been observed for teacher ratings than for parent ratings (Niclasen et al., 2012).

Because the five-factor model has already been established in the literature, we decided to continue with this model in CFA testing. From a CFA perspective, it was concluded that a factor model defined by the five individual scales is superior and should be applied when used in samples of D/HH children. Thus, we recommend the use of the five individual scales and discourage the use of the broader *Internalizing/Externalizing* and *Total difficulties scales* in samples of children with hearing loss. This finding is similar to that of a study looking at high- and low-risk samples of children without hearing loss (Goodman et al., 2010). The latter study concluded that the broader *Internalizing/Externalizing*

Table 6. Means and *SD*s for the 2007 sample

	2007 (full)	Hear (full)		2007 (boys)	Hear (boys)		2007 (girls)	Hear (girls)	
	N = 328	N = 5,595		*n* = 178	*n* = 2,790		*n* = 149	*n* = 2,805	
SDQ scale	Teachers	Teachers	*p*	Teachers	Teachers	*p*	Teachers	Teachers	*p*
Hyperactivity	4.33 (3.28)	2.3 (2.31)	.001	5.29 (3.33)	3.02 (2.92)	.001	3.15 (2.81)	1.40 (2.01)	.001
Conduct	1.88 (2.15)	0.83 (1.37)	.001	2.26 (2.33)	1.11 (1.72)	.001	1.42 (1.83)	0.54 (1.21)	.001
Peer problems	2.72 (2.70)	1.31 (1.79)	.001	3.10 (2.85)	1.39 (1.96)	.001	2.27 (2.45)	1.23 (1.91)	.001
Emotional	2.60 (2.45)	1.37 (1.82)	.001	2.38 (2.42)	1.27 (1.92)	.001	2.88 (2.47)	1.47 (2.02)	.001
Prosocial	6.73 (2.80)	7.42 (2.18)	.001	6.25 (2.87)	6.77 (2.62)	.02	7.33 (2.59)	8.07 (2.08)	.001
Internalizing	5.32 (4.37)	2.68 (3.15)	.001	5.48 (4.47)	2.66 (3.37)	.001	5.15 (4.26)	2.70 (3.45)	.001
Externalizing	6.20 (4.87)	3.04 (3.33)	.001	7.56 (5.01)	4.13 (4.21)	.001	4.57 (4.17)	1.94 (2.88)	.001
Total difficulties	11.52 (7.80)	5.72 (5.45)	.001	13.04 (7.98)	6.80 (6.42)	.001	9.72 (7.23)	4.64 (5.34)	.001

Note. Independent sample *T* tests were used to compare this sample with a sample of children without hearing impairment from the Aarhus birth cohort (data adapted from Niclasen, 2013). SDQ = Strengths and Difficulties Questionnaire.

Table 7. Means and *SD*s for the 2014 sample for parent-rated SDQ scores

	2014 (full)	Hear (full)		2014 (boys)	Hear (boys)		2014 (girls)	Hear (girls)	
	N = 233	N = 6,559		*n* = 103	*n* = 3,322		*n* = 102	*n* = 3,237	
SDQ scale	Parents	Parents	*p*	Parents	Parents	*p*	Parents	Parents	*p*
Hyperactivity	4.33 (1.52)	2.06 (2.11)	.001	4.38 (1.50)	2.40 (2.29)	.001	4.35 (1.59)	1.72 (1.91)	.001
Conduct	1.70 (1.60)	0.94 (1.21)	.001	1.77 (1.67)	1.02 (1.28)	.001	1.50 (1.51)	0.86 (1.14)	.001
Peer problems	2.49 (1.73)	0.96 (1.58)	.001	2.57 (1.77)	1.00 (1.61)	.001	2.45 (1.70)	0.92 (1.55)	.001
Emotional	2.67 (2.44)	1.68 (1.90)	.001	2.75 (2.46)	1.60 (1.91)	.001	2.70 (2.56)	1.76 (1.90)	.001
Prosocial	8.33 (2.00)	8.49 (1.54)	.50	8.12 (2.23)	8.19 (1.69)	.70	8.60 (1.66)	8.78 (1.38)	.30
Internalizing	5.16 (3.45)	2.65 (2.94)	.001	5.32 (3.37)	2.60 (2.97)	.001	5.15 (3.60)	2.69 (2.90)	.001
Externalizing	6.03 (2.43)	2.00 (2.90)	.001	6.15 (2.38)	3.42 (3.13)	.001	5.85 (2.53)	2.58 (2.65)	.001
Total difficulties	11.20 (4.90)	5.65 (4.98)	.001	11.47 (4.63)	6.02 (5.24)	.001	11.00 (5.22)	5.27 (4.72)	.001

Note. Independent sample *T* tests were used to compare this sample with a sample of children without hearing impairment from the Aarhus birth cohort (data adapted from Niclasen, 2013). SDQ = Strengths and Difficulties Questionnaire.

scales should be applied in low-risk samples, whereas the five subscales should be retained in high-risk samples.

Comparing the individual model fits for the two investigated samples, it appears that the best fits were observed for the 2007 sample. We likewise observed higher, and thus better, scale reliability measures for the 2007 sample compared to the 2014 sample. The discrepancies might be due to the choice of informant. The children in the 2007 sample were rated by their teachers, whereas the children in the 2014 sample were rated by their parents. Teachers SDQ ratings have previously been reported to have higher scores of internal consistency (Niclasen et al., 2012) and better model fits in CFA testing (Niclasen et al., 2013) than parent ratings. Thus, on the basis of the results of the CFAs and the reliability measures, it appears that the factor structure is superior for the teacher-rating of the 2007 sample.

Comparing Mean Psychopathology Scores of Children With and Without Hearing Loss

The mean levels of mental health problems were, in both samples of children with hearing loss, found to be significantly higher than those for the community sample. This concurs with results from previous studies, which have consistently reported higher mean difficulties scores among samples of children with hearing loss (Fellinger et al., 2009; Stevenson et al., 2010, 2015). There may be several explanations for such differences. The first and simplest explanation would be that there are indeed higher levels of psychopathology among children with a hearing loss. Hearing loss in childhood can lead to a delayed language development which in turn can affect both social and academic development and mental health (Fellinger et al., 2012; Mayberry, 2003). In agreement with the present study, previous studies have also reported an increased prevalence on all problem subscales of the SDQ (Stevenson et al., 2015).

However, a second potential explanation for the large differences between the two samples of children with hearing loss and the cohort of children without hearing loss could results from the fact that the means and range of ages of the children were not entirely comparable. The mean age of the 2007 sample rated by their teachers was somewhat higher than the hearing sample, whereas the mean age for the 2014 sample rated by their parents was rather lower. The age ranges of both the 2007 and 2014 sample were much wider than the community sample which consisted of 10–12-year-old children. Previous studies of children have found that the prevalence of externalizing disorders decreases with age whereas, the prevalence of internalizing disorders increases with age. Thus, the difference in internalizing scores would be inflated for the 2007 sample, and likewise for the externalizing scores for the 2014 sample. However, because of the relative small sample size, and unknown *SD*s for the age distribution of the hearing samples, we were not able to investigate this issue further.

A third potential explanation could be that the children without hearing loss derive from a birth cohort. Being based on volunteer participation, cohorts are often characterized as being "super normal"—significantly under-representing single and young parents with low socioeconomic background, high rates of unemployment, and low educational levels. Parents of children exhibiting deviant behaviors are less likely to take part in cohort studies and are therefore underrepresented in them (Nohr, Frydenberg, Henriksen, Olsen, & 2006). For example, one Norwegian cohort-based study concluded that attention deficit hyperactivity disorder (ADHD) phenotype was twice as prevalent among nonparticipants than among participants and concluded that prevalence rates are therefore likely to be underestimated if attrition bias is not taken into account (Ullebø, Posserud, Heiervang, Obel, & Gillberg, 2012). In our study, the mean problem scores of the community sample are most likely underestimating the background population. This in turn inflates the difference in mean scores between the children with and without a hearing loss.

Mean Psychopathology Scores Among Two Samples of D/HH Children

Comparing mean scores of the two samples of children with hearing loss is somewhat more problematic because different SDQ raters were employed in the two samples. The mean scores of the two samples were indeed very similar, although the 2007 sample, rated by their teachers, had slightly higher mean scores than the 2014 sample rated by their parents, except for the *Emotional* scores. Parents and teachers are known to rate behavioral and emotional problems differently. Parents generally rate *Externalizing* behaviors as less problematic and thus have lower mean scores than do teachers (Goodman, 2001; Niclasen et al., 2012). Thus, when the type of informant is taken into account, this is what is expected. The findings suggest that there are no significant differences in mean scores between the two samples, indicating that the levels of difficulties among the two groups do not differ. This finding stands in contrast to studies reporting superior mental health among children with CI and in mainstream settings (most of the children in the 2014 sample) compared to D/HH children without CI and in deaf school settings (a majority of the children in the 2007 sample). Some studies report that the mental health of children with CI is close to the "normal" level of children without a hearing loss (Huber & Kipman, 2011; Theunissen et al., 2014). That the 2014 sample was a national sample including all children with a hearing loss and not merely a CI sample may explain why we did not find this to be the case. No conclusion on specific variables (CI, mainstreaming or language modality) can be drawn comparing the two included samples of D/HH children based on national surveys. What can be concluded, however, is that both samples of children with severe to profound hearing loss experience a higher risk of mental health problems compared to children without hearing loss irrespective of the choice of informant.

Conflict of Interest

No conflicts of interest were reported.

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References

Bengtsson, S., Larsen, L. B., & Sommer, M. L. (2014). *Døvfødte børn og deres livsbetingelser [Congenital deaf children and their life conditions]*. Copenhagen, Denmark: SFI - Danish Social Research.

Bøttcher, L., & Dammeyer, J. (2013). Disability as a risk factor? Development of psychopathology in children with disabilities. *Research in Developmental Disabilities*, 34, 3607–3617. doi:10.1016/j.ridd.2013.07.022

Byrne, B. M. (2013). *Structural equation modeling with Mplus: Basic concepts, applications, and programming*. New York, NY: Routledge.

Cosetti, M. K., & Waltzman, S. B. (2012). Outcomes in cochlear implantation: Variables affecting performance in adults and children. *Otolaryngologic Clinics of North America*, 45, 155–171. doi:10.1016/j.otc.2011.08.023

Dammeyer, J. (2010). Psychosocial development in a Danish population of children with cochlear implants and deaf and hard-of-hearing children. *Journal of Deaf Studies and Deaf Education*, 15, 50–58. doi:10.1093/deafed/enp024

Danish Health and Medicine Authority. (2010). *Kliniske retningslinjer for pædiatrisk cochlear implantation i Danmark - udredning, operation, efterbehandling og monitorering [Clinical guidelines for pediatric cochlear implantation in Denmark - assessment, surgery, and follow up]*. Copenhagen, Denmark: National Board of Health. Retrieved August 24, 2015 from http://sundhedsstyrelsen.dk/da/udgivelser/2012/kliniske-retningslinjer-for-paediatrisk-cochlear-implantation-i-danmark#.

Dickey, W. C., & Blumberg, S. J. (2004). Revisiting the factor structure of the Strengths and Difficulties Questionnaire: United States, 2001. *Journal of the American Academy of Child and Adolescent Psychiatry*, 43, 1159–1167. doi:10.1097/01.chi.0000132808.36708.a9

Fellinger, J., Holzinger, D., Beitel, C., Laucht, M., & Goldberg, D. P. (2009). The impact of language skills on mental health in teenagers with hearing impairments. *Acta Psychiatrica Scandinavica*, 120, 153–159. doi:10.1111/j.1600-0447.2009.01350.x.

Fellinger, J., Holzinger, D., & Pollard, R. (2012). Mental health of deaf people. *Lancet*, 379, 1037–1044. doi:10.1016/S0140-6736(11)61143-4.

Field, A. (2009). *Discovering statistics using SPSS*. London, UK: SAGE.

Goodman, R. (2001). Psychometric properties of the Strengths and Difficulties Questionnaire. *Journal of the American Academy of Child & Adolescent Psychiatry*, 40, 1337–1345. doi:10.1097/00004583-200111000-00015.

Goodman, A., Lamping, D. L., & Ploubidis, G. B. (2010). When to use broader internalising and externalising subscales instead of the hypothesised five subscales on the Strengths and Difficulties Questionnaire (SDQ): Data from British parents, teachers and children. *Journal of Abnormal Child Psychology*, 38, 1179–1191. doi:10.1007/s10802-010-9434-x

Heiling, K. (1995). *The development of deaf children, academic achievement levels and social processes*. Hamburg, Germany: Gallaudet University Press.

Hindley, P. A. (2000). Child and adolescent psychiatry. In P. A. Hindley & N. Kitson (Eds.), *Mental health and deafness* (pp. 42–74). London, UK: Whurr.

Hintermair, M. (2007). Prevalence of socioemotional problems in deaf and hard of hearing children in Germany. *American Annals of the Deaf*, 152, 320–330. doi:10.1353/aad.2007.0028.

Huber, M., & Kipman, U. (2011). The mental health of deaf adolescents with cochlear implants compared to their hearing peers. *International Journal of Audiology*, 50, 146–154. doi:10.3109/14992027.2010.533704

Knoors, H., & Marschark, M. (2014). *Teaching deaf learners: Psychological and developmental foundations*. New York, NY: Oxford University Press.

Mayberry, R. I. (2003). Cognitive development in deaf children: The interface of language and perception in neuropsychology. In S. J. Segalowitz & I. Rapin (Eds.), *Handbook of neuropsychology* (Vol. 8, pp. 487–523). Amsterdam, the Netherlands: Elsevier.

Niclasen, J. (2013). *Prenatal exposure to alcohol and behavioural and emotional development at age seven assessed by the Strengths and Difficulties Questionnaire (SDQ) – an investigation of the psychometric properties of the SDQ and empirical results from a large-scale cohort study* (Doctoral dissertation). University of Copenhagen, Copenhagen, Denmark.

Niclasen, J., Skovgaard, A. M., Andersen, A. M., Sømhovd, M. J., & Obel, C. (2013). A confirmatory approach to examining the factor structure of the Strengths and Difficulties Questionnaire (SDQ): A large scale cohort study. *Journal of Abnormal Child Psychology*, 41, 355–365. doi:10.1007/s10802-012-9683-y

Niclasen, J., Teasdale, T. W., Andersen, A. M., Skovgaard, A. M., Elberling, H., & Obel, C. (2012). Psychometric properties of the Danish Strength and Difficulties Questionnaire: The SDQ assessed for more than 70,000 raters in four different cohorts. *PLoS One*, 7, e32025. doi:10.1371/journal.pone.0032025

Nohr, E. A., Frydenberg, M., Henriksen, T. B., & Olsen, J. (2006). Does low participation in cohort studies induce bias? *Epidemiology*, 17, 413–418. doi:10.1097/01.ede.0000220549.14177.60.

Obel, C. (2003). *Stress during pregnancy and fetal brain development* (Doctoral dissertation). Aarhus University, Aarhus, Denmark.

Palmieri, P. A., & Smith, G. C. (2007). Examining the structural validity of the Strengths and Difficulties Questionnaire (SDQ) in a U.S. sample of custodial grandmothers. *Psychological Assessment*, 19, 189–198. doi:10.1037/1040-3590.19.2.189

Preisler, G. (1999). The development of communication and language in deaf and severely hard of hearing children: Implications for the future. *International Journal of Pediatric Otorhinolaryngology*, 49(Suppl. 1), S39–S43. doi:10.1016/S0165-5876(99)00130-5.

Schreiber, J. B., Nora, A., Stage, F. K., Barlow, E. A., & King, J. (2006). Reporting structural equation modeling and confirmatory factor analysis results: A review. *The Journal of Educational Research*, 99, 323–338. doi:10.3200/JOER.99.6.323-338.

Stevenson, J., Kreppner, J., Pimperton, H., Worsfold, S., & Kennedy, C. (2015). Emotional and behavioural difficulties in children and adolescents with hearing impairment: A systematic review and meta-analysis. *European Child & Adolescent Psychiatry*, 24, 477–496. doi:10.1007/s00787-015-0697-1

Stevenson, J., McCann, D., Watkin, P., Worsfold, S., & Kennedy, C. (2010). The relationship between language development and behaviour problems in children with hearing loss. *Journal of Child Psychology and Psychiatry*, 51, 77–83. doi:10.1001/jamapediatrics.2013.3974.

Swanwick, R., Dammeyer, J., Hendar, O., Kristoffersen, A., & Salter, J. (2014). Shifting contexts and practices in sign bilingual education in northern Europe. In M. Marschark, H. Knoors, & G. Tang (Eds.), *Bilingualism and bilingual education* (pp. 465–494). New York, NY: Oxford University Press.

Theunissen, S. C., Rieffe, C., Kouwenberg, M., Soede, W., Briaire, J. J., & Frijns, J. H. (2011). Depression in hearing-impaired children. *International Journal of Pediatric Otorhinolaryngology*, 75, 1313–1317. doi:10.1016/j.ijporl.2011.07.023

Theunissen, S. C., Rieffe, C., Netten, A. P., Briaire, J. J., Soede, W., Schoones, J. W., & Frijns, J. H. (2014). Psychopathology and its risk and protective factors in hearing-impaired children and adolescents: A systematic review. *JAMA Pediatrics*, 168, 170–177. doi:10.1001/jamapediatrics.2013.3974

Ullebø, A. K., Posserud, M. B., Heiervang, E., Obel, C., & Gillberg, C. (2012). Prevalence of the ADHD phenotype in 7- to 9-year-old children: Effects of informant, gender and non-participation. *Social Psychiatry and Psychiatric Epidemiology*, 47, 763–769. doi:10.1007/s00127-011-0379-3