Children's Glasgow Sensory Questionnaire (C-GSQ): Validation of a Simplified and Visually Aided Questionnaire for Quantifying Sensory Reactivity in Children

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Abstract

This study aimed to validate an adaptation of the Glasgow Sensory Questionnaire (GSQ) – an adult self-report measure of sensory reactivity – intended for use with children aged between 8 and 11. Initially, 234 children filled out this adapted questionnaire with visual comprehension aids, while their caregivers completed the Autism Spectrum Quotient: Children's Version. A second study was conducted with 156 child-caregiver dyads filling out the Children's and Caregiver versions of the GSQ, as well as the Children's Autism Spectrum Quotient (AQ-Child). The results found that the Children's Glasgow Sensory Questionnaire (C-GSQ) had good internal reliability. However, the C-GSQ factor structure was different from what was observed in adults and both studies found a significant but surprisingly small correlation between C-GSQ and AQ-Child scores. Additionally, the correlation between caregiver reports of sensory reactivity and autistic traits was found to be more similar to results from adults. This discrepancy between self-report and caregiver-report may have implications for the interpretation of previous data on sensory reactivity in children.

Keywords: Autism, Sensory, Children, Caregivers, Questionnaire

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Many sensory environments are experienced differently by autistic people than neurotypical people. Some of these experiences are more positive, such as the soothing from stimming. Others are more negative, for example, physical pain from the ringing of a fire bell. Differences can be found in both the interoceptive and exteroceptive senses, with the percept of any given sense potentially being both more and less intense at the same time (Robertson & Simmons, 2013). These differences can then be expressed behaviourally as increased avoidance or seeking of stimuli compared to a neurotypical person (Dunn, 2002).

Sensory processing differences can be separated into sensitivity, reactivity, and responsivity (He et al., 2022). While these terms have previously been used interchangeably, it has been argued that sensitivity should only refer to the early processing in the sensory cortices, while reactivity and responsivity should refer to the emotional and behavioural responses to a stimulus (Schulz & Stevenson, 2019). This distinction means that there can sometimes be a disconnect between stimulus and response. For example, an adverse sound may not lead to a reaction due to camouflaging or someone may become distressed in anticipation of a sound that has not yet presented itself. Depending on the exact questions used, it is thought that self-report measures are more likely to be capturing sensitivity and reactivity, while parent/caregiver or clinician-report are more likely to be reporting responsivity (Schulz & Stevenson, 2019). As this paper is looking at the self-reports of children, it will be focussing on sensory *reactivity*.

These sensory processing differences can make life difficult for autistic people when not properly supported. Not only are sensory features prominent in narratives of the autistic experience (Grandin, 1992), but they have also been linked to poorer educational outcomes (Ashburner et al., 2008), higher anxiety (Green & Ben-Sasson, 2010), and greater social difficulties (Thye et al., 2018). In settings such as schools or the workplace where there is little control over the sensory environment, autistic people can be distracted, debilitated, and distressed (Jones et al., 2020; Robertson & Simmons, 2015). Based on these findings, it

is clear that a better understanding and identifications of sensory needs will help autistic people lead more fulfilling lives.

Autism can be conceptualised as a continuum, with any individual encompassing a unique selection of autistic traits. This variation throughout the general population has been identified in many aspects of autism. Sensory issues are no exception to this, with several studies reporting subclinical levels of sensory reactivity in non-autistic participants (Mayer, 2017; Robertson & Simmons, 2013). The Adult Autism Spectrum Quotient (Baron-Cohen et al., 2001) is widely used as a measure of levels of autistic traits in both autistic and non-autistic populations. High levels of traits have been associated with several typical autistic features including clumsiness (Moruzzi et al., 2011) and biological motion perception (Burling et al., 2019). These findings would suggest that not only is the study of the general population useful for research of autistic traits, but also that research into the sensory issues associated with autism would be beneficial for more than just diagnosed groups.

There are several measures which aim to capture sensory processing patterns in autism, the most prominent of which is the Sensory Profile (Dunn, 1999) and its subsequent adaptions such as the Infant/Toddler Sensory Profile (Dunn, 2002). The SP uses 125 questions assigned to six sensory categories (audition, vision, touch, taste/smell, movement, and body position/touch) and two behavioural categories (Kientz & Dunn, 1997). It should be noted that while emotional/social and activity levels affect sensory processing, they are not generally considered part of basic sensory processing (Tavassoli et al., 2014). This may limit the construct validity of a tool aiming to measure sensory experiences. Furthermore, there is some inconsistency in the predictive validity of the SP. The pupillary light reflex constriction reflex has been successfully correlated with the SP (Daluwatte et al., 2015), while in a study of EEG indices of sensory sensitivities were instead better predicted by autism symptom severity (Brandwein et al., 2015).

To address these issues, the Sensory Perception Quotient (SPQ) was developed by Tavassoli et al. (2014). The SPQ is a 92-item questionnaire which consists of specific hypothetical experiences exploring sensory processing sensitivities across the five classic modalities (Auditory, Olfactory, Taste, Touch, and Visual). The SPQ has shown excellent internal consistency and is able to discriminate between groups of participants with and

without ASD (Tavassoli et al., 2014). Unfortunately, by limiting itself to these five modalities, the SPQ misses some of the sensory experiences of autistic people.

A notable sense for autism research is proprioception. Several studies have found differences in autistic children relative to non-autistic people (Ament et al., 2015; Wada et al., 2014), while parents of autistic children have reported repetitive movements such as spinning and jumping (Dickie et al., 2009). This suggests that proprioception is affected in autistic individuals and may be important for describing their sensory experiences.

The Glasgow Sensory Questionnaire (GSQ) measures seven sensory modalities – vision, audition, touch, olfaction, gustation, proprioception, and the vestibular sense. Each of these modalities is separated into hyper- and hypo-sensitivities. The original study by Robertson & Simmons (2013) found that these effectively measured the sensory experiences of their participants.

Since its publication, the GSQ has been validated in several different languages and is consistently shown to be correlated with autistic traits (Sapey-Triomphe et al., 2018; Takayama et al., 2014). These findings were also replicated in a study by Horder et al. (2014) in a comparison study also using the Adolescent/Adult Sensory Profile (AASP; Brown & Dunn, 2002) and the Cardiff Anomalous Perception Scale (CAPS; Bell et al., 2006). Mayer (2017) then built on these studies to examine the relationships between the subscales of the Autism Spectrum Quotient (AQ) and GSQ. They found significant correlations between nearly all subscales except Attention to Detail and Imagination. Given the consistency of these results, it would be expected that these findings generalise to both clinical and non-adult populations.

The SP, SPQ, and GSQ are all measures of adult sensory experiences, however, it is equally important to investigate the sensory experiences of children. It has been suggested that both non-autistic and autistic children are unable to provide valid and reliable responses to survey questions for a variety of reasons including difficulties engaging with the measures and a lack of insight into their cognitions (Ozsivadjian et al., 2014; Upton et al., 2008). As such, parental/caregiver report has been the primary means of measuring sensory sensitivities in children, examples of which include the Infant/Toddler Sensory Profile (Dunn, 2002) and the Sensory Experiences Questionnaire (Baranek et al., 2006). While

the input of parents can be insightful, there are also problematic elements. Some parents can be confused by the concept of a sensory experience and what would constitute such an experience (Dickie et al., 2009). It has been further argued that consulting with the child directly can reveal information that would otherwise be missed if only the parent is consulted, especially regarding their subjective feelings and experiences (Soffer & Ben-Arieh, 2014). This study therefore aims to develop and validate a measure of sensory sensitivities for children that is compatible with research in adults.

To maximise the effectiveness of any questionnaire aimed at children, certain adaptions should be made. Most importantly the language should be appropriate for the cognitive skills of the target population, which varies between different age groups. When items are well within the reading ability of the child, they respond with similar levels of reliability to adults (Dworsky, 2014). Similarly, when questions are too difficult for children, they are more likely to provide item non-responses or random responses (Borgers et al., 2000). Another consideration is the type of response option, with Franc et al. (2018) finding that using frequencies with as few options as possible is the most effective. If measures are designed while considering the requirements of the target age group, children can provide both valid and reliable reports of their internal states.

The aim of this paper is to construct a children's self-report measure of sensory reactivity by adapting the established Glasgow Sensory Questionnaire. The first study in this manuscript will validate this measure by confirming its relationship with the children's version of the AQ and establishing its factor structure. The following second part will further explore the relationship between the adult and child adaptions of the Glasgow Sensory Questionnaire.

Study 1

Methods

Participants

The participants of this study consisted of 234 children aged between 7 and 15 years (mean = 10.13, SD = 1.91) as well as their parents/caregivers. The participants were recruited as part of an educational workshop which took place at a local hands-on science museum. The workshop included activities exploring the senses including prism glasses,

'feely boxes', and a smell identification challenge. No incentives outside of the workshop were offered for participation in the study. 149 (64%) of the participants identified as female and 85 (36%) as male. The majority of the participants lived in the local metropolitan area (60%). 14 dyads started the questionnaires before withdrawing, indicating a completion rate of 94%.

Measures

Autism Spectrum Quotient: Children's Version (AQ-Child). The AQ-Child is an adaption of the Autism Spectrum Quotient (Baron-Cohen et al., 2001) designed for caregivers to report on the autistic traits of their children (Auyeung et al., 2008). The questionnaire uses 50 items which are divided into 5 subscales: social skills, attention switching, attention to detail, communication, and imagination. Participants respond to each item using a four-point Likert scale ranging from Definitely Disagree to Definitely Agree. As recommended in Auyeung et al. (2008), rather than using the binary scoring system of the adult version, this study scored responses between 0 and 3, meaning that scores range between 0 and 150. If a participant scores above 76, it is likely that they would be diagnosed as autistic.

Children's Glasgow Sensory Questionnaire (C-GSQ). The C-GSQ is an adapted version of the Glasgow Sensory Questionnaire (GSQ) as developed by Robertson & Simmons (2013). The GSQ contains 42 closed questions assessing the frequency of different sensory experiences and is scored according to a five-point Likert scale ranging from 1 (Never) to 5 (Always). These items equally cover hyper- and hypo- sensitivities of each of the seven modalities. In the process of adapting the GSQ for children, each of the questions were assessed for simplicity and contextual appropriateness for children and modified accordingly. Secondly, a series of cartoon-style visual aids were developed for each of the questions to aid the child's understanding and for the researchers to better explain. Finally, the Likert scale was modified so that the options for 2 (Rarely) and 4 (Often) were left blank, prompting the researchers to explain the significance of these options to the children. Further details about the construction of the questionnaire can be found in the supplementary materials.

Procedure

Ethical approval was obtained from the Ethics Committee of the University of Glasgow College of Science and Engineering and informed consent and assent were collected from participants prior to data collection. The parent/caregiver was given a paper copy of the AQ-Child to complete, while the children were given the C-GSQ. The experimenters went carefully through the example questions with the children to ensure that they understood the question styles and what was expected of them. All participants were encouraged to ask the researchers for assistance throughout. The participants were debriefed upon completion of their questionnaire. Children who finished first were then directed toward the activities taking place in the workshop while their caregiver completed their questionnaire.

Results

Principal Component Analysis

The underlying structure of the C-GSQ was investigated using a Principal Component Analysis (PCA) with an 'Oblimin' rotation. This rotation allows for the components to be correlated, rather than orthogonal. This is reasonable to assume given that previous research has shown that different sensory sensitivities are correlated with each other (Robertson & Simmons, 2013). A visual inspection of the scree plot indicated that the optimal number of components was 5. This solution was found to account for 32% of the total variance of C-GSQ scores. The item loadings can be found in table 1.

A visual inspection of the loadings indicates some trends, such as the prominence of sensory hypersensitivities in the second component and olfactory in the fourth component. However, the key takeaway message is that the solution is more complex than those observed for the adult GSQ (Robertson & Simmons, 2013) and the Sensory Profile Questionnaire (Tavassoli et al., 2014), both of which found a single highly explanatory component.

Internal Reliability

The C-GSQ was found to have a moderate reliability with a Cronbach's α of 0.84, with no improvements from removing any items.

Relationship with Autistic Traits

The overall C-GSQ score was significantly correlated with AQ-child scores ($r = 0.14$, $df = 232$, $p = 0.031$), indicating some relationship between level of autistic traits and personal experiences of sensory sensitivities. This is visualised in figure 1.

[Figure 1]

Relationship with Age

There was no significant correlation between age and C-GSQ score ($r = 0.04$, $df = 232$, $p = 0.54$), with the distributions of scores by age shown in figure 2. This suggests there is no effect of age and its correlates on self-reported sensory reactivity, including reading ability.

[Figure 2]

Study 2

Methods

Participants

In the power analysis conducted for this study's pre-registration, the aim was set to recruit 300 caregiver-child dyads. However, data collection was ended early in late 2020 as a consequence of restrictions connected to the COVID-19 pandemic. In the end, data were collected from 170 dyads with the children completing the C-GSQ and their caregivers completing the AQ-child and P-GSQ. Of these, 165 children completed the C-GSQ and 156 caregivers completed both the AQ-child and P-GSQ. The participants were recruited as part of an educational workshop that took place in a science museum, schools, and community groups. The mean age of the children was 9.98 ($SD = 1.87$) and ranged between 6 and 16. 107 of the children were male and 63 were female. No other demographic information was recorded about the participants.

Measures

Parents Glasgow Sensory Questionnaire (P-GSQ). The P-GSQ is also an adaption of the Glasgow Sensory Questionnaire, however, it is aimed at the caregivers of children. Developed by Smees et al. (2020), the original questions were adjusted, as well as adding one additional question to the hypersensitive proprioception subscale. Items and subscales are structured in the same way as the C-GSQ.

Procedure

Ethical approval was given by the University of Glasgow Science and Engineering ethics committee. Informed consent was obtained from the caregiver and assent from the child before their participation. The caregiver was then asked to fill out the AQ-child and P-GSQ in reference to their child. Meanwhile, the experimenters directed the child on how to fill out the C-GSQ and helped them with any questions they struggled with. In a change to the previous procedure from Study 1, the child and caregiver were deliberately separated when filling out their questionnaires to avoid either side from influencing the other. Once the children had finished their questionnaires, they were invited to take part in the activities of the sensory workshop. If more than 10% of a participant's data on a questionnaire was missing, that questionnaire was excluded from the analysis.

Results

Pre-registered Analyses

Internal Reliability. The C-GSQ was found to have a moderate reliability with a Cronbach's α of 0.87. Both the P-GSQ and AQ-Child had excellent internal reliability with α of 0.93 and 0.91 respectively.

Correlations Between Questionnaires. The data were visually inspected and deemed sufficiently normal for parametric tests given the sample size. The caregiver version of the GSQ was significantly correlated with both the AQ-Child ($r = 0.47$, $df = 152$, $p < 0.001$) and the child-report version of the GSQ ($r = 0.23$, $df = 150$, $p = 0.02$). There was not a significant correlation between the AQ-Child and the C-GSQ ($r = 0.04$, $df = 157$, $p > 0.99$). All p-values were modified using a Bonferroni correction for multiple comparisons.

Exploratory Analyses

Measurement Invariance. The single-factor model had an acceptable fit. The best fitting model was found to be where factor loadings were invariant, but intercepts and means were not. For model fit statistics, refer to table 3.

[Table 3]

Item-Specific Comparison. Children self-reported an average score of 53.7 on the C-GSQ, while caregivers reported an average score of 36.5 for their child on the P-GSQ. This difference was statistically significant ($t(151) = 8.22$, $p < 0.001$) and was equivalent to an increased score of 0.41 per item when self-reporting. For each item completed by both caregiver and child, the difference between their responses was calculated. The mean differences by item are shown in figure 4. Of particular note was question 17 – 'Are you ever told by others that you put too much bubble bath in the bath because you like the smell' - where children were less likely to agree with the statement than their caregivers.

[Figure 4]

Caregiver/Child disagreement across autistic traits. The difference between caregiver and child-report scores was calculated by subtracting each child's P-GSQ score from their C-GSQ score. This difference was found to be significantly negatively correlated with AQ-Child score ($r = -0.32$, $df = 148$, $p < 0.001$). This relationship is visualised in figure 5.

[Figure 5]

Influence of Age. A multiple linear regression was used to test whether age, GSQ type, or the interaction between the two predicted overall GSQ scores. Dummy coding was used for the questionnaires, with self-report being used as the baseline. The coefficient estimates of this model can be found in table 3. The overall model was found to be statistically significant (adjusted $R2 = 0.17$, $F(3, 314) = 22.98$, $p < 0.001$). A visual representation of the findings can be seen in figure 6.

[Figure 6]

Discussion

The first study investigated the validity of the Children's Glasgow Sensory Questionnaire (C-GSQ), a self-report measure of sensory reactivity in children. A principal components analysis found a five-component solution was the optimal configuration. The C-GSQ was found to have good internal consistency. The C-GSQ was found to have a significant but surprisingly weak correlation with the AQ-child. It was also found that C-GSQ scores were not correlated with age.

The second study followed these results and compared the responses of children and caregivers to adaptions of the Glasgow Sensory Questionnaire. As part of the pre-registered analyses, it was found that the AQ-child significantly correlated with the caregiver-report P-GSQ. In contrast, it was found that C-GSQ and P-GSQ significantly correlated, but only weakly, while no significant correlation was identified between the C-GSQ and the AQ-Child. The exploratory analyses suggested that both the children and their caregivers were addressing the same underlying concept when completing their questionnaires, but their responses to questions seem to be systematically higher. Finally, it was also found that scores from caregivers increased with age, while self-reported sensory sensitivities remained consistent.

The small correlation between the C-GSQ and AQ-child was surprising given the large correlation coefficients recorded between the AQ and adult versions of the GSQ, including 0.78 in Robertson & Simmons (2013), 0.48 in Horder et al., (2014), and 0.81 in Sapey-Triomphe et al. (2018). However, the correlation between caregiver reports of autistic traits and sensory sensitivities is more similar to the adult literature and closer to what

would be expected given research conducted on diagnosed autistic children (Tomchek & Dunn, 2007).

Given these results, it could be argued that there is no value in asking children about their sensory experiences. In the exploratory analyses, it was found that higher levels of caregiver-reported autistic traits were associated with less disagreement between child- and caregiver-report measures of sensory sensitivities. A possible explanation for this is that the children were not responding to the questionnaires as we would expect, meaning that the questionnaires converge as their sensory sensitivities increase and are reported by their caregivers. As autistic traits in children have been associated with alexithymia (difficulty identifying and describing one's own emotions; Griffin et al., 2016), children with more autistic traits and sensory sensitivities may be less likely to be aware of and report them.

Yet, this is not necessarily the case. The measurement invariance analysis indicates that the responses from both the caregivers and children correspond to a similar factor structure and are therefore measuring a comparable latent variable. There is also the question about the effect of age. Previous studies using longitudinal data have found that non-autistic children have fewer sensitivities over time, while autistic children have more stable sensory issues (Dwyer et al., 2020; McCormick et al., 2016). Neither caregiver- nor self-report data matched this trend, though these data were cross-sectional.

A possible explanation for what has been observed is that children experience relatively stable sensory processing difficulties as they get older in this age range. As caregivers are imperfect observers of their child's behaviour (Soffer & Ben-Arieh, 2014), it is possible that they are not responding to changes in their child's sensory functioning, but instead their greater ability to verbalise their sensory experience. It has also been previously

noted that there is a disconnect between caregiver-report questionnaires and experimenter-observed behaviour, leading Schulz & Stevenson (2019) to posit that caregivers respond to their child's sensory reactivity, while behavioural tasks capture sensory sensitivity.

If this conclusion is correct, then methods relying solely on caregiver-report measures of sensory differences are introducing unexpected measurement error and may be capturing phenomena unrelated to sensory processing. For example, rather than representing their younger child's sensory experience, the caregiver's scores may instead represent the caregiver's attentiveness or anxiety regarding their child's well-being. This paper does not intend to suggest that caregiver-reports be discarded, but instead to be used carefully and ideally in concert with other measures.

Limitations

There are a few limitations to this study relating to the data collection. Firstly, the participants were primarily recruited in a busy location for which there was an entrance fee, meaning that the dyads were likely skewed to be more affluent than average. This is notable given disparities in the presentation and experience of both autism and sensory processing difficulties across socioeconomic divides (Chou et al., 2015; Roman-Urrestarazu et al., 2021), potentially leading to a result which is less representative of the wider population. The relatively sensorily adverse environment of a busy "hands-on" science museum was also likely to discourage children with sensory difficulties and anxious parents, as well as being a distraction while completing the questionnaires. However, the high completion rate of the measures suggests that participants were motivated and engaged throughout, potentially because of the desire to take part in the sensory workshop.

Partway through data collection in Study 1, it was noticed that, in an attempt to assist their child with completing their questionnaire, some caregivers were influencing their child's answers. As this only affected a small number of items per child and resulted in small changes to the answers, none of these responses were excluded. In Study 2, measures were taken to eliminate this possibility by separating caregiver and child during questionnaire completion.

Conclusions

The C-GSQ seems to be a valid measure of sensory sensitivities in children. While caregiver-report of autistic traits was only weakly related to child-report of sensory reactivity, both questionnaires seem to be capturing the same concept. Future work could look to include more autistic children to see how they feel about their own senses. The C-GSQ could also be digitised to allow for animations and improved reading comprehension.

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Tables

Table 1

C-GSQ Principal Components Analysis Loadings

Item	1	2	3	4	5	Modality	Hyper/Hypo
1			0.33		0.27	Tactile	Hyper
2		0.52				Gustatory	Hyper
3		0.28	-0.36			Proprioception	Hypo
4	0.34		0.37			Visual	Hypo
5				0.37		Proprioception	Hypo
6		0.50				Auditory	Hyper
7			0.33	0.30	-0.27	Olfactory	Hypo
8	0.53	0.28				Visual	Hyper
9	0.39					Auditory	Hypo
10	0.58					Vestibular	Hyper
11			0.46			Visual	Hyper
12			0.50			Vestibular	Hypo
13		0.55				Olfactory	Hyper
14	0.30		-0.26	0.25		Auditory	Hypo
15		0.28	0.28	-0.44	0.30	Tactile	Hyper
16			0.35			Tactile	Hypo
17				0.66		Olfactory	Hypo
18	0.58					Visual	Hyper
19				0.49		Visual	Hypo
20	0.26		0.43			Vestibular	Hypo
21		0.49				Olfactory	Hyper
22		0.32	0.52			Tactile	Hyper
23		0.51				Gustatory	Hyper
24				0.37		Olfactory	Hyper
25		0.35				Auditory	Hyper
26	0.34					Gustatory	Hyper
27	0.48				0.33	Tactile	Hypo
28					0.52	Gustatory	Hypo
29					0.39	Proprioception	Hypo
30	0.59					Vestibular	Hyper
31	0.46		0.35			Auditory	Hyper
32		0.28			0.39	Vestibular	Hyper
33				0.36		Auditory	Hypo
34			0.39			Vestibular	Hypo
35			0.29	0.34		Gustatory	Hypo
36		-0.46	0.29	0.29		Olfactory	Hypo
37				0.51		Proprioception	Hyper
38					0.38	Proprioception	Hyper
39						Tactile	Hypo
40	-0.25	0.26			0.48	Gustatory	Hypo
41					0.65	Proprioception	Hyper
42			0.38			Visual	Hypo

Table 2

Coefficient estimates from a multiple linear regression exploring the effect of child age and self/caregiver reporting.

	Estimate	***Std. Error***	***t***	***p***
Intercept	*52.79*	*8.84*	*5.97*	*<0.001***
Age	*0.12*	*0.87*	*0.14*	*0.89*
Caregiver Report	*-46.28*	*12.59*	*3.68*	*<0.001***
Age x Caregiver Report	*2.84*	*1.24*	*2.30*	*0.02**

Table 3

Model fit statistics for the test of measurement invariance between caregiver and self-report on the GSQ.

	x^2	**df**	***p***	***CFI***	***RMSEA***	***BIC***	***AIC***
Configural	*2987.8*	*1638*		*0.632*	*0.074*	*36895*	*35963*
Loadings	*3026.2*	*1679*		*0.633*	*0.073*	*36699*	*35919*
Intercepts	*3478.5*	*1720*		*0.521*	*0.083*	*36918*	*36290*
Means	*3532.4*	*1721*		*0.506*	*0.084*	*36966*	*36342*

Figures

Figure 1

Scatterplot of AQ and C-GSQ Scores

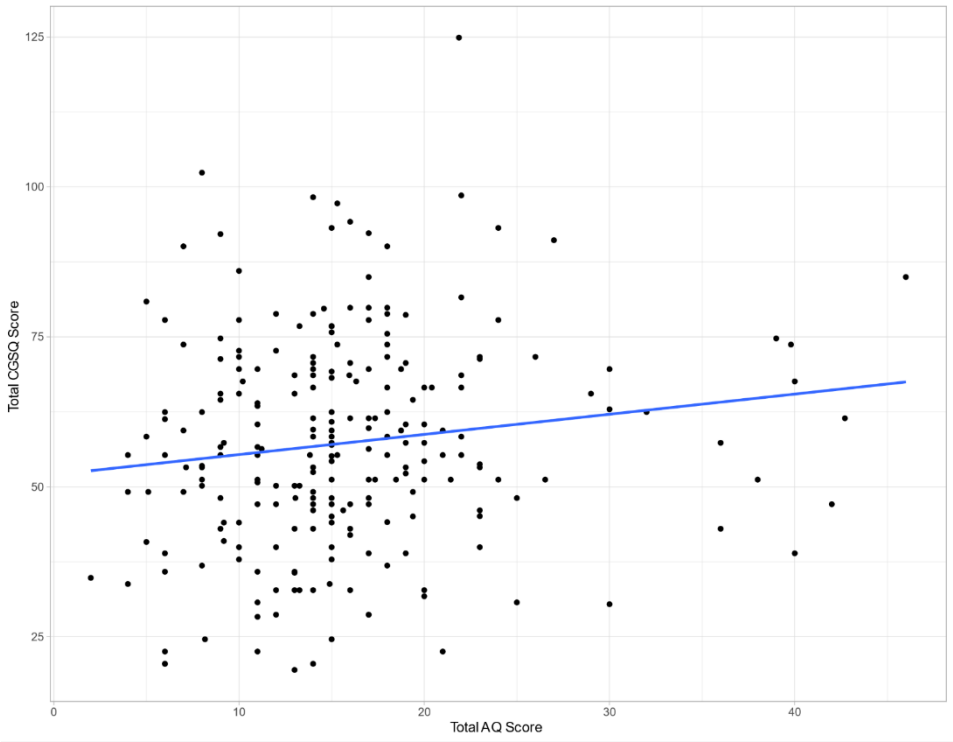


Figure 2

Violin plots of the distribution of C-GSQ scores by the child's age. Quartiles by age are also shown.

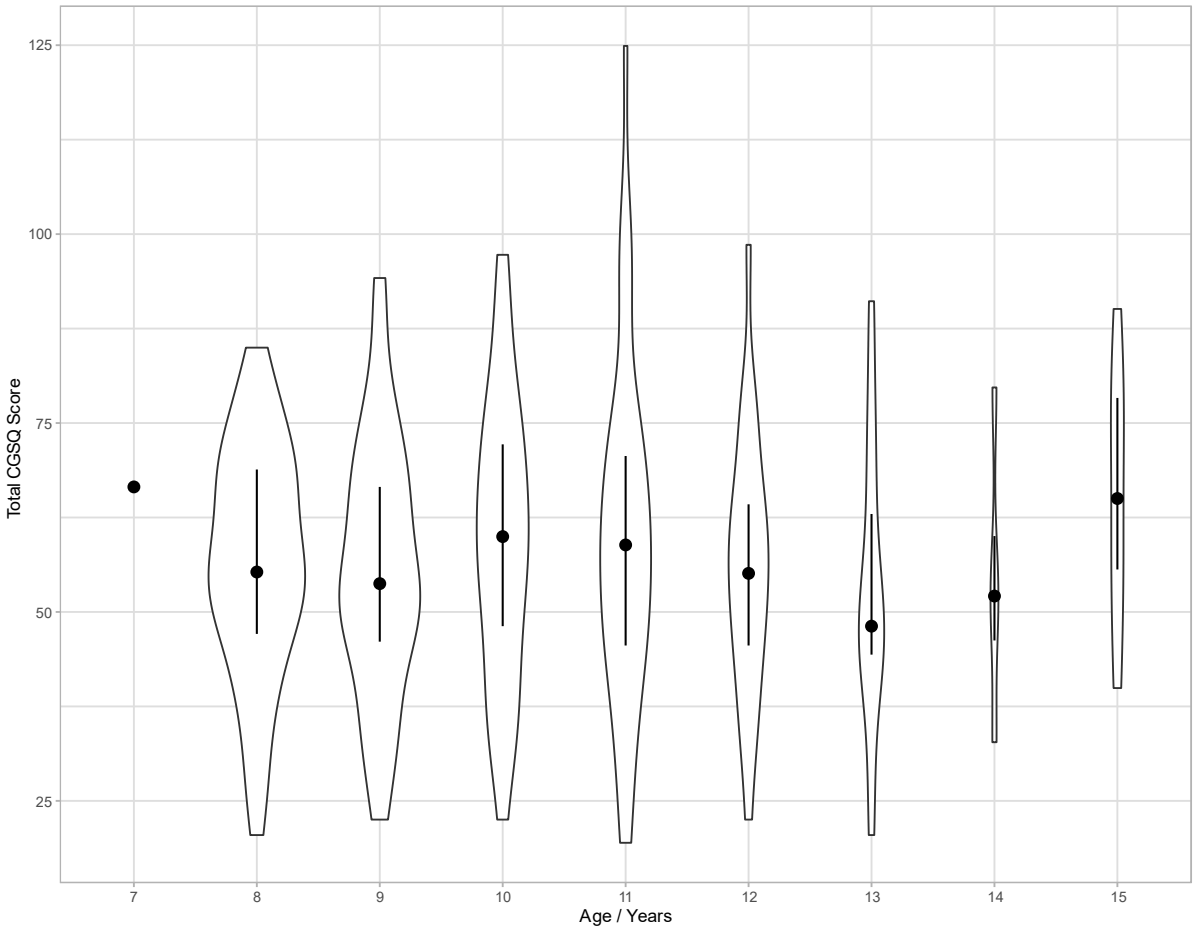


Figure 3

Scatterplots of relationships between sensory and autistic traits questionnaires. a) C-GSQ compared to P-GSQ. b) AQ-Child compared to P-GSQ. c) AQ-Child compared to C-GSQ

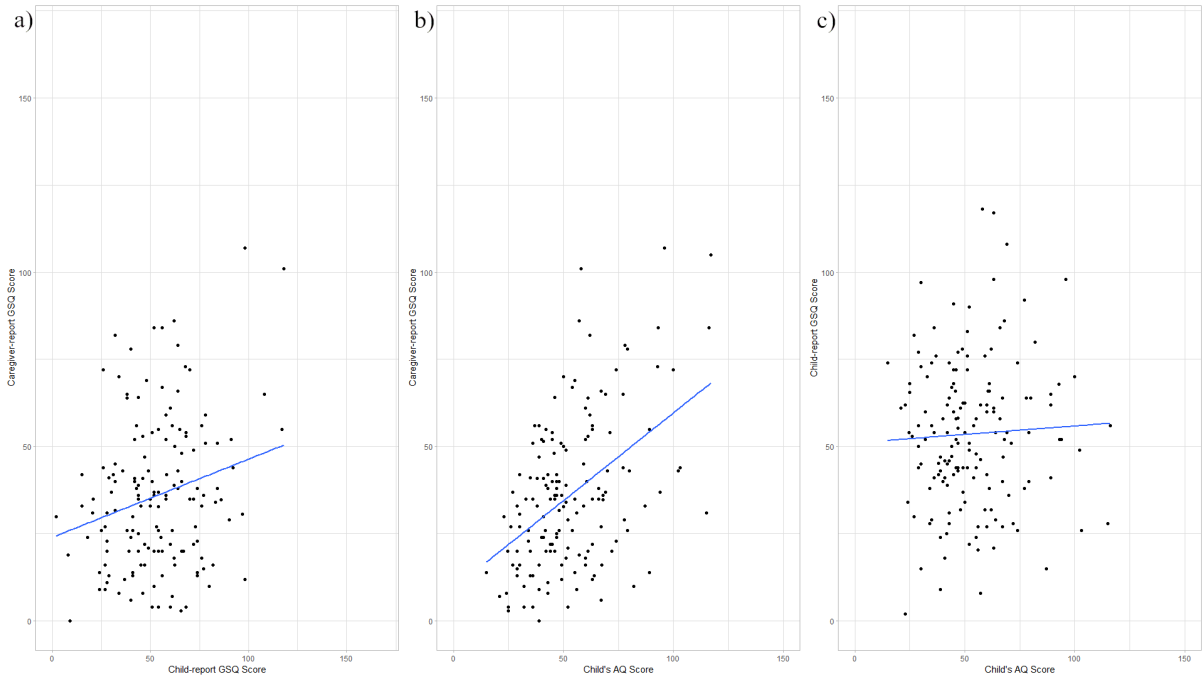


Figure 4

Line plot showing mean differences between caregiver and self-report responses by question on the Glasgow Sensory Questionnaire. Error bars represent standard errors, and the horizontal line is the overall mean response difference.

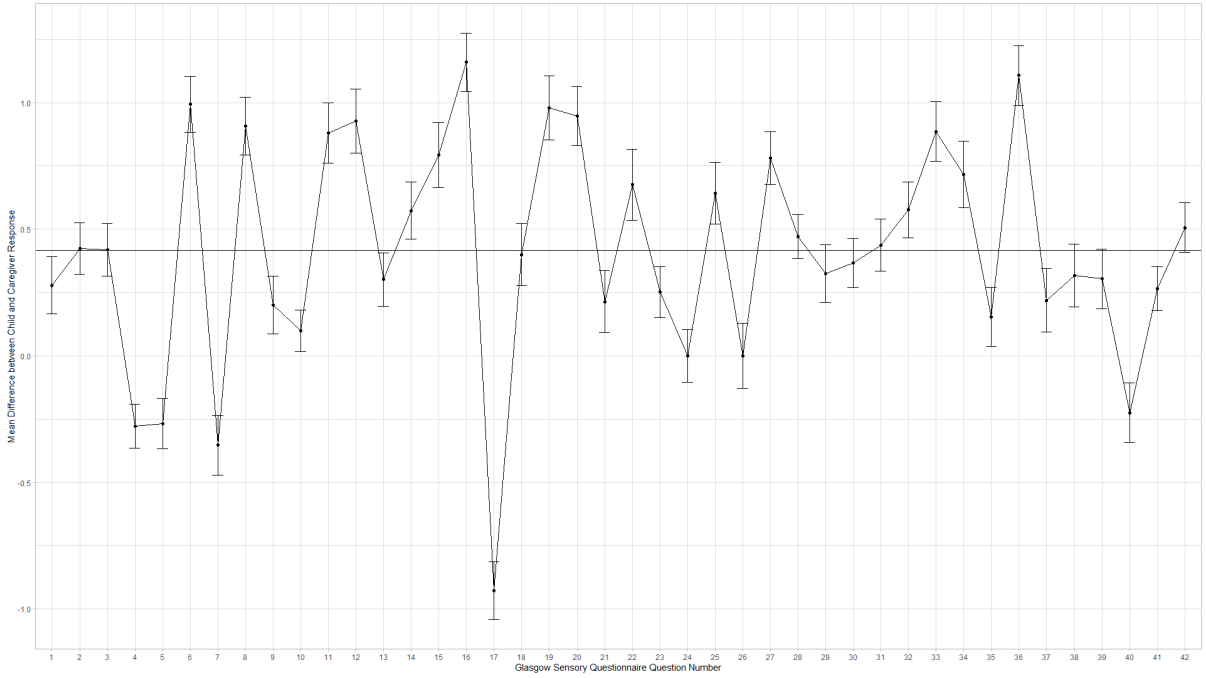


Figure 5

Scatterplot of caregiver-report of autistic traits and the difference between caregiver- and self-report levels of sensory sensitivities.

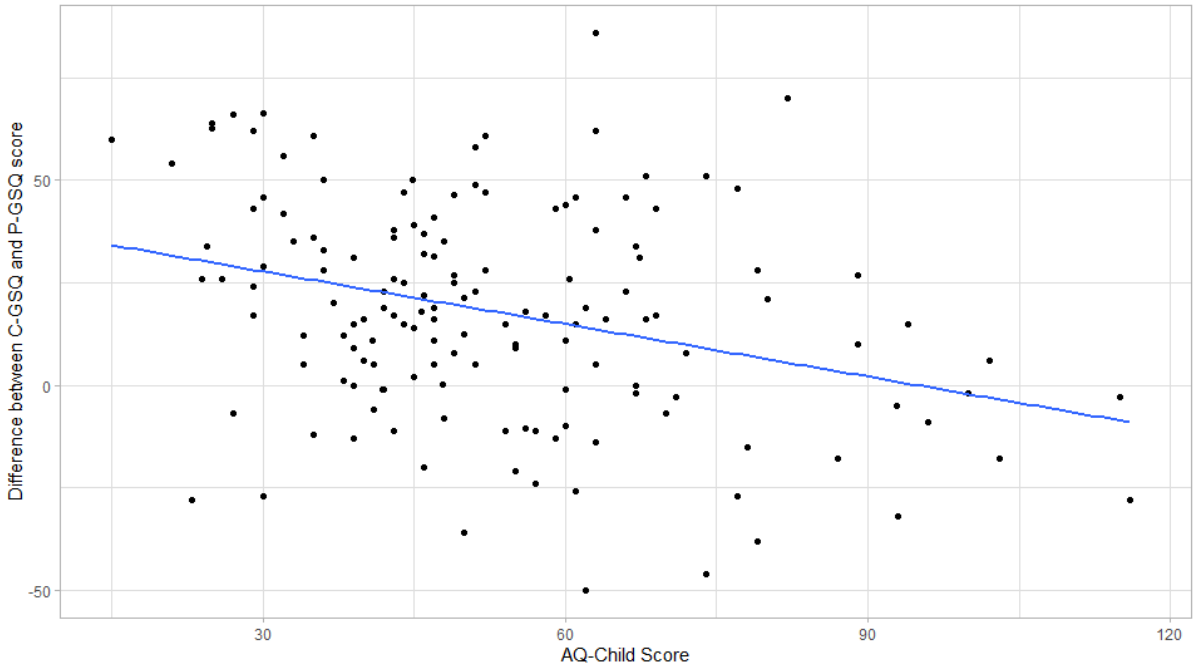
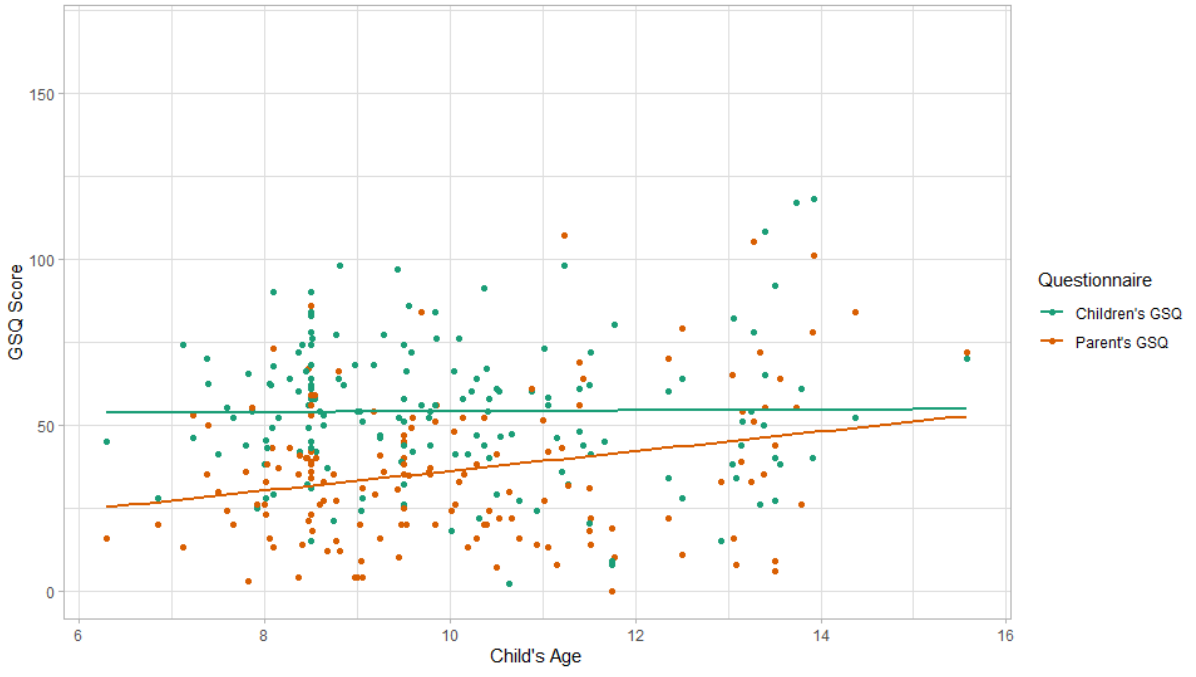


Figure 6

Scatterplot of child's age and Glasgow Sensory Questionnaire Score, grouped by caregiver- or self-report.



Appendices

1 = Questionnaire

2 = Process of construction