The Supports Intensity Scale Children's Version – Icelandic Translation: Examining Measurement Properties

James R. Thompson

University of Kansas (USA)

Leslie A. Shaw

Cornell University (USA)

Karrie A. Shogren

University of Kansas (USA)

Tryggvi Sigurðsson

Guðný Stefánsdóttir

State Diagnostic and Counselling Centre for the Disabled (Iceland)

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Abstract

An innovation in developing the Supports Intensity Scale – Children's Version (SIS-C) was the adoption of latent variable modeling approaches to norm development. In regard to translated versions of the SIS-C, the latent modeling approaches provided opportunities to leverage the large standardization sample generated in the U.S. (n = 4,015) to generate translation-specific norms from data collected on smaller samples in other countries and enable future cross-cultural analyses. In this study, data were collected on children in Iceland who received special education services (as defined and delivered in Iceland), a more diverse group of children with disabilities than the U.S. sample. This provided a unique context to explore cross-cultural differences. Findings indicated the structure of the SIS-C (i.e., seven support need domains organized under an overall support needs construct), was supported in the Icelandic context. However, findings also suggested that supports planning teams in Iceland must consider specific age-related factors that differ from other cultural contexts.

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The supports paradigm has exerted significant influence over the delivery of supports and services throughout the world (Stancliffe, Arnold, & Riches, 2016; Thompson, Schalock, Agosta, Teninty, & Fortune, 2014). To operationalize the supports paradigm, reliable and valid assessments of support needs are essential to document mismatches between personal competencies and environmental demands to enable the identification and arrangement of personalized supports that enhance human functioning and personal outcomes. Support needs is defined as a psychological construct; "the pattern and intensity of support a person requires to participate in activities associated with typical human functioning" (Thompson et al., 2009, p. 135). The Supports Intensity Scale – Adult Version (SIS-A; Thompson et al., 2004; Thompson et al., 2015) and the Supports Intensity Scale - Children's Version (SIS-C; Thompson et al., 2016) provided the first standardized assessments of support needs in adults and children with intellectual disability. Since SIS-A was originally published in 2004 (i.e., Thompson et al., 2004), it has been translated into a dozen languages and has been widely adopted in North American and around the world to guide supports planning for adults with intellectual and developmental disabilities (AAIDD, 2019a; AAIDD, 2019b).

The SIS-C consists of two sections: (a) Exceptional Medical and Behavioral Needs and (b) Supports Needs Index Scale. The Exceptional Medical and Behavioral Needs section, which is not included in the standardized portion of the scale, evaluates support that is needed to manage medical conditions (e.g., respiratory care, feeding assistance, skin care, diabetes) and behavioral issues (e.g., externally-directed destructiveness, self-directed destructiveness, elopement). These items are included to enable planning teams to understand factors that have been confirmed by research to influence support needs in the domains assessed on the Supports Needs Index scale (Seo, Shogren, Wehmeyer, Little, & Palmer, 2017). The second section, the Supports Needs Index Scale, is the standardized portion of the SIS-C and includes items organized into seven domains/subscales: Home Life Activities, Community and Neighborhood Activities, School Participation Activities, School Learning Activities, Health & Safety Activities, Social Activities, and Advocacy Activities. Items in this section are rated on three dimensions: type of support (e.g., amount of physical assistance), daily support time (hours and minutes devoted to support), and frequency of support (how often support is needed). Averaged ratings across the three dimensions are used to calculate standard scores for each subscale as well as the composite standard score, the Support Needs Index (SNI). The SNI "reflects a child's overall intensity of support needs" (Thompson et al., 2016, p. 16).

The SIS-C in the Icelandic Context

SIS-C translations

There have been growing international efforts to translate and promote the adoption of the SIS-C since its English version publication in 2016. An innovation in developing the SIS-C was adoption of latent variable modeling approaches to develop norms for the scale (Seo, Little, Shogren, & Lang, 2016a). The use of this approach to norm development introduced an opportunity to leverage the large standardization sample generated in the U.S. for norming (n = 4,015; aged 5 to 16) by linking it to smaller standardization samples collected in other countries to generate translation-specific norms (Seo, Shaw, Shogren, Lang, & Little, 2016b). This process has been applied to the Spanish (Verdugo et al., 2016) and Catalan (Giné et al., 2017) translations of the scale, enabling country-specific norms as well as analysis of cross-cultural differences in support needs assessment.

The ability to leverage the U.S. standardization sample is particularly important to generating international norms for the SIS-C given the need to consider developmental differences that influence support needs in the range of ages for which the SIS-C was standardized (Shogren et al., 2015). Given the age range for which the SIS-C was developed, in standardizing the U.S. version of the scale, a stratified sample plan was developed. First, the sample was stratified into two-year age bands, generating six sampling cells (5-6, 7-8, 9-10, 11-12, 13-14, and 15-16 year olds). Within each age band, the sample was further stratified based on level of intellectual functioning (i.e., mild, moderate, severe/profound) to ensure representation of the range of intellectual impairments in those with intellectual disability, which yielded 18 sampling cells in total. The target for each sampling cell was 200 children. The reasons for this complex sampling plan were that it was assumed that (a) support needs would be strongly correlated with age, with younger children showing more intense support needs compared to older children, irrespective of disability status, and (b) the level of intellectual impairment would also influence support needs across time. Research with the U.S. standardization sample confirmed these findings, with differences in latent means based on age cohorts across support need domains assessed on the SIS-C (i.e., Home Living, Community and Neighborhood, School Participation, School Learning, Health & Safety, Social, and Advocacy Activities) (Shogren et al., 2015). This finding led to the creation of separate norms for each of the age cohorts (Thompson et al., 2016).

Generating sufficient samples to enable this size of a standardization sample in international contexts can be challenging both because of resources for data collection, as well as for restricted available samples. As such, an approach to generating full coverage of the sampling cells for international standardization samples was developed to generate independent norms for translated scales. For translated scales, smaller numbers were required in each cell (e.g., approximately 40 children in each cell) (Seo, Shaw et al., 2016). Findings revealed that it was possible to generate independent norms based on this sampling plan for the Spanish and Catalan translations of the scale. Specifically, measurement invariance within each translation and across the translation and the U.S. sample was established (Giné et al., 2017; Verdugo et al., 2016).

Interestingly, however, the Spanish and Catalan data revealed slight differences in the variability in age cohorts. In the U.S. context, separate norms needed to be developed for each of the age bands in the sample. However, in both the Spanish and Catalan translation of the SIS-C, the age bands could be collapsed into two groups for norm development, a 5-10 and 11-16 year-old group. It was hypothesized that there may be cultural factors related to the structure of the Spanish and Catalonia schooling system, as well as greater homogeneity within Spain and Catalonia that contributed to these findings. It was recommended that future researchers further examine the findings related to other cultural contexts, both methodologically and conceptually.

The purpose of the present paper, therefore, is to report on the findings from the Icelandic translation of the SIS-C. The Icelandic translation provided another opportunity to test the newly devised methods reported by Seo, Little et al. (2016) in another, unique cultural context. Further, the Icelandic standardization sampling process varied from that used in the U.S., Spain, and Catalonia due to the small population size in Iceland, the inclusion of children with other disability diagnoses than intellectual disability, and the large proportion of children from the total population in the sample.

The Icelandic Context

Special education services in Iceland are arranged according to a cascade approach to placement (Deno, 1970). Some students receiving special education attend general education classrooms full-time with additional supports embedded within their classrooms; others spend part of their day in a general education classroom with embedded supports and part of their day in a separate, special education classroom within a general education school; still others, spend their full school day in a special education classroom within a general education school; and finally, there are some students who attend special schools catering exclusively to students with disabilities. Consistent with the worldwide movement over the past three decades of providing more inclusive educational opportunities for students with disabilities (Wehmeyer, Shogren, & Brown, 2017), the more restrictive options (special school or full-time special class) have been used less often in Iceland in recent years. Marinósson and Bjarnason (2014) reported that only 1.3% of the Icelandic school age population attended a special schools or special class on a full-time basis.

In addition, the Iceland cultural context is unique, and this investigation provided an opportunity to further explore cross-cultural differences. Iceland is rooted in Scandinavian culture, stemming from its Norwegian and Danish settlers. Although certainly not unique to Scandinavian culture, emphasis on the worth and dignity of each individual has been espoused throughout Scandinavia (Lacy, 2000). Scandinavian values were apparent in the work of Nirje (1969) and others during the 1950s and 60s when the principle of normalization was first articulated. At its core, the normalization principle held that people with disabilities are deserving of similar life conditions and experiences as people from the general population. Nirje identified the following eight "facets and implications" of normalization: the opportunity to (a) experience a normal rhythm of a day; (b) experience a normal routine of life; (c) follow a normal rhythm of the year; (d) experience normal developmental sequences of the life cycle; (e) express preferences and make choices; (f) live in a sexual world; (g) have access to normal economic standards; and (h) live in the same type of housing as ordinary citizens.

Scandinavian values of equality and tolerance have also been evident in Icelandic social movements and public policies over the past quarter century. For instance, Iceland stood out from western democracies in regard to its relatively early and ongoing commitment to gay rights, gender equality, and environmental protection. Of course, like all democracies, Icelanders have diverse views on a wide range of political and social issues, and public support for various policies and politicians have shifted over time (Granados, 2010). Nevertheless, Iceland has a longstanding system of public funded services that are intended to support people with disabilities to experience meaningful lives as valued members of their communities.

Research Questions

1. Do responses on indicators for the SIS-C Icelandic Translation differ by the six age groups for the seven support need domains (Home Life, Community & Neighborhood, School Participation, School Learning, Health & Safety, Social, and Advocacy Activities) and the Support Needs Index (SNI) on the SIS-C?
2. Are there latent mean differences due to age for the support need domains and composite SNI?
3. Are there latent variance differences due to age for the support need domains and composite SNI?

Methods

Sample recruitment and characteristics

In Iceland, the decision was made to not use a stratified sampling plan, and instead target data collection to all of the children with disabilities receiving special education services in

Icelandic schools. Unlike the Spanish and the U.S. samples that targeted children with a diagnosis of intellectual disability, the Icelandic sample focused on all children receiving special education services regardless of disability diagnosis.

Permission to collect data was provided by human subjects committees/entities associated with Iceland's central government and the State Diagnostic and Counseling Centre in Reykjavik (the organization collecting data for this investigation). The State Diagnostic and Counseling Centre received contact information for children (n=1,014) supported through the central government's *Equitarian Fund*, which is the means to the national government uses to allocate finances to local communities to provide special education services for students with disabilities in their schools. The Centre proceeded with a two-step process to recruit children for assessment. First, permission needed to be obtained from each local school to contact parents/guardians regarding their willingness to have their children assessed. Second, the parents/guardians in the schools that agreed to participate were contacted and asked to provide consent.

The first assessments were conducted in February of 2016, and data collection continued until June of 2017. Six hundred forty-nine (649) children were assessed, which was 64% of the target population. The reasons for children not participating varied, including local schools that did not agree to participate, parents/guardians who did not provide permission, and children who simply could not be located (e.g., they may have moved, they may have aged out of services, or the roster supplied by the central government had incorrect contact information). Regardless of the reason, the non-response (36.0%) is relatively small compared to benchmarks Baruch and Holtom (2008) identified from their analysis of the response rates in published organizational research studies.

There is no indication that children receiving special education services who were not assessed with the SIS-C differed in significant ways from those who were assessed. SIS-C assessments were completed on children from all geographical areas in Iceland, which accounts for not only cultural differences between rural and urban areas, but also economic differences. Also, all age-groups are well represented in the sample. Finally, the sample characteristics (see Table 1) are consistent with percentages reported in other sources regarding demographic characteristics of Icelandic students receiving special education services (e.g., see Marinósson & Bjarason, 2014).

As is shown in Table 1, the Icelandic norming sample consisted of 649 children and youth ages 5 to 17 (*M* = 10.89, *SD* = 3.59), the majority of whom were male (*n* = 479, 74%), lived with their family in the community (*n* = 623, 96%), and spoke Icelandic (*n* = 565, 87%) or Icelandic and another language (*n* = 15, 2%). It was relatively common (39.3%) for respondents to report that they did not know the range in which the child's IQ score fell (i.e., level of intellectual impairment). Icelandic respondents were, however, more confident in reporting adaptive behavior levels (only 3% missing data). With respect to disability diagnoses, 86% of the sample had more than one diagnosis. The largest disability category was autism spectrum disorder (*n* = 467), followed by intellectual disability (n = 397), attention deficit hyperactivity disorder (*n* = 283), language disorder (*n* = 108), and physical disability with mobility limitations (*n* = 104). Although significant percentages of students in the U.S. and Spanish samples had multiple diagnoses, the Icelandic sample was considerably more diverse in terms the scope of disability conditions represented among students assessed with the SIS-C.

To address our research questions, measurement invariance was tested first with the Icelandic sample alone before the U.S. norming sample of 4,015 children age 5-16 was added to the Icelandic sample. The U.S. norming sample (see Thompson et al., 2016, for more information) was added to the Icelandic norming sample to provide stability to the models, and enable the application of the latent variable modeling process reported by Seo et al. (2017). More details of the process are provided in the Analysis section below.

SIS-C: Icelandic Translation

As discussed earlier, the SIS-C was developed to measure the pattern and intensity of support needs of children and youth with intellectual and developmental disabilities ages 5-16. A systematic process to guide translations of the SIS-C (Tassé & Thompson, 2010) was followed to create the SIS-C Icelandic Translation used in this study. The translation process consisted of three phases:

(1) An initial committee was formed and divided into two teams, with each team having a professional translator and bilingual content expert. Each team independently translated items on the SIS-C, and a joint meeting was convened to compare translations. Disparities were addressed leading to the *Preliminary Translation*.

(2) The *Preliminary Translation* was provided to an independent, second committee of bilingual content experts and translators. This group verified the quality and/or accuracy of the *Preliminary Translation* by comparing it to the original, English version of the SIS-C. The initial and second committees met to discuss differences and reach consensus, at which point the *Pretest Translation* was created.

(3) The *Pretest Translation* was piloted with a group of potential SIS-C Icelandic Translation users who were asked to provide feedback through focus groups and Likert scale ratings. Final edits were made based on this feedback to create the *Final Translation* (i.e., the SIS-C Icelandic Translation used in this study).

To generate norms for the SIS-C Icelandic Translation, items from the SNI Scale were parceled in two stages. The first stage, which parallels the SIS-C manual scoring instructions, averages the values for Type, Frequency, and Daily Support Time support need ratings. After creating the item parcels, these values were averaged to produce three indicators per support need domain, using the same mapping of items to parcels as implemented in the U.S., Spain, and Catalonia norming (Giné et al., 2017; Thompson et al., 2016; Verdugo et al., 2016). Parceling reduced the number of indicators from 61 to 21, along with the variability in each indicator in the factor (Little, Rhemtulla, Gibson, & Schoemann, 2013).

Analysis

The process established to test invariance of translated versions of the SIS-C (Seo, Shaw et al., 2016) was used to guide testing for measurement and latent invariance for the SIS-C Icelandic Translation. The data were first pre-processed to check for missing values and create groups for invariance testing, before evaluating measurement invariance across the 6 age groups in the Icelandic sample. It should be noted that the Icelandic data collection was extended to children aged 17, because there were students who reached this age while receiving special education services and supports in the Icelandic context. However, because there were only 20 children aged 17 in the sample, this group was combined with the 15-16 age cohort. Thus, the oldest age group in the Icelandic norming included children aged 15-17, unlike in the U.S. context, where age 16 was the cutoff for inclusion in the SIS-C sample, as the SIS-A extends downward to age 16. After measurement invariance was established in the Icelandic sample, it was combined with the U.S. sample for a 12-group (6 Icelandic age groups + 6 U.S. age groups) model that was used in subsequent testing.

Missing Data. There was only one item (support needs attending special community or neighborhood events) in the 61 support need questions for which there was any missing data in the Icelandic sample. To analyze a complete data set, as the Icelandic norming sample was merged with the U.S. norming sample, a single data set with 25 iterations was imputed using predictive mean matching in *mice* package version 2.30 (van Buuren & Groothuis-Oudshoorn, 2011) in R 3.4.0 (R Core Team, 2017).

Icelandic measurement invariance testing. Although the norming process selected for the data required a 12-group confirmatory factor analysis model of both the U.S. and Icelandic norming samples, measurement invariance was evaluated first for the Icelandic sample alone. According to Chen (2007), there is the potential that the large U.S. sample could obscure measurement variance in the Icelandic groups, and it is recommended to first test measurement in the smaller sample. As such, measurement invariance testing was conducted first on the 6 Icelandic age cohorts for each of the seven support need domains (Home Life, Community and Neighborhood, School Participation, School Learning, Health and Safety, Social, and Advocacy Activities) and the composite SNI model. The scale of the latent variables was set using effects coding, a method that uses model constraints and all of the indicators on a factor to set the scale for the latent variable. For factor loadings, one indicator is constrained to the number of indicators minus the factor loadings for all other indicators on the factor; indicator intercepts are constrained to equal zero (Slegers & Little, 2007).

Measurement invariance testing was conducted in three steps. The first step was configural in which the same factor analysis model was applied to all groups but all estimates were free to vary. The second step, referred to as weak or metric, constrains all factor loadings to equality across groups to determine if the construct manifests in the indicator equally (Kline, 2011). Change in the comparative fit index (CFI) was used to determine if all factor loadings could be equated across groups. If the change in CFI was < .01 (Cheung & Rensvold, 2002), then factor loadings could be equated and testing proceeded to the third step. If change in CFI was .01 or larger, then nested model testing would need to be used to identify the estimate or estimates that need to be freed in order to obtain a model with change in CFI < .01; in such a case, the model would be partially invariant. The third step, called strong or scalar invariance, constrained all intercepts to equality across groups indicating the observed score was the same across groups (Brown, 2006). The same change in CFI criteria was utilized to evaluate equality of intercepts with nested model testing implemented when change in CFI was too large.

Icelandic and U.S. invariance testing. Results from Icelandic measurement invariance testing were implemented in the Icelandic + U.S. 12-group model. Measurement invariance was repeated with the same change in CFI criteria used to judge whether the model was invariant or partially invariant at each stage. Once measurement invariance or partial measurement invariance was established, latent invariance testing was conducted to determine if latent means and latent variances could be equated across the Icelandic age groups. Latent mean testing used the strong model as a starting point, and latent variance testing started with the final latent mean model. Nested model testing evaluated change in model fit with α of .005, a value chosen to control for estimates obtained from multiple models. After comparing model fit statistics for maximum likelihood (ML) to those from robust maximum likelihood (MLR) estimation, MLR was selected as the more appropriate estimator for the data (Curran, West, & Finch, 1996). All models were estimated with Mplus 7.2 (Muthén & Muthén, 1998-2015) using MLR estimator and the Satorra-Bentler (2001) scaled chi-square test statistic for nested model testing.

Results

Univariate descriptive statistics for the 61 items on Section 2 of the SIS-C (the Supports Needs Index Scale) and the 21 parcels created from these items indicated that all indicators were approximately normal with absolute values for skewness < 2 and kurtosis < 7. After checking the indicators for normality, analysis proceeded with measurement invariance testing to determine if the indicators were responded to similarly across all age cohorts.

Research Question 1 – Measurement Invariance

Measurement invariance testing of the 6 Icelandic age cohorts was first conducted for the support needs domains models with 7 factors (Home Life Activities, Community and Neighborhood Activities, School Participation Activities, School Learning Activities, Health & Safety Activities, Social Activities, and Advocacy Activities), then the overall, single factor SNI model. An estimation warning in the configural subscale model of equal structure for the seven domains suggested a correlation close to 1 between community and neighborhood activities and school participation activities ($\Psi_{CN,SP} = 0.98$) in the 13-14 age group in the Icelandic model. Rather than combine these two factors into one factor for this age group, two correlated residuals were added to the model in order to reduce the latent correlation to an acceptable level, leading to a more stable model. This model choice enabled the retention of the same factor model across all groups. In order to determine whether the correlated residuals would significantly change the results, latent means and variances were compared in the two models; they were not statistically different. After adding the correlated residuals to the subscale model, testing proceeded without any other estimation warning messages. All standardized factor loadings, listed in Table 4, exceeded 0.70, which meant that error variance was less than shared construct variance, and the ideal minimum (Brown, 2006) for factor loading size was exceeded. And, as seen in Table 2, change in CFI was < .01 in each step of invariance testing, so the subscale model passed measurement invariance (Cheung & Rensvold, 2002).

Like the support needs domains model, the SNI model also contained 21 parcels. To account for the unmodeled subscale structure and obtain latent mean and variance estimates for the SNI, correlated residuals were added between parcels associated with the same construct. For example, home life parcels, HL1, HL2, and HL3, had correlated residuals with each other but they were not correlated with any other indicators in the model. The root mean error of approximation (RMSEA) did exceed 0.10, an indication of poor model if viewed in isolation. Characteristics of the data and model led to a poor RMSEA, namely parcels that led to small unique variances (Browne, MacCallum, Kim, Andersen, & Glaser, 2002). With other fit statistics and model results indicating acceptable fit for this interim model whose purpose was to identify invariance issues that would be obscured by the large U.S. sample, testing proceeded. The model passed weak invariance testing, which indicated the factor loadings could be equated across groups. Strong invariance testing returned a change in CFI of .015, exceeding the .01 threshold (Cheung & Rensvold, 2002). Nested model testing identified one parcel in the School Participation Activities domain (SP2) that could not be equated across the age groups. In order to minimize the number of free intercepts in the final strong model while still meeting the change in CFI criterion for invariance testing, intercepts for SP2 were freed in the 5-6 age group, equated in the 7-8 and 9-10 age groups, and then equated in the 11-12, 13-14, and 15-17 age groups. Final change in CFI was .01, considered sufficient for this stage of testing.

Measurement invariance testing was then repeated for the Icelandic + U.S. norming samples using 12 groups, 6 Icelandic age groups plus 6 U.S. age groups. The Icelandic-only invariance testing results determined which parameters needed to be freed in the Icelandic groups for the 12-group model. In the subscale model, the correlated residuals in the Icelandic 13-14 age group were included from the start of the process. The SNI model intercepts were constrained to equality in the strong model, so the SP2 intercept was freed for the 5-6 age group, equated for youth ages 7-10, and equated for the remaining groups. The U.S. age groups, previously shown to pass measurement invariance testing (Seo, Little et al., 2016) were included without any modifications to the model.

The model structure and factor loadings could be equated in the weak stage across the Icelandic and U.S. age groups in the support needs domains model. Attempts to equate intercepts in the strong model across all 12 groups resulted in a change in CFI > .01 (Cheung & Rensvold, 2002). As shown in Table 3, visual inspection of the indicators across the countries highlighted the fact that intercepts were smaller on every indicator in the Icelandic sample. Intercepts were constrained across age groups within country, resulting in a change in CFI of .004. Although the subscale model was partially invariant in the strong model, no factor loading or intercepts parameters needed to be freed within the 6 Icelandic age groups. The final factor loadings and intercepts for the Icelandic age groups are listed in Table 4.

Measurement invariance testing of the SNI model also passed invariance testing at the weak stage and failed strong invariance due to intercept differences between country. Similar to the subscale model, intercepts were equated across age groups for each country. As shown in the model fit information in Table 2, that model modification resulted in a change in CFI of .007. Because the SP2 intercept was not equated across all Icelandic age groups, the SNI model was partially invariant at the strong level of testing.

Even though two correlated residuals were needed in the 13-14 age group for Iceland, its addition did not produce latent parameters that were statistically different than the model without the correlated residuals. Additionally, those residuals had minimal impact on the corresponding measurement parameters. The single indicator whose intercept could not be equated across all Icelandic age groups as well as intercept differences by country did result in a partially invariant model for the SNI construct. Due to the use of effects coding, the other two school participation indicators set the scale for the latent variable. Overall, the patterns of findings in testing for measurement invariance suggested that aside from the school participation indicators, the same set of indicators can be used across the Iceland and U.S. samples, and that proceeding with tests for equality of latent means, variances, and the development of norms using this process was justified.

Based on the final partially strong invariant model, coefficient omegas and coefficient alphas, measures of reliability, ranged from .883 to .939 for all cases across the age groups and the total sample. These reliability values represent good to excellent internal consistency of the SIS-C Icelandic Translation scores (Kline, 2011; McDonald, 2013).

Research Question 2 – Equality of Latent Means

The final strong invariance model served as the starting model to test whether latent means could be equated across the Icelandic age groups. No constraints were placed on the U.S. latent parameters as the U.S. sample was simply being used to enable testing within the Icelandic age groups. Each Icelandic subscale latent mean was evaluated separately with nested model testing guiding the process. As the results in Table 5 indicate, latent means for school learning (SLA) and advocacy activities (AA) did not differ across age group. Home Living Activities (HLA), Community and Neighborhood Activities (CNA), Health & Safety Activities (HSA), and the SNI was best represented with two latent means, one of children and youth ages 5-10 and one for youth ages 11-17. Latent means for School Participation Activities (SPA) differed the most by age group. The final model contained this combination of freed and equated parameters across groups: 5-6 free, 7-8 equated to 9-10, 11-12 equated to 15-17, and 13-14 freed. This pattern of freed and equated latent means is almost the same as the SP2 intercept in the SNI model for Iceland-only norming sample, confirming the need to specifically consider the school participation construct in the Icelandic sample, as SP2 is an indicator of this construct. The one difference was in the 13-14 age group. Although the estimate does not appear that different, constraining that latent mean to be equal to youth ages 11-12 and 15-17 generated an estimation warning message. Once that mean was freed for that age group, the model converged without warning.

Research Question 3 – Equality of Latent Variances

The final latent mean models were used as a starting point to test equality of variances across groups. It was determined through nested model testing that subscale latent variances in the Icelandic sample could be equated across all age groups, except for school participation. Variances could be equated for the children and youth in the 5-6, 7-8, and 9-10 age groups ($\Psi_{SP} = 0.50, SE = 0.04$). Variance could also be equated for youth 11 years and older. Variance was larger in the older age group with $\Psi_{SP} = 0.62, SE = 0.05$. SNI latent variance could be equated across all age groups. Table 6 contains latent variances for the subscales and SNI by age group from both the strong invariance model and final latent variance models.

Discussion

This study further confirms the applicability of a process developed to standardize translations of the SIS-C (Seo, Shaw et al., 2016), extending the process to a population-based sample rather than a stratified sample. It also highlights unique considerations in the assessment of support needs in the Icelandic context, which included some youth without a diagnosis of intellectual disability.

It is important to acknowledge that the disability characteristics reported in Table 1 were based on the reports of the respondents, which were overwhelmingly a combination of parents and educators (e.g., teachers, school psychologists, school social workers). Administration of the SIS-C requires assessors to complete a structured interview with at least 2 respondents who know the child very well. Although respondents were eminently qualified to answer questions about supports children needed because they knew the children quite well, there was no way to verify their reports of the disability diagnoses or assessment results (e.g., IQ scores, adaptive behavior scores) provided in Table 1.

The large percentage (72%) of students with a diagnoses of Autism Spectrum Disorder (ASD) in this nationwide sample likely reflects a worldwide trend over the past 30 years towards diagnosing more children with either a primary secondary disability of ASD. Data from the U.S., for instance, suggests that many of today's children with a primary disability diagnoses of ASD might have been diagnosed with a primary disability of intellectual disability in previous years. The U.S. Department of Education's annual reports on Individuals with Disabilities Education Act (e.g., 1995; 2018) reveal that since the early 1990s the percentage of children qualifying for special education services with a primary disability of ASD has grown from less than 1% to almost 9%, whereas children with a primary disability of intellectual disability (ID) dropped from 11% to slightly under 7%. Controversy persists regarding the changing criteria that has been used to diagnose ASD over the past several decades, with some people arguing for more restrictive criteria and others arguing for more expansive criteria (e.g., see Wakefield, 2016). It is likely the large percentage of the Icelandic sample (72%) with an ASD diagnosis reflects expanding diagnostic criteria for inclusion on the autism spectrum as well as the reality that access to special education services in Iceland is not aligned with specific disability diagnoses. That is, although documenting a qualifying disability serves a gatekeeping function, specific services are based on children's individual needs not on disability diagnossis. For instance, a child needing visual supports to learn will be eligible to receive such supports regardless of what disability diagnosis was applied to qualify the child for special education services.

The findings suggest that the same items and measurement structure used on the SIS-C when normed with children aged 5 to 16 in the U.S. (Thompson et al., 2016), in Spain (Verdugo et al., 2016), and in Catalonia (Giné et al., 2017) holds in the Icelandic context, with a few specific considerations. First, the age in the Icelandic sample was extended to 17, with no major impacts on model fit, verified by running some test models with and without the youth age 17. Ongoing work, however, is needed to explore the application of the SIS-A and SIS-C in youth ages 16 to 18, as this group is currently included in the norms for the SIS-A instead of the SIS-C. The SIS-A was extended downward to the age of 16 to enable the assessment of support needs in adult environments for youth preparing for the transition from school to the adult world. Preliminary research in the U.S., however, has suggested that youth ages 16 to 17 show similar measurement properties on the SIS-C; this in combination with the findings related to 17 year olds in Iceland suggests that the scale might be useful to youth still focused on school-based activities and supports, rather than planning for the transition to adulthood (Seo et al., 2015). Further research is needed to determine considerations that inform the most appropriate measure of support needs for youth ages 16-18, and the most appropriate norm-reference measure in this age range.

Second, there were specific measurement-related factors identified in the initial Icelandic models that suggested specific cultural considerations that must be considered in developing translation-specific norms and in implementing supports planning. There appears to be a strong relationship between items that measure community and neighborhood activities and school participation activities. This finding is unique to the Icelandic norming process and there are several plausible explanations. One potential cultural explanation is that there is a stronger interrelationship between community and neighborhood activities and school participation in Iceland than in other cultural contexts. Alternative, the strong relationship between community/neighborhood and school participation items could be related to item translation issues, or it may be that there is no meaningful difference between the two subscales (in which case, they should be combined). Further research is needed to explore the degree to which there are more commonalities in the Icelandic context related to the demands of participation in school and community and neighborhood activities, and the influence on the assessment of support needs in these domains. Schools in Iceland are almost always a centerpiece of community life, and many community/neighborhood and school activities occur in the same setting. That is, many community/neighborhood activities involving children as well as adults take place in Icelandic schools (e.g., after-school programs for students that involve organized sports, music, art, and dance; polling places for adults during elections; places to hold community club meetings) Thus, the intensity (i.e., frequency, type, time) of supports an Icelandic student with a disability needs to participate in school may be very similar to the intensity of supports needed to participate in community and neighborhood activities due to the reality that so many activities in both domains occur in the same, familiar environment.

Third, the model was most unstable in school participation activities in the 13-14 age group. Without the ability to currently collect data from more participants, it is unclear as to whether the instability was due to the particular age cohort or the developmental stage in the Icelandic context. Because the whole population was assessed, the current 13-14 age group should be re-assessed after they have moved to the 15-17 age group. Modeling of those results could help determine whether the model instability is related to the particular cohort or not. The original indicators rather than parcels for school participation should be also evaluated more closely with a focus on cross-cultural comparisons to identify the source of differences on this construct.

Fourth, the ratings of the intensity of support needs was lower across all indicators and domains in the Icelandic sample than in the U.S. sample. This finding deserves further research, but suggests that there might be differences in the Icelandic context that could result from the population-based sample (as there were not equal number of children with varying levels of intellectual impairment) or from the characteristics of children with intellectual and developmental disabilities in Iceland. This finding is supported by the findings of no measurement differences in the SIS-C Spanish Translation (Verdugo et al., 2016) or SIS-C Catalan Translation results (Giné et al., 2017), in which each sample was combined with the U.S. for the norming process.

Fifth, in terms of considering mean level differences across support need domains, the school participation domain showed greater variability across age cohorts, necessitating independent norms for 5-6 year olds, 7-10 year olds, 13-14 year olds, and the same norms for 11-12 and 15-17 year olds. This pattern of findings shows greater diversity of age groups, in line with the U.S. norming process which found differences across all age bands (Shogren et al., 2015). However, greater similarities were found in school learning and advocacy activities with no differences in latent means across any of the age groups. And, similar patterns to that in the Spanish and Catalan translations were found for home living, community and neighborhood, health and safety, and overall SNI scores with children falling into two groups 5-10-year-olds and 11-17-year-olds. As such, there are unique cultural considerations related to the Icelandic context that must be further researched and integrated into supports planning given this unique pattern of similarities and differences in support needs across age bands. These findings may be an artifact of the small sample size, and therefore this analysis should be repeated with a larger sample in the future.

Finally, in terms of the variances, there was great homogeneity across the age bands, with only the school participation domain showing any differences in variances across the age groups. This suggests that there may be less variability in scores within Iceland as compared to the U.S. sample (Seo, Shaw et al., 2016) but similar to the Spanish and Catalan samples (Giné et al., 2017; Verdugo et al., 2016).

Conclusion

Given standard guidelines in cross-cultural research that suggest that if a majority of the items are invariant in measurement models, then there are universal aspects of the latent construct (Lee, Preacher, & Little, 2010) that can be explored cross-culturally, the results of the present analyses confirm the universal aspects of support needs assessment. The structure of the SIS-C, seven support need domains (i.e., Home Living, Community and Neighborhood, School Participation, School Learning, Health & Safety, Social, and Advocacy Activities) organized under an overall SNI construct, is supported in the Icelandic context. However, the findings also suggested that supports planning teams in the Icelandic context must consider specific age-related factors that differ from other cultural contexts. It will be particularly important in planning for school participation to engage in frequent assessment of developmental changes in support needs as there were significant, latent differences in the majority of age bands. For the domains of home living, community and neighborhood, and health and safety, as well as for overall support needs, exploring these changes during the transition from childhood to pre-adolescence will be most important, as significant differences were found in 5-10- and 11-17-year-olds. Finally, for school learning and advocacy, there were not age-related differences; however, supports planning teams must consider environmental changes and align supports with these changes over time.

Further research should explore specific factors that might influence these support need domains across developmental stages in Iceland, as well as the influence of other factors related to the educational system and community and family supports and engagement in this process. The parallels between of the age differences and the structure of Icelandic schooling is interesting. The ten years of compulsory education in Iceland spans ages 6 to 16, with the first four years (ages 6-10), next three years (ages 10-13), and final three years of schooling being distinct from one another in terms of instructional time (1,200, 1,400, and 1,480 minutes of instruction per week respectively for years 1-4, 5-7, and 6-8) and curricular complexity (Compulsory School Act, 2008). It could be that the age group distinctions between the 5-10- and 11-17-year-olds in this study's sample are related to differences in the expectations, experiences, and responsibilities associated with the first four years of schooling compared to the final six years.

The current investigation was unique among research studies using data from the SIS-C due to data being collected from the population of students receiving special education services in Iceland (not a stratified sample), and the diversity of students on whom data were collected in regard to disability characteristics. The original U.S. version (Thompson et al., 2015), as well as the translated Spanish (Verdugo et al., 2016) and Catalan (Giné et al., 2017) versions, focused data collection on students with a diagnosis of intellectual disability and efforts to obtain a representative sample were undertaken. Despite missing data and outliers, the vast majority of students in these samples had an intellectual disability diagnosis. In the Icelandic sample, nearly 4 out of 10 students did not have an intellectual disability diagnosis, and the most commonly reported diagnosis (72%) was Autism Spectrum Disorder.

For a variety of reasons, not the least of which is that disability characteristics are reported by interviewers and not verified through diagnostic record review, specific and definitive claims regarding differences in the disability characteristics of students in samples from various countries are difficult to make. However, the diversity of the disability conditions reported in the Icelandic sample (Table 1) is so strikingly different than those reported in previous literature, it is clear that the Icelandic sample was unique. Additionally, it would be very surprising if the Icelandic sample was not unique due to the fact that *all of students* (i.e., not a subset) receiving special education services in Iceland were targeted for assessment with the SIS-C, not just students with intellectual disability.

The findings in this study that support the hierarchical latent structure of the SIS-C (i.e., seven support need domains organized under an overall support needs construct) suggests that not only do items on the SIS-C items have universal properties, but the SIS-C may be useful to understanding students by their needs for support across disability populations. Regardless of whether a student’s primary disability diagnosis is autism spectrum disorder, physical/motor disability, a mood disorder, attention deficit hyperactivity disorder or any other disability condition, parents, educators, and human service professionals must ultimately focus their energy on identifying and arranging the supports that will provide the student the best opportunity to learn and participate in school and community settings. Although more research is needed regarding what types of supports, and what approaches to support planning, are best suited to students with different disability characteristics, the importance of understanding how mismatches between personal competencies and environmental demands create support needs for all students (regardless of disability diagnosis) is self-evident.

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Table 1

Demographic Characteristics of Icelandic and U.S. Normative Sample

	Iceland		U.S.	
Variable	*n*	%	n	%
Gender				
Male	479	73.8	2710	67.5
Female	170	26.2	1202	29.9
Age Group				
5-6	118	18.2	513	12.8
7-8	114	17.6	562	14.0
9-10	93	14.3	762	19.0
11-12	103	15.9	804	20.0
13-14	114	17.6	818	20.4
15-17	107	16.5	487	12.1
Student's Level of Intellectual Impairment				
55-70 or Mild	207	31.9	1157	28.8
40-55 or Moderate	122	18.9	1321	32.9
25-39 or Severe	32	4.9	862	21.5
< 25 or Profound	33	5.1	459	11.4
Missing	255	39.3	216	5.4
Student's Level of Adaptive Behavior Impairment				
Mild	230	35.4	948	23.6
Moderate	226	34.8	1335	33.3
Severe	107	16.5	1052	26.2
Profound	66	10.2	563	14.0
Missing	20	3.1	117	2.9
Diagnoses/Classifications				
Intellectual disability	397	61.2	4015	100.0
Developmental delay	65	10.0	1588	39.6
Autism spectrum disorder	467	72.0	2124	52.9
Low vision/Blindness	29	4.5	545	13.6
Deafness/hearing impairment	14	2.2	191	4.8
Psychiatric disability	27	4.2	248	6.2
Physical disability – arm/hand limitations	47	7.2	742	18.5
Physical disability – mobility limitations	104	16.0	950	23.7
Chronic health conditions	38	5.9	673	16.8
Brain, neurological disorder	9	1.4	763	19.0
Speech disorder	44	6.8	1527	38.0
Language disorder	108	16.6	1174	29.2
Learning disability	27	4.2	1028	25.6
Attention deficit hyperactivity disorder	283	43.6	696	17.3
Primary Language				
English	0	0.0	2299	57.3
Spanish	0	0.0	88	2.2
Icelandic	565	87.1	0	0.0
Icelandic and another language	15	2.3	0	0.0
Other	68	10.5	90	2.2
Missing	1	0.2	1538	38.3

Table 2

Fit Indices for the Nested Sequence in the Multiple-Group Confirmatory Factor Analysis for the SIS-C Icelandic Translation

Score Type	Model	χ^2	*df*	*p*	RMSEA	RMSEA 90% CI	CFI	TLI	Constraint Tenable
Iceland only Sub-scale scores	Configural	2125.5	1006	.00	.103	.097 - .109	.914	0.893	---
	Weak	2275.6	1078	.00	.101	.096 - .107	.911	0.896	Yes
	Weak with correlated residuals	2255.2	1076	.00	.101	.095 - .106	.912	0.897	Yes
	Strong	2426.9	1145	.00	.102	.096 - .107	.904	0.895	Yes
Iceland only SNI	Configural	2352.9	1008	.00	.111	.105 - .117	.900	0.876	---
	Weak	2567.7	1108	.00	.110	.105 - .116	.891	0.876	Yes
	Strong	2872.2	1208	.00	.113	.108 - .118	.876	0.870	No
	Partial Strong	2804.3	1206	.00	.111	.105 - .116	.881	0.875	Yes
Iceland + US Sub-scale scores	Configural	5180.8	2014	.00	.064	.061 - .066	.964	0.955	---
	Weak	5634.9	2168	.00	.064	.062 - .066	.960	0.954	Yes
	Strong	6961.8	2322	.00	.072	.070 - .074	.947	0.942	No
	Partial Strong	6113.5	2307	.00	.065	.063 - .067	.956	0.952	Yes
Iceland + US SNI	Configural	6514.0	2016	.00	.076	.074 - .078	.948	0.935	---
	Weak	7178.2	2236	.00	.075	.073 - .077	.943	0.936	Yes
	Strong	8845.8	2454	.00	.082	.080 - .084	.927	0.925	No
	Partial Strong	7970.6	2435	.00	.076	.075 - .078	.936	0.934	Yes

Table 3

Indicator intercept estimates and standard errors (SE) grouped by country

	Iceland		United States	
	Estimate	SE	Estimate	SE
Home Life 1	1.35	0.04	2.26	0.02
Home Life 2	1.62	0.04	2.26	0.02
Home Life 3	1.64	0.04	2.53	0.01
Community & Neighborhood 1	1.82	0.04	2.85	0.01
Community & Neighborhood 2	1.97	0.03	2.82	0.01
Community & Neighborhood 3	2.14	0.03	2.76	0.01
School Participation 1	2.46	0.03	3.11	0.01
School Participation 2	1.70	0.04	2.87	0.02
School Participation 3	1.84	0.03	2.96	0.01
School Learning 1	2.46	0.03	3.35	0.01
School Learning 2	2.50	0.03	3.22	0.01
School Learning 3	2.57	0.03	3.20	0.01
Health & Safety 1	1.69	0.03	2.98	0.01
Health & Safety 2	1.86	0.03	2.87	0.01
Health & Safety 3	2.02	0.03	3.03	0.01
Social 1	1.89	0.03	2.86	0.02
Social 2	1.95	0.04	2.85	0.02
Social 3	2.29	0.04	2.98	0.01
Advocacy 1	1.99	0.03	2.92	0.01
Advocacy 2	2.01	0.03	2.84	0.01
Advocacy 3	2.08	0.03	3.06	0.01

Note: The exact questions contained in each parcel is listed in the Technical Chapter for the SIS-C.

Table 4

Factor loadings and intercepts for the SIS-C Icelandic Translation subscale model

	Unstandardized		Standardized	
Activities	Loading (SE)	Intercept (SE)	Loading (SE)	Intercept (SE)
Home Life				
Parcel 1	1.08 (0.006)	-0.32 (0.019)	0.88 (0.021)	-0.26 (0.019)
Parcel 2	0.99 (0.006)	0.10 (0.018)	0.89 (0.020)	0.10 (0.018)
Parcel 3	0.93 (0.005)	0.21 (0.016)	0.94 (0.017)	0.22 (0.020)
Community & Neighborhood				
Parcel 1	1.01 (0.007)	-0.14 (0.022)	0.91 (0.025)	-0.18 (0.030)
Parcel 2	0.99 (0.006)	-0.00 (0.017)	0.88 (0.023)	0.05 (0.022)
Parcel 3	1.01 (0.007)	0.14 (0.019)	0.86 (0.020)	0.17 (0.027)
School Participation				
Parcel 1	0.90 (0.008)	0.42 (0.022)	0.89 (0.025)	0.62 (0.057)
Parcel 2	1.11 (0.007)	-0.72 (0.039)	0.93 (0.017)	-0.90 (0.082)
Parcel 3	1.00 (0.008)	-0.42 (0.022)	0.86 (0.032)	-0.54 (0.043)
School Life				
Parcel 1	1.02 (0.007)	-0.11 (0.021)	0.94 (0.015)	-0.13 (0.026)
Parcel 2	0.99 (0.008)	0.03 (0.027)	0.90 (0.027)	0.03 (0.032)
Parcel 3	0.99 (0.007)	0.08 (0.023)	0.91 (0.020)	0.10 (0.029)
Health & Safety				
Parcel 1	0.98 (0.005)	-0.12 (0.016)	0.93 (0.015)	-0.14 (0.019)
Parcel 2	1.02 (0.006)	-0.03 (0.017)	0.93 (0.016)	-0.03 (0.019)
Parcel 3	1.00 (0.006)	0.15 (0.017)	0.91 (0.017)	0.16 (0.021)
Social				
Parcel 1	1.02 (0.004)	-0.19 (0.015)	0.89 (0.023)	-0.21 (0.019)
Parcel 2	1.03 (0.005)	-0.16 (0.017)	0.89 (0.018)	-0.17 (0.020)
Parcel 3	0.95 (0.006)	0.35 (0.019)	0.98 (0.028)	0.40 (0.030)
Advocacy				
Parcel 1	1.05 (0.005)	-0.14 (0.014)	0.97 (0.008)	-0.14 (0.015)
Parcel 2	1.06 (0.005)	-0.14 (0.015)	0.97 (0.007)	-0.14 (0.017)
Parcel 3	0.89 (0.007)	0.28 (0.019)	0.91 (0.019)	0.31 (0.027)

Table 5

Latent means across age groups before and after testing for differences

Age Group	HLA	CNA	SPA	SLA	HSA	SA	AA	SNI
	Freely estimated latent means in the strong invariance model							
5-6	1.73	2.29	2.67	2.57	2.07	2.20	2.10	2.22
7-8	1.60	2.06	2.37	2.51	1.94	2.12	2.13	2.10
9-10	1.75	2.01	2.34	2.58	1.97	2.12	2.02	2.09
11-12	1.39	1.89	2.04	2.48	1.75	1.99	2.04	1.94
13-14	1.35	1.84	2.13	2.50	1.73	1.99	1.97	1.91
15-17	1.41	1.83	1.97	2.40	1.67	1.86	1.89	1.84
	Final latent means after equating across age groups							
5-6	1.69	2.12	2.67	2.51	1.99	2.15	2.02	2.14
7-8	1.69	2.12	2.36	2.51	1.99	2.15	2.02	2.14
9-10	1.69	2.12	2.36	2.51	1.99	2.15	2.02	2.14
11-12	1.39	1.85	2.00	2.51	1.72	1.94	2.02	1.90
13-14	1.39	1.85	2.13	2.51	1.72	1.94	2.02	1.90
15-17	1.39	1.85	2.00	2.51	1.72	1.94	2.02	1.90

Note: HLA = Home Living; CNA= Community and Neighborhood Activities; SPA = School Participation; SLA = School Learning; HSA = Health and Safety; SA = Social; AA = Advocacy Activities; SNI = Overall Support Needs Index

Table 6

Latent variances across age groups before and after testing for differences

Age Group	HLA	CNA	SPA	SLA	HSA	SA	AA	SNI
	Freely estimated latent variances in the strong invariance model							
5-6	0.94	0.48	0.45	0.59	0.69	0.66	0.81	0.49
7-8	0.75	0.41	0.45	0.48	0.51	0.61	0.53	0.41
9-10	0.77	0.46	0.63	0.47	0.55	0.63	0.59	0.49
11-12	0.67	0.49	0.58	0.48	0.49	0.59	0.48	0.45
13-14	0.91	0.52	0.67	0.43	0.64	0.60	0.53	0.49
15-17	0.77	0.50	0.59	0.52	0.45	0.48	0.45	0.42
	Final latent variances after equating across age groups							
5-6	0.81	0.48	0.50	0.50	0.56	0.60	0.58	0.46
7-8	0.81	0.48	0.50	0.50	0.56	0.60	0.58	0.46
9-10	0.81	0.48	0.50	0.50	0.56	0.60	0.58	0.46
11-12	0.81	0.48	0.62	0.50	0.56	0.60	0.58	0.46
13-14	0.81	0.48	0.62	0.50	0.56	0.60	0.58	0.46
15-17	0.81	0.48	0.62	0.50	0.56	0.60	0.58	0.46

Note: HLA = Home Living; CNA= Community and Neighborhood Activities; SPA = School Participation; SLA = School Learning; HSA = Health and Safety; SA = Social; AA = Advocacy Activities; SNI = Overall Support Needs Index