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Measuring support needs in children with motor disability: Validity and utility of the Supports Intensity Scale (SIS-C)

Virginia Aguayo*, Victor B. Arias, Miguel Ángel Verdugo, Antonio M. Amor

Institute on Community Integration, University of Salamanca, Spain

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ABSTRACT

Background: It is unknown whether the Supports Intensity Scale-Children's version (SIS-C) is valid and useful to assess support needs for children with motor and intellectual disabilities.
Aims: (a) To assess the structural validity of the SIS-C using factor analyses in a sample of children with motor disabilities; and (b) to analyze the SIS-C's reliability and its discriminative capacity in children with different levels of motor function.
Methods and Procedures: A cross-sectional design was used to assess 210 children (aged 5–16 years). Among them, 88% had an intellectual disability and 84% had cerebral palsy, with variations in mobility (Gross Motor Function Classification System; level V: 56.19%), handling of objects (Manual Ability Classification System; level V: 38.09%), and communicating (Communication Function Classification System; level V: 42.86%).
Outcomes and Results: The model with seven support needs factors and three method factors showed the best fit. The support needs model was reliable and indicated high convergent validity. However, the SIS-C scores showed a strong ceiling effect in children with more significant limitations in gross and fine motor functions.
Conclusions and Implications: The seven-dimensional model of support needs could be replicated in children with motor disabilities. However, the usefulness of SIS-C is limited in discriminating between children with greater restrictions in mobility and handling of objects.

What this paper adds?

The seven-dimensional model proposed by the Supports Intensity Scale-Children's Version (SIS-C), which was designed to measure support needs in young people with intellectual disabilities, was replicated in a sample of children with a motor disability as the main diagnosis (N = 210; 84.29% with cerebral palsy and 88.1% with an intellectual disability). This result is the first evidence in favor of the cross-sectional validity of support needs as a construct to be applied in children with motor disabilities, and suggests that the seven-dimensional model could be an adequate framework to investigate their support needs. However, a strong ceiling effect is observed in all dimensions in which children with more significant limitations in motor function were concentrated. Consequently, the SIS-C could not be useful in discriminating between high levels of support needs, which are frequent in children with multiple disabilities and/or greater functional limitations. A future research challenge is to design appropriate indicators to discriminate among children with high support needs.

The present work contributes to the study on the supports paradigm and provides information about the validity and usefulness of the SIS-C for the assessment of support needs in children and adolescents with developmental disabilities.

* Corresponding author at: Institute on Community Integration, Faculty of Psychology, University of Salamanca, Avda. de la Merced, 109-131, 37005 Salamanca, Spain.

E-mail address: aguayo@usal.es (V. Aguayo).

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1. Introduction

According to the current supports paradigm, individuals with disabilities differ from their peers in the frequency and intensity of the support they need to meet the demands of the context (Thompson et al., 2009). Support needs relate personal competencies to these demands, especially the required support to participate successfully in the individual's environment (Schalock et al., 2010; Schalock, 2018). The assessment of support needs facilitates the design of individualized support plans, whose objectives are to improve the functioning and to enhance the quality of life of the person with disability (Claes, Van Hove, Vandevelde, van Loon, & Schalock, 2010; Thompson et al., 2002). Moreover, the assessment allows us to classify individuals according to their levels of support needs (Arnold, Riches, & Stancliffe, 2014) and assigns organizational and state resources based on their needs (Chou, Lee, Chang, & Yu, 2013; Giné et al., 2014).

The Supports Intensity Scale (SIS) for adults (2015, Thompson et al., 2004) and the Supports Intensity Scale-Children's Version (SIS-C; Thompson et al., 2016) are possibly the most widely used instruments to assess support needs in individuals with disabilities, in over 16 countries (American Association on Intellectual and Developmental Disabilities, n.d.). The SIS-C assesses support needs in seven areas of daily living that are related to the individual's quality of life (Lombardi, Croce, Claes, Vandevelde, & Schalock, 2016), namely: home living, community living, school participation (employment in the SIS – adult version), school learning (lifelong learning in the SIS – adult version), health and safety, social activities, and advocacy. The activities in each dimension are scored by a caregiver, who estimates the intensity of support needed through three indicators: the type of support needed, the frequency of the required support, and the daily time it takes to give the support. In turn, higher scores reflect a higher intensity of support needs.

Based on a theoretical model of seven dimensions of support needs, the model of the SIS was proposed and empirically tested for people with intellectual disabilities (ID; Seo, Shogren, Little, Thompson, & Wehmeyer, 2016; Verdugo, Arias, & Guillén, 2017). The authors of the SIS (2014, Thompson et al., 2002) designed a set of indicators, which were organized in seven dimensions. Those indicators were obtained from an extensive review of the literature and Q-sort methodology. Subsequent investigations have analyzed this structure using the classical test theory and the factor analysis. The psychometric properties were verified using the item response theory in at least one study (Guillén, Verdugo, Arias, & Vicente, 2015), which endorsed the validity of the SIS indicators.

Theoretically, the support needs concept is not only considered for people with ID but is also applied to individuals with other disabilities (Thompson & Viriyangkura, 2013; Thompson et al., 2009). However, research on the validity and utility of the SIS in other groups apart from individuals with ID is scarce, especially in the population with a motor disability as the principal diagnosis.

The studies conducted on adults with a motor disability yielded inconsistent results regarding the internal structure of the SIS, based on seven correlated factors (Shogren et al., 2014; Thompson et al., 2015). Bossaert et al. (2009) could not replicate the SIS factorial structure in a sample of 1303 adults with different disabilities (47.81% with brain injury). Their analysis led to a solution with four factors (i.e., personal and social skills, community living, daily living, and employment), which involved 22 of the 49 items of the SIS. Smit, Sabbe, and Prinzie (2011) assessed 65 adults with cerebral palsy (80%), spina bifida, and brain injury. These authors found significant correlations between the SIS dimensions of support needs; however, the range was low (.44–.82; half of the correlations lower than 0.70). Also, weak relationships were found between the support needs construct and practical skills when using the Barthel Index. Arnkelsson and Sigurdsson (2016) assessed 270 adults with a motor disability, mainly cerebral palsy. They found two general support needs profiles: one associated with the presence of motor disability, and the other with ID as the second diagnosis (55% of the sample). Support needs varied between groups, depending on the content of specific items. When both diagnoses were present, there were high support needs scores in all the items. When only one of the two diagnoses was present, the group without ID obtained low scores on the items that did not involve motor effort. Arnkelsson and Sigurdsson (2016) concluded that the items of the SIS were sensitive to tasks that posed a challenge for individuals with motor disabilities, and that "the SIS may not be a pure latent trait measure" (p. 149).

No studies have assessed the validity of the SIS-C in children with a motor disability as the principal diagnosis. It is fundamental to know the support needs of children with motor impairments to understand the supports they require. While all children need supports, this need decreases with age (Shogren et al., 2015). However, the presence of motor limitations entails a constant need for support, especially related to the performance of motor activities, such as walking, using the hands, or moving around. Knowledge of the required support is relevant for professionals and families who are involved in the design of support plans, besides the consideration that at least one in 500 children is born with neuromotor alterations (Novak et al., 2017) and can present cognitive deficits or additional health conditions (Oeseburg, Dijkstra, Groothoff, Reijneveld, & Jansen, 2011; Rosenbaum, Paneth, Leviton, Goldstein, & Bax, 2007). The present study addresses the measurement of support needs in children with motor limitations and ID using the SIS-C.

We determined two research objectives. First is to assess the structural validity of the SIS-C in a sample of children with motor disabilities. To that end, a factor analysis is used to explore whether the seven-dimensional model proposed for children with ID (Seo et al., 2016; Seo, Shaw, Shogren, Lang, & Little, 2017; Verdugo et al., 2017) is reproducible in a sample of children with different levels of motor function. Second is to determine the usefulness of the SIS-C for the assessment of support needs in children with motor disabilities by estimating the model-based reliability and analyzing the discriminative capacity of the scale along with the evaluated continuum (e.g., presence of relevant floor or ceiling effects).

2. Method

2.1. Participants

A field test was performed to collect data about the support needs of children with motor disabilities. Two hundred and ten

Table 1
Descriptive Statistics for the Children' Characteristics.

Variables	Age Cohort						Total
	5-6	7-8	9-10	11-12	13-14	15-16	N (%)
Age frequency	46	31	40	33	33	27	210 (100%)
Gender							
Male	24	17	27	16	16	17	117 (55.6%)
Female	22	14	13	17	17	10	93 (44.4%)
Home setting							
Family home	44	28	34	28	33	25	192 (91.43%)
Residence	2	1	4	3	0	2	12 (5.71%)
Supervised apartment	0	2	2	1	0	1	6 (2.86%)
School setting							
Special education school	31	23	25	16	27	19	144 (68.57%)
Special classroom in ordinary school	1	2	2	5	3	7	20 (9.52%)
Ordinary school	12	5	13	13	2	1	46 (21.91%)
Estimation of limitations in intellectual functioning							
No limitations in intellectual functioning	8	2	9	6	0	0	25 (11.90%)
Mild	3	1	4	3	4	1	16 (7.62%)
Moderate	7	7	4	4	5	7	34 (16.19%)
Severe	18	12	14	8	10	12	74 (35.25%)
Profound	10	9	9	12	14	7	61 (29.05%)
Estimation of limitations in adaptive behavior							
No limitations in adaptive behavior	8	3	8	7	2	2	30 (14.29%)
Mild	5	0	5	3	3	3	19 (9.05%)
Moderate	9	6	6	4	4	3	32 (15.24%)
Severe	18	12	12	5	9	12	68 (32.38%)
Profound	6	10	9	14	15	7	61 (29.05%)
Health condition							
Cerebral palsy	34	25	35	30	31	22	177 (84.29%)
Others	12	6	5	3	2	5	33 (15.71%)
Other health conditions							
Epilepsy	26	16	19	17	19	15	112 (53.33%)
Feeding limitations	30	18	21	18	21	14	125 (59.52%)
Vision limitations	22	16	19	17	17	15	106 (50.48%)
Hearing limitations	7	6	7	3	2	0	25 (11.90%)
Levels of gross motor function (GMFCS)							
I. Walks without limitations	2	1	5	4	3	3	18 (8.57%)
II. Walks with limitations	11	8	5	5	5	3	37 (17.62%)
III. Walks using a hand-held mobility device	1	3	3	3	2	3	15 (7.14%)
IV. Self-mobility with limitations	7	2	1	3	2	2	17 (8.10%)
V. Transported in a manual wheelchair	25	17	24	18	20	14	118 (56.19%)
Levels of manual ability (MACS)							
I. Handles objects easily and successfully	2	1	3	0	0	2	8 (3.81%)
II. Handles most objects but with reduced quality	6	6	7	7	5	5	36 (17.14%)
III. Handles objects with difficulty	8	6	4	6	5	4	33 (15.71%)
IV. Handles a limited selection of objects	14	5	11	7	7	5	49 (23.33%)
V. Is not able to handle objects	16	13	14	13	15	9	80 (38.10%)
Levels of communication function (CFCS)							
I. Sends and receives effectively and efficiently	3	2	7	8	1	1	22 (10.48%)
II. Sends and receives but may need extra time	2	2	6	5	3	2	20 (9.52%)
III. Sends and receives, but not with unfamiliar partners	5	3	5	1	5	5	24 (11.43%)
IV. Inconsistently sends and /or receives with familiar partners	16	7	5	5	8	7	48 (22.86%)
V. Seldom effectively sends and receives, with familiar partners	20	17	15	14	15	9	90 (42.86%)

Spanish children were asked to participate. The criteria for selecting the sample were as follow: Children (a) must be between the ages of 5 and 16 years old, which is the range of ages adopted by the SIS-C for the assessment, (b) must be living with a motor impairment that causes a motor disability, and (c) must sign the consent form to participate in the study. The children were located on seven Spanish autonomous communities, including Castile and Leon (30.48%), Catalonia (18.57%), Andalusia (14.29%), Aragon (13.81%), Basque Country (11.43%), Valencian Community (7.14%), and Cantabria (4.29%).

Table 1 shows the children's characteristics. They were classified by considering their functional levels of self-initiated movement in accordance with the Gross Motor Function Classification System (GMFCS; Palisano, Rosenbaum, Bartlett, & Livingston, 2008), their ability to use their hands when handling objects following the Manual Ability Classification System (MACS; Eliasson et al., 2006), and their effective communication according to the Communication Function Classification System (CFCS; Hidecker et al., 2011).

Information about the children was provided by 125 health or educational professionals (62.40% of whom were teachers) that

Table 2
The Answer Format Scheme for each Indicator of the SIS-C.

Score	Support Type	Support Frequency	Daily Support Time
0	None	Negligible	None
1	Monitoring	Infrequently	Time < 30 min.
2	Verbal prompting	Frequently	30 min. ≤ Time < 2 hr.
3	Partial physical assistance	Very frequently	2 hr. ≤ Time < 4 hr.
4	Full physical assistance	Always	Time ≥ 4 hr.

knew them for over six months. On average, each professional estimated the support needs of three children. The professionals worked at 36 organizations and schools throughout Spain.

2.2. Instrument

The field test version of the SIS-C, validated in Spanish (Guillén et al., 2015; Verdugo, Arias, Guillén, & Vicente, 2014; Verdugo, Guillén, Arias, Vicente, & Badia, 2016), was used to assess the support needs of the children.

The SIS-C includes two sections. The first contains 30 activities related to exceptional support needs, which are medical (e.g., support needed for seizure management) or behavioral activities (e.g., support needed to prevent self-injury). The second section includes 61 activities related to support needs, divided into the seven dimensions of home living, community living, school participation, school learning, health and safety, social activities, and advocacy. This second section is analyzed in the present study. Its answer format is shown in Table 2.

According to the manual (Thompson et al., 2016), the SIS-C is completed through a semi-structured interview with a professional who knows the child well. In our study, 64 interviewers were trained to conduct the interviews (including 24 psychologists/pedagogues, and 21 special education/needs teachers).

2.3. Procedure

The Bioethics Committee of the University of Salamanca approved the ethical standards of this study, and the research was conducted following the principles of the Declaration of Helsinki (World Medical Association, 2013). Participants gave informed consent at the start of the study. Personal data were collected, stored, and protected according to Organic Law 15/1999, of December 23, for the Protection of Personal Data (LOPD 15/1999), guaranteeing the participants' confidentiality and anonymity.

The recruitment of participating organizations was conducted mostly by email and telephone. Data collection was carried out from June 2016 to June 2018. At first contact, participants were introduced to the study details and the main objectives of the research. We requested their collaboration in the application of scales and their assistance in recruiting additional professionals by snowball sampling. The work of the participants in this study was carried out voluntarily and free of charge.

Once professionals were identified to participate in the study, a member of the research team visited the different organizations and schools and trained some professionals in the use of the SIS-C, so they could also be the interviewers who collect the data. The training consisted of a review of the current socio-ecological models, the purpose and the implications of the assessment of support needs, and how to conduct the SIS semi-structured interviews. Additional guidance for when professionals should estimate the support needs of those children with more significant physical and communicative limitations was provided, following the recommendations cited in Schalock, Thompson, and Tassé (2018, p. 26). The scales were completed in pencil and paper format. Telephone and email communication were constant between the participants and the research team.

2.4. Data analysis

First, we checked that the sample size could provide the statistical power necessary for the estimation of the factorial models. To that end, a Monte Carlo simulation was performed (Muthén & Muthén, 2002) for 210 cases with ten replications. We used the parameters of the model proposed by Verdugo et al. (2017) with 814 participants. A sample of 210 cases produced coverages higher than 0.91, parameters and standard error biases below 10%, and sufficient power (> 0.80) in the relevant parameters. The proportion of missing data was low (2.31%). No evidence was found of systematic patterns of missing data associated with the other variables of the model (Little's test sig > .05).

The first phase of the analysis addressed the first objective of the present study, i.e., to recover the theoretical structure of the support needs' model in children with motor disabilities. To that end, we estimated and compared the fit of three confirmatory factor models of the SIS-C. The second phase of the analysis attempted to fulfill the second research objective (usefulness of the SIS-C for the evaluation of support needs in children with a motor disability). This way, we assessed the distributional properties of the factor scores obtained with the best-fit model. These two phases are described below. Note that the term "factor" will be used to refer to the dimensions of the SIS-C when a factorial analysis is involved.

2.4.1. Specification of the models

The SIS-C measures support needs in children with ID across 61 activities, organized into seven environmental contexts. The

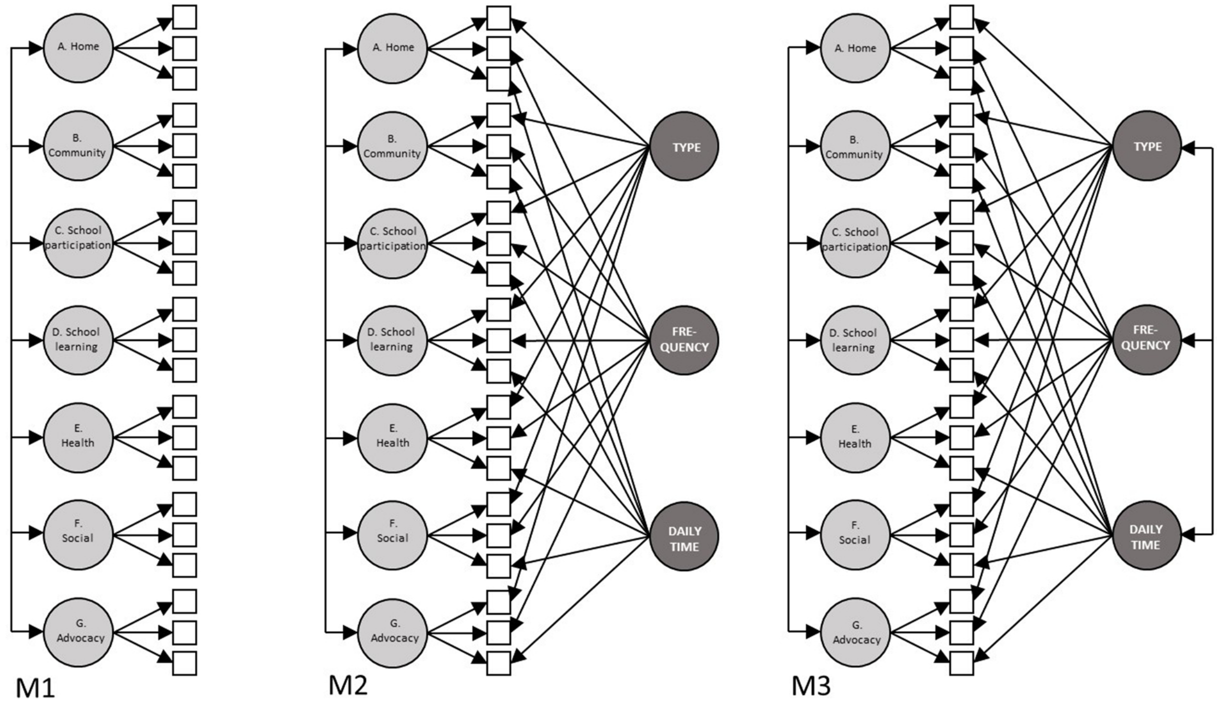

Fig. 1. Conceptual representation of Model 1 (correlated traits, no methods), Model 2 (correlated traits-uncorrelated methods), and Model 3 (correlated traits-correlated methods).

Note: Light-gray shaded circles represent the seven substantive dimensions of Supports Intensity Scale for Children. Dark-gray shaded circles represent the method factors (type, frequency, and daily support time), and white squares represent the parcels. For clarity, the factor variances and error terms of the indicators have not been represented.

intensity of the support is estimated by combining the scores in the type of support, frequency, and daily time during which support is given. Type, frequency, and time measure three facets of the same variable (intensity of supports), so they are expected to contribute substantive and non-redundant information. However, some degree of spurious divergence associated with specific characteristics of each assessment procedure is also expected (e.g., if the same trait is measured by two different methods, some of the discrepancies could be attributed to the characteristics of the method, not to the target trait). If not considered, these method effects are a potential threat to the validity of the scores. In the case of the SIS-C, previous studies demonstrated the presence of non-ignorable method effects in the SIS-C (Verdugo et al., 2017).

We analyzed the structure of the SIS-C from a multitrait-multimethod perspective, as performed by Verdugo et al. (2017) and Seo et al. (2016) in samples of children and adults with ID. Given a set of traits measured by different methods, the multitrait-multimethod framework (Campbell & Fiske, 1959) allows researchers to evaluate the convergent validity (i.e., different evaluation methods have concurrent validity in the measurement of the same trait), and the discriminant validity (i.e., the level at which different traits measured with the same method are empirically separable). The multitrait-multimethod approach is integrated into the confirmatory factor analysis (Jöreskeg, 1971; Marsh & Hocevar, 1988; Widaman, 1985;) through the development of taxonomies of nested models. In the present study, we estimated three models (Fig. 1).

Model 1 (M1 −correlated traits, no methods) represents the theoretical structure of the scale, with seven correlated factors. Three parcels measured each support need factor; each parcel was the sum of the responses to the items in each of the three measurement methods. For example, the factor “home living” was measured by the sum of the responses to the type, frequency, and daily support time in household activities (similar to the way in which direct scores are obtained from each sub-scale, according to the SIS-C application manual [Thompson et al., 2016]). The hypothesis underlying this model is that the structure of support needs is represented better by seven first-order correlated factors.

In model 2 (M2 −correlated traits, uncorrelated methods), we specified seven support needs factors and three method factors (type, frequency, and daily time). Each method factor was measured by the parcels referred to each of the three methods. For example, the method factor “frequency” was measured by the parcels composed of frequency items, regardless of their substantive dimension. We estimated the correlations between the traits, but not between traits and methods, or between the methods themselves (i.e., we hypothesized that the sources of method variances were independent). The hypothesis underlying this model is that the structure of support needs is represented better by seven first-order correlated factors, plus three completely orthogonal method factors.

Model 3 (M3 −correlated traits, correlated methods) was similar to M2, except that the correlations of the method factors were freely estimated. The hypothesis underlying this model is that the structure of support needs is represented better by seven first-order correlated factors, plus three method factors correlated with each other.

Prior to the factor analyses, we verified by parallel analysis (Timmerman & Lorenzo-Seva, 2011) that the structure of each separate subscale was sufficiently one-dimensional. We assessed the internal structure of the SIS-C in two ways. First, we compared the fit of the three models according to the recommendations of Hu and Bentler (1999). The comparative fit index (CFI) and Tucker-Lewis index (TLI) above 0.90 and 0.95 suggest acceptable and good fit, respectively. A root mean square error of approximation (RMSEA) below 0.08 and 0.05 indicated acceptable and good fit, respectively. Second, we assessed the parameters of the best-fit model, with particular attention to the distribution and size of the factor loads and the total variance explained by the factors and the indicators. We estimated the convergent validity of the factors by calculating their total variance explained (i.e., the variance captured by the substantive factors vs. that captured by the method factors and the residual variance). Finally, we estimated the reliability of the factors through the omega hierarchical coefficient (ωh; Zinbarg, Yovel, Revelle, & McDonald, 2006), where ωh is the reliable systematic variance ratio in unit-weighted composite raw scores that can be attributed to the general factor. Consequently, ωh is an estimator of the accuracy with which the scores in each support needs dimension represent the position of the subject in that same latent variable, once the effects of the method factors and the residual variance have been controlled. A high ωh (> 0.70; Reise, 2012) is necessary to guarantee adequate reliability of the substantive factor.

We used robust maximum likelihood to estimate the models. The analyses were carried out using Mplus version 7.3 (Muthén & Muthén, 2014). We included a multilevel component in all models (TYPE = COMPLEX) to control the possible non-independence in the observations made by the same interviewer (64 clusters).

2.4.2. *Analysis of sample heterogeneity*

Once the best-fit model was identified, we assessed the distributional properties of the factor scores in each substantive SIS-C dimension, both in the complete sample and in the subsamples specified by their gross and fine motor function levels.

3. Results

3.1. *Fit and properties of the factor models*

We compared the three models in pairs to decide the best-fit model. With the first contrast (M1 vs. M2), we proved that the method factors in the SIS-C could not be ignored. As shown in Table 3, the M1 fit was unacceptable (RMSEA = 0.201; CFI = 0.681; TLI = 0.600) and substantially worse than M2 (RMSEA = 0.078; CFI = 0.958; TLI = 0.940; chi-square difference = 4.320 [24], $p < .000$). It implies that it is necessary to model the method variance to achieve a good fit to the data.

Consequently, a contrast between M2 and M3 was made to estimate whether the evaluation method had a different and independent impact on the measurement of support needs. When setting the correlations between the methods to zero, M3 did not fit significantly better than M2 (chi-square difference = 4.2 [3], $p > .05$). The model fit indices were practically identical (M3: RMSEA = 0.078, CFI = 0.958, TLI = 0.939). The correlations in M3 were not significant (except between “daily time” and “frequency” (r = 0.17; $p < .05$)), so there was no evidence of a common source of method variance. As such, we selected M2 as the final model.

The parameters of M2 were assessed to estimate its validity and reliability in the measurement of support needs. The factor loads of the traits were generally high (range = 0.99-0.49; M = 0.84; SD = 0.10), and they explained 74% of the model’s total variance, which suggests a high convergent validity of the support needs factors measured with the SIS-C. It is notable that the size of the method effects differed in each indicator, as shown in Table 4. The factor loads of the methods “type of support” and “support frequency” were low, meaning that each method factor explained minimal variance in the whole model (3 and 0.7%, respectively). However, the factor loads of “daily time support” were high (range = 0.60-0.75; M = 0.71), and the total variance explained of this indicator was similar to that of the traits (12%, on average).

The reliability based on the model was adequate, despite the presence of relevant variance of the method in the daily time indicators. The ωh values varied between 0.89 (home living) and 0.78 (school learning).

3.2. *Analysis of sample heterogeneity*

To explore the distribution of the factorial scores according to the GMFCS and MACS levels, jitter-plots were made. The dimension “home living” is represented in Fig. 2.

Table 3
Fit Indices of the Estimated Models.

Model	χ^2(df)	RMSEA (CI)	CFI	TLI	BIC	AIC	SRMR	fp
M1 (correlated traits, no methods)	1587 (168)	0.201 (.19-.21)	0.681	0.600	24909	24643	0.134	84
M2 (correlated traits, uncorrelated methods)	334 (147)	0.078 (.06-.08)	0.958	0.940	23177	22825	0.034	105
M3 (correlated traits, correlated methods)	330 (144)	0.078 (.06-.08)	0.958	0.939	23185	22824	0.026	108

Note: χ^2(df): Chi-square (degrees of freedom from the baseline model); RMSEA (CI): Root mean square error of approximation (confidence interval); CFI: Comparative fit index; TLI: Tucker-Lewis index; BIC: Bayesian information criterion; AIC: Akaike information criterion; SRMR: Standardized root mean square residual; fp: Free parameters.

Table 4
Parameters in Model 2 (correlated traits-uncorrelated methods) for Parcels.

	Loadings		Variance			ωh
	Trait	Method	Trait	Method	Residual	
Home living activities						0.89
P1-Type	0.99	−0.01	0.97	0.00	0.03	
P2-Frequency	0.98	0.09	0.96	0.01	0.03	
P3-Daily time	0.64	0.61	0.41	0.37	0.22	
Community living activities						0.82
P1-Type	0.99	−0.04	0.98	0.00	0.01	
P2-Frequency	0.93	0.28	0.87	0.08	0.06	
P3-Daily time	0.49	0.76	0.24	0.57	0.19	
School participation activities						0.86
P1-Type	0.99	0.01	1.00	0.00	0.00	
P2-Frequency	0.97	0.22	0.93	0.05	0.02	
P3-Daily time	0.61	0.69	0.37	0.47	0.15	
School learning activities						0.78
P1-Type	0.98	0.18	0.95	0.03	0.01	
P2-Frequency	0.91	0.21	0.82	0.04	0.14	
P3-Daily time	0.53	0.72	0.28	0.52	0.20	
Health and safety activities						0.79
P1-Type	0.95	0.23	0.91	0.05	0.04	
P2-Frequency	0.97	0.22	0.93	0.05	0.02	
P3-Daily time	0.56	0.76	0.31	0.58	0.11	
Social activities						0.84
P1-Type	0.96	0.21	0.92	0.04	0.04	
P2-Frequency	0.98	0.15	0.96	0.02	0.01	
P3-Daily time	0.67	0.70	0.45	0.49	0.06	
Advocacy activities						0.82
P1-Type	0.97	0.22	0.93	0.05	0.02	
P2-Frequency	0.98	0.13	0.96	0.02	0.02	
P3-Daily time	0.59	0.75	0.35	0.56	0.09	
ETV			0.74	0.19	0.07	

Note: All loadings are fully standardized; P: Parcel; ETV: Proportion of explained total variance in the whole model by traits, methods, and residuals; ωh: Omega hierarchical.

There was a remarkable density of children in the highest values of the variable. As shown in Table 5 and in Fig. 2, the distribution of the complete sample was asymmetrical. The distribution range of the children was broad (almost four standard deviations), and the interquartile range was approximately one standard deviation.

The scores were further condensed in the highest values when taking into consideration the levels in GMFCS and MACS, as shown in Fig. 2. The children in categories I, II, and III were distributed homogeneously over an extensive area of the latent variable (four standard deviations of amplitude in categories I and II, and three standard deviations in category III), and their distributions were slightly asymmetrical (-0.01 and -0.45, respectively). Category IV had a greater density in higher levels of the variable, much lower dispersion of scores, and higher asymmetry (-2.03). In category V, most of the children were placed in the ceiling of the variable, and there was little variance in their scores (the interquartile range covered 0.1 standard deviation).

We observed similar results in the other support needs factors with low levels of dispersion and relevant ceiling effects in the high categories of GMFCS and MACS (the results are available from the corresponding author).

4. Discussion

The first part of the study aims to analyze the internal structure of the SIS-C in children with motor disabilities. A model with seven correlated factors (equivalent to the theoretical structure of the scale) in addition to three independent method factors showed the best fit. Despite the presence of method factors, the support needs factors showed high convergent validity (according to the magnitude of the primary factorial loads and the variance explained by the substantive factors), and enough reliability (according to the values of the omega hierarchical).

This result is consistent with that found in samples of children with ID (Seo et al., 2016; Verdugo et al., 2017), in which the models with method factors also showed the best fit. To determine this similarity of results, we calculated the congruence coefficient (Tucker, 1951) between the primary factorial loads of our study and those obtained by Verdugo et al. (2017), Table 4, p. 9). The result of this comparison was 0.991, which was higher than the cut-off point of 0.95 suggested for considering the factors compared equivalent (Lorenzo-Seva & ten Berge, 2006).

As in the studies cited, according to our data, most of the method variance was concentrated in the indicators referring to “daily time support”. Although there is no conclusive explanation of this phenomenon, it is possible that part of the method variance was due to differences in the response scales (Verdugo et al., 2017). While the daily time response scale was composed of ordinal numbers (e.g., “less than 30 min”), the response scales for type and frequency of support consisted of vague quantifiers (e.g., “frequently”). In

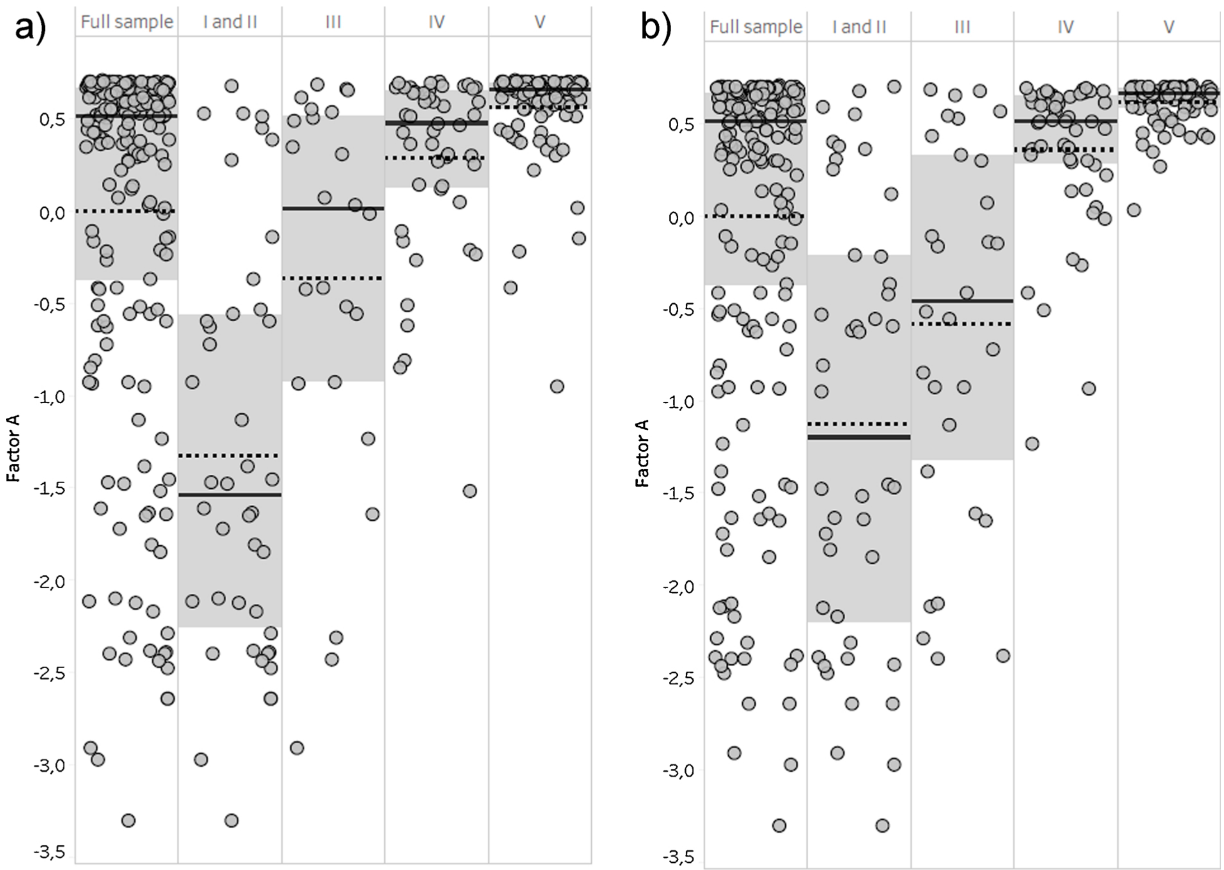

Fig. 2. Factor scores distribution for the home living dimension using the Gross Motor Function Classification System (Panel a) and Manual Ability Classification System (Panel b) levels.
Note: Each point represents a participant. The shaded bands represent the interquartile range, the dotted lines represent the mean, and the solid lines represent the median. The abscissa axis represents the factor standardized scores with mean = 0 and standard deviation = 1, for more straightforward interpretation. The ordinate axis represents a random variable, whose only function was to separate the points to allow easy visualization of the density of individuals.

Table 5
Descriptive Statistics of the SIS-C's Factor Scores.

	Mean	Median	SD	Skewness
GMFCS levels				
Full sample	0	0.51	1	−1.55
I and II	−1.13	−1.20	1.18	−0.01
III	−0.59	−0.46	1.02	−0.45
IV	0.36	0.52	0.42	−2.03
V	0.62	0.67	0.12	−2.42
MACS level				
Full sample	0	0.51	1	−1.55
I and II	−1.32	−1.54	1.11	0.36
III	−0.36	0.02	1.07	−1.07
IV	0.29	0.47	0.49	−1.73
V	0.56	0.66	0.26	−3.55

Note: GMFCS: Gross Motor Function Classification System; MACS: Manual Ability Classification System.

any case, our results suggest that the recommendations for the improvement of the SIS-C (Verdugo et al., 2017) could be extended to children with motor disabilities.

The recovery of the theoretical structure of SIS-C in children with motor disabilities is compatible with a cross-condition conception of support needs in groups with disabilities (Thompson & Viriyangkura, 2013; Thompson et al., 2009). Moreover, our results indicate that the seven-dimensional model could be a useful framework for investigating support needs in children with a motor disability. This framework would allow the development of evaluation systems that might facilitate the comparison of children with different types of disabilities for applied and research purposes. Indeed, in the absence of a study on measurement invariance, we cannot assure that the SIS-C scores are metrically equivalent between children with ID, with or without a motor disability. However, the high congruence between our results, and those of studies done on children with a primary diagnosis of ID, highly suggests that support needs do not represent a qualitatively different construct in children with motor disabilities. Previous studies conducted with adults (Bossaert et al., 2009) obtained different results, given that it had not been possible to recover the factorial structure of the SIS-A in individuals with motor disabilities. This discrepancy could be because of differences in the intensity of support needs in child/adolescent and adult populations (2016, Thompson et al., 2015), or due to the use of different SIS versions.

The seven-dimensional model seemed to be adequate to describe the structure of support needs in children with ID and motor disability. However, this does not imply that the SIS-C, in its current format, is a useful tool for *all* children with motor disabilities. In the second part of the study, we observed a strong ceiling effect in all factors. Most children with more significant limitations in their motor function exhibited very high levels of support needs, forming clusters with a very high density of individuals and minimal variability of scores. This ceiling effect could imply that in children with severe motor limitations, the SIS-C was not able to discriminate between children according to their level of support needs. Thus, its usefulness for assessing specific areas is compromised.

We can interpret this result in two ways. The first is that a part of the sample exhibited extreme support needs levels (i.e., their scores were genuinely homogeneous). The second is that the SIS-C was not discriminative at very high support needs levels, which was frequently observed in children with multiple disabilities and/or more significant functional limitations. Since no other studies are assessing the SIS-C in children with a motor disability, we were not able to compare our results. However, studies conducted with adult populations found similar results: high scores on all items in individuals with ID and motor disabilities (Arnkelsson & Sigurdsson, 2016), high or very high average scores in support needs dimensions in individuals with ID and physical impairments (Wehmeyer, Tassé, Davies, & Stock, 2012), and increased support needs scores when the ID and a physical/diverse primary disability were combined (Guscia, Harries, Kirby, Nettelbeck, & Taplin, 2006).

If the ceiling effect was due to the characteristics of the scale itself, a future research challenge is to design specific items that can be discriminative at very high support needs levels and therefore, would be appropriate for the estimation of individualized support profiles for children with greater functional limitations. The design of new items does not necessarily require specific scales. Techniques used in modern psychometry, as in item response theory (Embretson & Reise, 2000), would allow people not only to design suitable items for the assessment of different support needs levels but also to overcome the limitations of fixed-format scales in favor of personalized tests based on banks of calibrated items (e.g., Weiss, 1983).

Our study has some limitations, the first being the sample size. Although the analyses suggested that the size was enough to recover the parameters of the model accurately, a larger sample size would have allowed us to perform detailed analyses based on other grouping variables (e.g., type of disability or degree of severity). Secondly, we recognize that our study is not reflective of the cerebral palsy population since we recruited a lower percentage of children with GMFCS I and II levels than studies of prevalence reported (Bartlett, Dyszuk, Galuppi, & Gorter, 2018). In consequence, we cannot generalize the results to children with lower motor limitations. Thirdly, the analyses were limited to the data obtained from the application of the SIS-C. One aspect that could be relevant in the study of support needs in children with motor disability is the assessment of the ecological validity of the SIS-C indicators, for example, through structured interviews with the usual informants (professionals and parents). Furthermore, we only considered the professional caregivers' estimation of support needs for conducting the analyses. It was not possible to obtain the evaluation of two informants from different contexts to accomplish a more accurate estimation of the child's support needs, which is highly recommended for the development of individualized support plans. Finally, although our results suggest that the support needs structure was not qualitatively different in children with motor disability, future studies should investigate the measurement invariance for children without motor disability.

Even with these limitations, the present study represents the first attempt to evaluate the SIS-C in children with ID and motor disability. Several studies (Albrecht & Khetani, 2017; Anaby et al., 2013) have suggested that the perceptions of caregivers mediate the relationship between the children and their involvement in the environment. Regarding a supports model, in which informal supports constitute one of the primary sources of care (Schalock et al., 2010), it is essential that professionals and families become involved in all the necessary activities to design support plans. The SIS-C is a tool that facilitates this joint work, provided that professionals and families perceive the usefulness of this assessment instrument and its contribution to plans aimed at improving personal outcomes in children with disabilities. We hope that our study will contribute to the progress of research in this field.

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Declaration of Competing Interest

The authors declare that they have no competing interests.

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