Hammill Institute on Disabilities

The Journal of Special Education
2022, Vol. 56(1) 37–48

DOI: 10.1177/00224669211024593
journalofspecialeducation.sagepub.com
SAGE

An Analysis of Disability Groupings and Transition Planning Experiences

Ernest C. Davenport, PhD[1], David R. Johnson, PhD[1], Yi-Chen Wu, PhD[1], Martha L. Thurlow, PhD[1], Xueqin Qian, PhD[2], and John M. LaVelle, PhD[1]

Abstract

One important aspect of special education research that makes it complex is the variability of the disability categories being studied. This study used the context of Individualized Education Program (IEP)/transition planning and National Longitudinal Transition Study 2012 (NLTS 2012) student and parent survey items associated with this context to illustrate the challenges of grouping disability categories. We examined how disability groupings are treated similarly with respect to their transition planning experiences across different survey items. Findings illustrate that the 12 transition-related disability categories can be empirically formed into four clusters according to their IEP/transition planning meeting experiences. Results indicate that regardless of the scale used, these groupings are relatively consistent (e.g., autism, multiple disabilities, and orthopedic impairments were always together), but different from groupings based on theory or another set of items (e.g., self-determination). Implications for practice and future research are discussed.

Keywords

IEP/transition planning, NLTS 2012, disability groups, combining groups

Researchers and educators often rely on special education disability categories as a starting point to describe the educational and intervention needs of students with disabilities. Because of small numbers, researchers sometimes combine the disability categories in the Individuals with Disabilities Education Improvement Act (IDEA, 2004) into groupings such as high-incidence disabilities, sensory disabilities, and cognitive impairments. Whether these groupings make sense for identifying interventions and outcomes for transition-age youth has not been questioned.

For transition planning, IDEA indicates that parents and students by age 16 should meaningfully participate in planning their post high school transition to further education, employment, and community living (Wagner et al., 2012). Parent and youth participation in Individualized Education Program (IEP) transition planning meetings has become the cornerstone of federal special education policy and efforts to support youth in achieving educational and post-school outcomes. Studies consistently show students' participation in IEP/transition planning has a positive relationship with achieving positive post high school outcomes (e.g., Carter et al., 2012; Shogren et al., 2015; Wagner et al., 2005).

Research also has found predictive psychological and classificatory factors associated with students' and parents' participation in the IEP/transition planning process. For example, predictors exist at the student level (e.g., disability classification, functional and communication skills, self-determination skills), parent/family level (e.g., parent's education level, household income, parent involvement at school), and school level (e.g., access to college and career readiness courses, early paid work experiences, guidance and support from school staff) (Carter et al., 2012; Griffin et al., 2014; Johnson et al., 2020; Shogren & Plotner, 2012; Wagner et al., 2005). Each predictor contributes to IEP/transition planning participation, though they play different additive roles as a function of student, family, and school characteristics, leading to differences in the ways the meetings are approached and conducted and what students and parents experience through this planning process. The degree to which these meetings are purposefully differentiated in practice is unclear, as is the possibility that underlying factors might lead to systematic differences in the ways in which the meetings are conducted. To address questions about possible systematic differences in IEP/transition

[1]University of Minnesota, Minneapolis, USA
[2]Lawrence Free State High School, KS, USA

Corresponding Author:
David R. Johnson, Department of Organizational Leadership, Policy and Development, University of Minnesota, 233 Burton Hall, 178 Pillsbury Drive SE, Minneapolis, MN 55455, USA.
E-mail: johns006@umn.edu

Table 1. Sample Size by Disability Categories.

Disability group	*n*[a]	Weighted *n*	Weighted %
Autism	750	101,449	6.0
Deaf-blindness	100	483	<0.01
Emotional disturbance	830	155,549	9.2
Hearing impairment	400	20,966	1.2
Intellectual disability	980	181,703	10.9
Multiple disabilities	720	49,885	2.9
Orthopedic impairment	340	16,925	1.0
Other health impairment	890	245,885	14.3
Specific learning disability	1,090	813,818	47.5
Speech or language impairment	590	53,154	3.1
Traumatic brain injury	220	10,745	0.6
Visual impairment	200	7,827	0.5
Total students with IEP	7,160	1,658,389	100.0

Source. U.S. Department of Education, National Center for Education Statistics, National Longitudinal Transition Study 2012 (NLTS, 2012).
Note. IEP = individualized education program.
[a]The unweighted *n* is rounded to the nearest 10.

planning participation depending on the disability category groupings of students with disabilities, we examined IEP/transition experiences across 12 transition-age disability categories (see Table 1).

Disability Groupings

One facet of special education research that makes it complex is the variability of the disability categories being studied (Odom et al., 2005). Researchers often focus on a single group (e.g., learning disabilities, autism) (Barnard-Brak & Fearon, 2012; Shogren et al., 2018; Trainor et al., 2016) or cluster groups based on similar characteristics. Examples of the latter approach include groupings based on high-incidence disabilities (e.g., learning disabilities, emotional disturbance, other health impairments) (Carter et al., 2009; Trainor et al., 2016) or low-incidence disabilities (e.g., multiple disabilities, visual impairments, hearing impairments) (Carter et al., 2012; Johnson et al., 2020). Recently, Shogren et al.'s (2014) study on self-determination measurement equivalence and latent differences across disability categories suggested six disability groupings: (a) high-incidence disabilities (learning disabilities, emotional disturbances, speech or language impairments, and other health impairments), (b) sensory disabilities (visual and hearing impairment), (c) cognitive disabilities (autism spectrum disorder, multiple disabilities, and deaf-blindness), (d) intellectual disability, (e) traumatic brain injury, and (f) orthopedic impairments. Combining disability categories is especially prevalent when the sample of students is small in number (e.g., deaf-blindness, hearing and vision impairments).

Often it is unclear what theoretical or statistical rationale forms the basis for the groupings, and it appears that an assumption of data aggregation is that members within a disability grouping are "similar" even if that assumption has not been empirically tested. The effects of this assumption could lead to mis-groupings, mistaken comparisons, and inappropriate intervention recommendations, especially when one considers the heterogeneity within disability categories. Intellectual disability, for example, reflects a range of severity, and autism is conceptualized as a spectrum from high to low functioning. Researchers cannot just address a basic question as to whether a practice or intervention is effective in special education as a whole; rather they must specify for which students the practice is effective and in what context (Guralnick, 1999). Limited research has examined how groups can be formed empirically. Consequently, researchers have used intuitive reasoning in establishing and justifying disability groupings. We use the context of IEP/transition planning and student and parent survey item responses from the National Longitudinal Transition Study 2012 (NLTS 2012) to empirically examine groupings of disability categories.

IEP/Transition Planning

Several studies have explored student and parent participation in IEP/transition planning meetings for specific disability categories. Shogren and Plotner (2012) found 32.7% of students with autism spectrum disorder provided some input or leadership in their IEP/transition planning meeting in contrast to 53.0% of students with intellectual disability. Wagner et al. (2012) found that parents of students with multiple disabilities were less likely to attend the meetings compared to students with learning disabilities. Johnson et al. (2020) found differences in the type and level of participation and contribution of students with the most significant cognitive disabilities during meetings compared to students with other disabilities. These studies examined

only selected disability categories or groupings (generally those with sufficient numbers), reaching the conclusion that students in different disability categories have different IEP/transition planning experiences. Yet, without including all students with disabilities in the 12 transition-age disability categories, the picture of potential differences in experiences and implications for interventions is incomplete.

Purpose

Our purpose was to explore the extent to which different groupings of disability categories emerged based on similarities and dissimilarities in IEP/transition planning meeting experiences. We also evaluated the extent to which groupings were stable when different metrics (e.g., means, variances) were used. Using data from the most recent nationally representative dataset (Bloomenthal et al., 2017; NLTS 2012), we developed indices and used them for comparing selected aspects of IEP/transition planning meetings across disability groups. As our analysis involved several steps, we reasoned that undertaking them would result in different groupings from those based on theory or other variables (e.g., self-determination) and justify the need for more attention to how categories are combined in future research.

Our research questions were as follows:

Research Question 1 (RQ1): Which of the 12 disability categories are similar based on aspects of the IEP/transition planning meeting?
Research Question 2 (RQ2): Which of the 12 disability categories are dissimilar based on aspects of the IEP/transition planning meeting?
Research Question 3 (RQ3): Do similarities and dissimilarities depend on which feature of the data is used (means, variances, correlations, structure)?

Method

NLTS 2012 Data

The National Longitudinal Transition Study (NLTS 2012) collected data on a representative sample of students and their parents using surveys administered via web, telephone, or field in-person interviewing. NLTS 2012 used survey data to describe the backgrounds of students with IEPs and their functional abilities, activities in school and with friends, academic supports received from school and parents, and preparation for life after school. NLTS 2012 is the first NLTS study in the series to permit direct comparison of youth with and without IEPs. The focus of this study, however, was specifically on students with IEPs in IDEA's 12 disability groups.

The NLTS 2012 sampling process was designed to allow results to generalize to students receiving special education services in the United States in 2012. A two-stage probability sample was established to produce precise, national estimates of the backgrounds and experiences of these students (Burghardt et al., 2017). The first stage consisted of selecting a stratified national probability sample of districts. Districts included local education agencies, independent charter schools, and state-sponsored special schools. The second stage consisted of selecting a stratified sample of youth from each district that agreed to participate.

Data were collected from February to October 2012 and January to August 2013. Survey administration in 2012 was by computer-assisted telephone interviewing. A web option and field interviews were introduced in 2013. Approximately 10,460 parent surveys of youth with IEPs were completed of 17,480 attempted for a 59% weighted response rate (60% unweighted). Roughly 8,960 surveys of youth with IEPs were completed for a 51% response rate (weighted and unweighted). Youth were 12 to 23 years during the interviews, with over 97% ages 13 to 22. Less than 2% were 12 or younger, and less than 1% were 22 or older. All were enrolled in Grades 7 to 12 or in a secondary ungraded class and were 13 or older as of December 2011. Because the focus in this study was to explore whether features of the IEP/transition planning meetings were consistent across disability categories, we included students who were ages 14 to 22 as of December 2011, enrolled in a school system at the time of survey administration, and categorized in one of the 12 disability categories. Although the IDEA requirement is for IEP/transition planning to start by age 16, some states use age 14 as the point where students begin participation in IEP/transition planning. The NLTS 2012 data were chosen because they were the most recent in a continuation of the National Longitudinal Transition Study series. Approximately 7,160 students were included in this study.

Development and Validation Procedure for Indices

Analyses were carried out to first obtain summary statistics and then to develop indices and scales. For each pair of disability categories, we obtained values for nine indices and four scales, operationalizing their differences. After validating the scales and obtaining factor scores, we conducted cluster analyses to identify groupings of disability categories.

Scales and indices development. We started by obtaining summary statistics for the 12 items shown in Table 2, separately for students in each disability category. Most of these items are scored in a binary fashion (1 for "No" and 2 for "Yes"). Items 7, 8, and 9 are scored in an ordinal fashion (1–4 or 1–3). The summary statistics included sample

Table 2. Transition Variables Used.

Survey items	Weighted %	%*SE*
1. Youth attended IEP/transition planning meeting (L1)	71.3	1.1
2. Youth attended IEP/transition planning meeting (E1a)	77.3	1.0
3. Youth was invited to the meeting (E6b)	91.0	0.8
4. Youth met with school staff to develop a transition plan (L2)	66.0	1.3
5. Parent Attended IEP/transition planning meeting (E1)	86.4	0.9
6. Parent was invited to the meeting (E6a)	89.7	0.9
7. Youth role in IEP/transition planning meeting (youth report, L2a)		
Youth did not participate	4.6	0.6
Youth was present in discussions but participated very little or not at all	25.3	1.2
Youth provided some input	46.1	1.3
Youth took a leadership role, helping set the direction of the discussions, goals, and plans	24.1	1.2
8. Youth role in IEP/transition planning meeting (parent report, E5)		
Youth did not participate	13.4	0.8
Youth was present in discussions but participated very little or not at all	17.6	1.2
Youth provided some input	43.9	1.3
Youth took a leadership role (helping set the direction of the discussions, goals, and plans)	15.1	0.9
9. Youth's contribution of coming up with goals for meeting (E4)		
A little	60.6	1.3
Some	31.1	1.1
Mostly Youth	8.3	0.8
10. Youth's interests, strengths, and preferences was discussed at the meeting (E6c)	92.0	0.7
11. Staff from any community service agency took part in the meeting (E6d)	35.0	1.5
12. Youth received information on education, careers, or community living option (E6e)	60.1	1.4

Source: U.S. Department of Education, National Center for Education Statistics, National Longitudinal Transition Study 2012 (NLTS 2012).
Note. IEP = individualized education program. E Items from Parent Survey; L Items from Student Survey.

sizes, means, standard deviations, variance-covariance matrices, and Pearson correlation matrices. These summary statistics were used to obtain nine indices representing discrepancies among all pairs of the 12 disability categories. There are $12 \times (12 - 1)/2 = 66$ unique pairs of categories (e.g., *Category 1* vs. *Category 2, Category 1* vs. *Category 3, Category 1* vs. *Category 4, . . ., Category 11* vs. *Category 12*). Each of the nine indices showed differences between two groups on a given feature of the data. Two of the nine indices reflected mean differences, three indices referred to differences in the inter-item correlations, and two indices referenced differences in variances or variance-covariance matrices. The final set with two indices referenced structure differences inherent in correlation matrices. Each of the nine indices was standardized ($M = 0$ and $SD = 1$) to make the indices comparable. The four scales and nine indices are described below.

Mean Scale. Two indices form the mean scale—*effect size* and *Mahalanobis* distance. *Effect sizes* (Cohen, 1988) give the difference in means for two groups relative to a standard deviation. We used the pooled standard deviation, which is the square root of a weighted average of the variances for the groups where the weights are the sample sizes for the groups. We had 12 effect sizes for the 12 variables, so we took the average absolute value of the effect sizes to obtain one value to represent the difference between each pair of disability categories on the full set of variables. *Mahalanobis* distance (Anderson, 1984, p. 206, Equation 12) is a multivariate analog of the effect size. It operates on all variables simultaneously. It not only takes standard deviations into account, but also the interrelationships (covariances/correlations) of the variables. When there is only one dependent variable, Mahalanobis reduces to the effect size.

Correlation Scale. The first scale in this set was based on discrepancies in the correlation matrices of the 12 variables for each pair of categories. For these indices, we used corresponding nonredundant elements in the correlation matrices for the two groups being compared. Three indices form the correlation scale: the root mean square error and the mean absolute error (*MAE*, Chai & Draxler, 2014), and a function of the correlation of the items in the two correlation matrices ($1 - R$, to make it a dissimilarity index, as are the others).

Variance Scale. Two indices were created for the variance scale—*Var_Dif* and *Box_M. Var_Dif* is the mean of the absolute difference of the variance between the two categories for all 12 variables. *Box_M* (Box, 1949, p. 319)

Table 3. Correlation Matrix for Nine Indices.

Indices	Effect size	Mahalanobis distance	RMSE	MAE	1–*R*	Variance difference	Box's M	LOSS	Det_Ratio
Effect size	1								
Mahalanobis distance	0.88****	1							
RMSE	0.75****	0.65****	1						
MAE	0.74****	0.65****	0.99****	1					
1–*R*	0.68****	0.54****	0.94****	0.92****	1				
Variance difference	–0.49****	–0.33**	–0.18	–0.18	–0.10	1			
Box's M	–0.30*	–0.16	–0.02	–0.01	–0.00	0.85****	1		
LOSS	0.09	0.10	0.44***	0.38**	0.27*	–0.10	–0.24	1	
Det_Ratio	–0.32*	–0.29*	0.03	–0.02	–0.07	0.38	0.24	0.64****	1

Source. U.S. Department of Education, National Center for Education Statistics, National Longitudinal Transition Study 2012 (NLTS 2012).
Note. RMSE = root mean square error; MAE = mean absolute error.
*$p < .05$. **$p < .01$. ***$p < .001$. ****$p < .0001$.

forms the basis for a test of the homogeneity for variance-covariance matrices for the categories tested (we compared two categories at a time).

Structure Scale. Indices in the structure scale quantify the amount of "relatedness" expressed in the correlation matrices. *LOSS* is a function of a statistic used to quantify differences in correlation (variance-covariance) matrices used in CFA/SEM that forms the basis of the chi-square test of whether the matrices are different (Joreskog, 1967). Here instead of comparing an original and reduced matrix, we compared matrices for *Category i* versus *Category j*. *Det_Ratio* is the ratio of the determinants of the two matrices being compared. If the larger determinant is in the numerator, *Det_Ratio* increases from 1 as the determinants become more discrepant. The determinant of a correlation matrix quantifies the global relatedness of the variables. The determinant is 1.0 when all intercorrelations are 0 and decreases as the relationship of the variables increases becoming 0 when some variables are redundant.

Validating the four scales. Correlations, factor analysis, and reliability analysis were used to validate the created scales. One would expect intrascale indices to be more related than interscale indices. Factor analysis of the nine indices is expected to return four factors with indices for each scale defining a factor. We used a Principal Axis extraction to ensure factors were defined by what the indices had in common (Preacher & MacCallum, 2003). This was followed by a Promax rotation (Hendrickson & White, 1964) to obtain a Varimax-like solution (Kaiser, 1958) while allowing the factors to be correlated (Tucker, 1940). Reliability analysis (Cronbach, 1951) was conducted to ascertain the degree to which the indices in each scale were consistent.

Table 3 shows intercorrelations for the nine indices. All indices were more highly related to indices from their own scale. The intercorrelation for the structure indices was lower than the others. The indices for the means and correlations shared substantial relationship. Finally, the indices for variance were negatively related to those for the mean and correlation.

Table 4 shows that the factor analytic results were fairly clean; the lowest loading for items that should load together was larger than 0.70, while the largest loading for an index not on its scale was less than 0.30. Also, again the Mean and Correlation scales were related; their factors correlated 0.60. The Mean and Variance scales were related negatively, correlating −0.52. Table 5 shows the reliability results. Cronbach's alphas for the Correlation scale was .98, for the Mean scale was .94, for the Variance scale was .92, and for the Structure scale was .78. All estimates were above 0.70 and three were above 0.90. This is especially notable given the relationship between Cronbach's alpha and number of items (our largest scale has only three indices).

Factor (latent) scores were then obtained for the four scales (Gorsuch, 1983). Latent scores were obtained by separate principal component analyses of the indices for that scale (e.g., for the *Mean Scale* only *Effect Size* and *Mahalanobis* were used). One factor was extracted and factor scores were requested for this factor. This process occurred four times, one for each scale (*Mean, Correlation, Variance*, and *Structure*).

Principal component analyses were used to obtain factor scores because they give an optimal re-expression of the variables in the scale in one dimension (Preacher & MacCallum, 2003). There was a high positive relationship between the Correlation and Mean latent scores (0.70, $p < .0001$) and a smaller, but significant negative relationship between the Mean and Variance latent scores (−0.34, $p < .01$). The remaining factor score intercorrelations were nonsignificant.

Table 4. Oblique Rotated Factor Pattern and Inter-Factor Correlations.

Indices	Factor 1	Factor 2	Factor 3	Factor 4
Effect size	0.289	–0.078	–0.059	**0.727**
Mahalanobis distance	0.108	–0.008	0.030	**0.890**
RMSE	**0.914**	0.010	0.109	0.097
MAE	**0.949**	–0.001	0.031	0.040
1–*R*	**1.030**	0.055	–0.110	–0.063
Var_Dif	0.019	**0.923**	0.092	–0.044
M	0.043	**0.960**	–0.072	0.022
LOSS	0.155	–0.202	**0.842**	–0.013
Det_Ratio	–0.130	0.238	**0.797**	0.002
Factor correlations				
Factor 1	1.000			
Factor 2	–0.246	1.000		
Factor 3	0.204	0.050	1.000	
Factor 4	**0.602**	**–0.519**	–0.179	1.000

Source. U.S. Department of Education, National Center for Education Statistics, National Longitudinal Transition Study 2012 (NLTS 2012).
Note. RMSE = root mean square error; MAE = mean absolute error. Factor loadings greater than 0.84 are shown in bold.

Table 5. Cronbach's Coefficient Alpha for the Scales and Corrected Correlations.

Scale	Index	Corrected item total correlations
Scale 1—Correlation	RMSE	0.984
(α = .983)	MAE	0.972
	1–*R*	0.935
Scale 2—Mean	Effect size	0.885
(α = .939)	Mahalanobis distance	0.885
Scale 3—Variance	Difference in variance	0.853
(α = .921)	Box's M	0.853
Scale 4—Structure	LOSS	0.636
(α = .778)	Ratio of determinants	0.636

Source. U.S. Department of Education, National Center for Education Statistics, National Longitudinal Transition Study 2012 (NLTS 2012).
Note. RMSE = root mean square error; MAE = mean absolute error.

Cluster Analyses

The factor scores were used as the input for the cluster analyses, which consisted of structuring the groups based on the obtained latent scale values. We performed a separate cluster analysis (Ward, 1963) on each scale. Cluster analyses show the relative distance between each pair of disability categories, thus allowing one to ascertain which groups are more similar and which are more distinct. Cluster analyses were conducted on 12 × 12 matrices representing discrepancies between all pairs of categories on each of the four scales. Groups that are more similar will have smaller discrepancies and be placed closer together.

Results

We report findings based on the indices that we developed. The extent to which different groupings of disability categories emerged based on similarities and dissimilarities in IEP/transition planning meeting experiences as well as the stability of the groupings using different metrics are included here. Because the intercorrelations of the 12 variables for the category of deaf-blindness had a determinant of 0, *LOSS, Det_Ratio, and Scale 4–Structure* are missing for comparisons of all categories with the category of deaf-blindness.

Disability Category Groupings

Cluster Analysis A in Figure 1 shows the dendrogram for the similarity/difference of the 12 groups based on the Correlation scale. Emotional disturbance, Hearing impairment, Intellectual disability, Other health impairment, Specific learning disability, and Speech or language impairment were most similar. This was followed by Autism, Multiple disabilities, Orthopedic impairment, and Traumatic

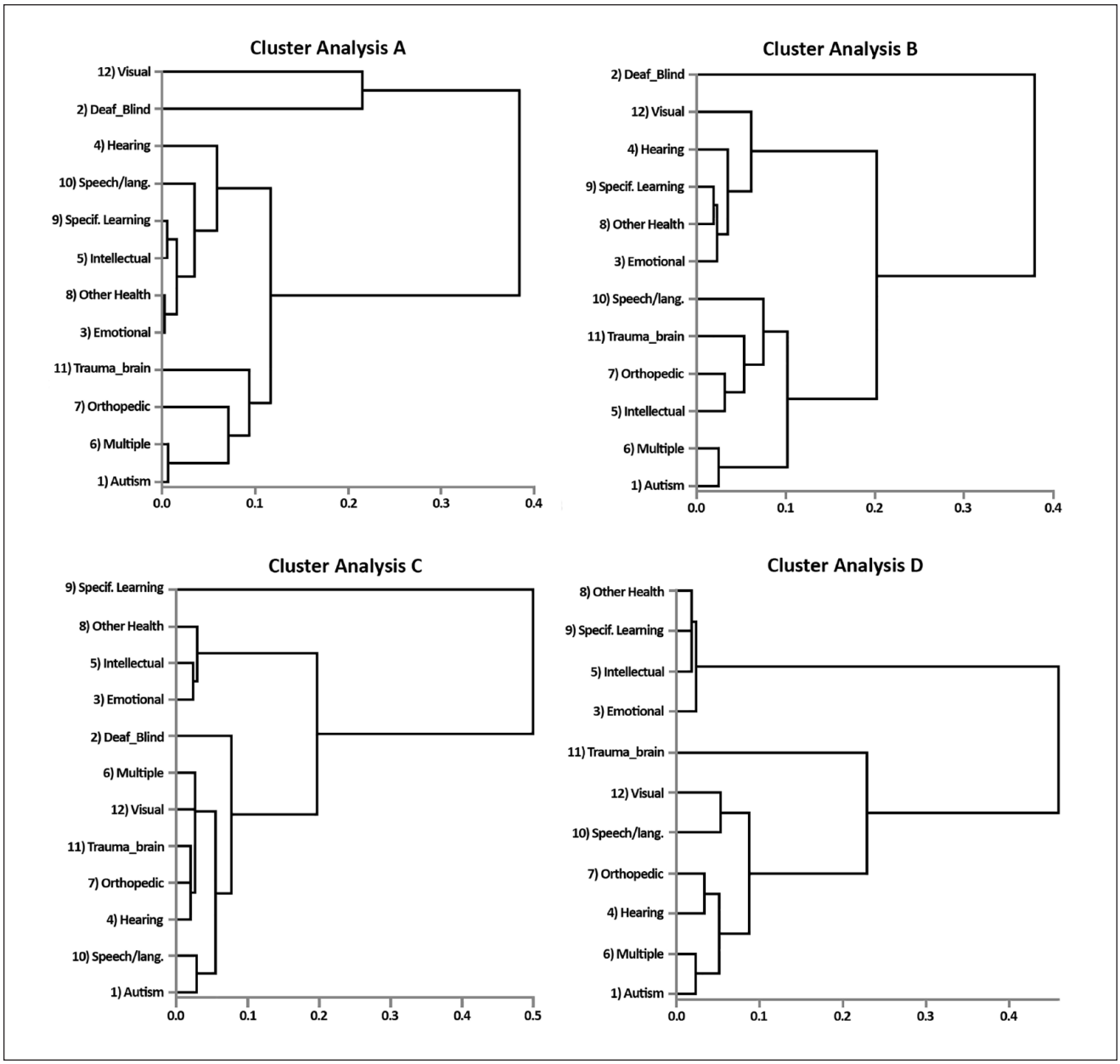

Figure 1. Cluster analysis results on the correlation scale.
Source. U.S. Department of Education, National Center for Education Statistics, National Longitudinal Transition Study 2012 (NLTS 2012).

brain injury which were next in similarity. Finally, Deaf-blindness and Visual impairment were similar, but their similarity was not as close as for the other groups.

Cluster Analysis B in Figure 1 shows the dendrogram based on the Mean scale. Here, Emotional disturbance, Hearing impairment, Other health impairment, Specific learning disability, and Visual impairment were most similar. This was followed by Autism, Intellectual disability, Multiple disabilities, and Orthopedic impairment. Deaf-blindness was not found to be similar to any other disability category.

Cluster Analysis C in Figure 1 shows the dendrogram for the Variance scale. Emotional disturbance, Intellectual disability, and Other health impairment were most similar. This was followed by Autism, Deaf-blindness, Hearing impairment, Multiple disabilities, Orthopedic impairment, Speech or language impairment, Traumatic brain injury, and Visual impairment, which were next in similarity. Specific learning disability was not found to be similar to any other disability category.

Cluster Analysis D in Figure 1 shows the dendrogram for the Structure scale. Emotional disturbance, Intellectual

Table 6. Cluster Summary.

Scale	Cluster	Disability groups
Scale 1–Correlation	One	Autism, Multiple disabilities, Orthopedic impairment, and Traumatic brain injury
	Two	Emotional disturbance, Hearing impairment, Intellectual disability, Other health impairment, Specific learning disability, and Speech or language impairment
	Three	Deaf-blindness and Visual impairment
Scale 2–Mean	One	Autism, Intellectual disability, Multiple disabilities, Orthopedic impairment, Speech or language impairment, and Traumatic brain injury
	Two	Emotional disturbance, Hearing impairment, Other health impairment, Specific learning disability, and Visual impairment
	Three	Deaf-blindness
Scale 3–Variance	One	Autism, Deaf-blindness, Hearing impairment, Multiple disabilities, Orthopedic impairment, Speech or language impairment, Traumatic brain injury, and Visual impairment
	Two	Emotional disturbance, Intellectual disability, and Other health impairment
	Three	Specific learning disability
Scale 4–Structure	One	Autism, Hearing impairment, Multiple disabilities, Orthopedic impairment, Speech or language impairment, and Visual impairment
	Two	Emotional disturbance, Intellectual disability, Other health impairment, and Specific learning disability
	Three	Traumatic brain injury
Group similarities (Summary)	One	Autism, Multiple disabilities, Orthopedic impairment, Speech or language impairment, and Traumatic brain injury
	Two	Emotional disturbance, Intellectual disability, Other health impairment, and Specific learning disability
	Three	Hearing impairment and Visual impairment
	Four	Deaf-blindness

Source. U.S. Department of Education, National Center for Education Statistics, National Longitudinal Transition Study 2012 (NLTS 2012).

disability, Other health impairment, and Specific learning disability were the most similar, followed by Autism, Hearing impairment, Multiple disabilities, Orthopedic impairment, Speech or language impairment, and Visual impairment, which were next in similarity. Finally, Traumatic brain injury was by itself. Deaf-blindness is not in these results as it had missing data on the Structure scale.

Stability of Disability Category Groupings

Table 6 summarizes the cluster analyses results. It shows that different features of the data (mean, correlation, variance, and structure) gave different results. Still, there were some similarities. Autism, Multiple disabilities, and Orthopedic impairment were always together. Speech or language impairment and Traumatic brain injury were also with this grouping for three of the four scales. Emotional disturbance and Other health impairment were always together and Intellectual disability and Specific learning disability were also with this grouping for three of the four scales. Finally, Hearing impairment and Visual impairment appeared together for three of the four cluster analyses. Thus, we have some consistency in grouping for 11 of the 12 categories. The first two groupings appear to be fairly consistent. The third grouping is not as consistent or large. Deaf-blindness was not as consistent. It had the smallest sample size of all groups, allowing for larger sampling error to possibly play into its inconsistency.

Table 7 shows the means and standard deviations of the factor scores by disability category, ordered by mean and variance similarity. The position of the categories in Table 7 should mirror (somewhat) the cluster analysis results for the Mean scale and the Variance scale (note which groups are close to each other). Values in Table 7 can be used to better understand the groupings and lead to testable hypotheses about interventions.

Discussion

Previous research typically relied on theory about similarities to group disability categories. One study (Shogren et al., 2014) used self-determination items to develop groupings. Whether either of these approaches reflects how students might be grouped based on their IEP/transition experiences was unknown. This study used a data-driven process to examine similarities and differences in the experiences of students in 12 disability categories.

Table 7. Means and Standard Deviations for Factor Scores.

Disability group	E1	E1a	E4	E5	E6a	E6b	E6c	E6d	E6e	L1	L2	L2a
					Means							
Autism	0.927	0.682	1.297	3.217	0.933	0.822	0.910	0.376	0.51	0.722	0.579	3.704
Deaf-blindness	0.979	0.81	1.255	3.001	0.979	0.96	0.977	0.537	0.287	0.767	0.635	3.776
Emotional disturbance	0.89	0.834	1.522	3.740	0.893	0.918	0.912	0.348	0.582	0.741	0.664	3.875
Hearing impairment	0.878	0.839	1.584	3.823	0.854	0.898	0.846	0.429	0.594	0.778	0.71	3.788
Intellectual disability	0.852	0.729	1.361	3.305	0.91	0.887	0.897	0.483	0.657	0.744	0.659	3.774
Multiple disabilities	0.899	0.671	1.286	3.032	0.928	0.824	0.906	0.406	0.514	0.718	0.541	3.748
Orthopedic impairment	0.902	0.758	1.415	3.569	0.927	0.941	0.936	0.431	0.639	0.741	0.582	3.782
Other health impairment	0.902	0.798	1.515	3.621	0.882	0.949	0.927	0.306	0.596	0.75	0.689	3.943
Specific learning disability	0.837	0.784	1.527	3.756	0.893	0.927	0.932	0.299	0.613	0.693	0.679	3.932
Speech or language impairment	0.816	0.696	1.45	3.56	0.831	0.833	0.891	0.269	0.589	0.524	0.548	3.952
Traumatic brain injury	0.874	0.737	1.306	3.559	0.873	0.918	0.956	0.312	0.524	0.664	0.606	3.79
Visual impairment	0.936	0.883	1.563	3.876	0.847	0.916	0.929	0.592	0.677	0.843	0.744	4.062
					Standard deviations							
Autism	3.327	5.938	6.39	11.199	3.175	4.85	3.641	6.153	6.355	5.723	6.356	10.322
Deaf- blindness	0.366	1.002	1.143	2.396	0.375	0.514	0.390	1.31	1.17	1.061	1.194	2.004
Emotional disturbance	4.822	5.698	9.633	12.353	4.781	4.212	4.367	7.363	7.611	6.735	7.170	12.608
Hearing impairment	2.709	3.052	5.266	6.391	2.817	2.421	2.899	3.982	3.954	3.438	3.663	6.62
Intellectual disability	5.395	6.758	8.891	13.254	4.252	4.709	4.522	7.424	7.027	6.628	7.135	13.74
Multiple disabilities	2.756	4.286	4.67	7.942	2.298	3.403	2.597	4.359	4.437	4.117	4.451	7.673
Orthopedic impairment	2.376	3.433	4.886	6.701	2.021	1.829	1.904	3.84	3.733	3.512	3.815	6.317
Other health impairment	5.531	7.466	11.851	15.143	5.648	3.852	4.535	8.054	8.607	7.983	8.153	14.651
Specific learning disability	11.3	12.598	20.242	27.132	9.079	7.627	7.383	13.406	14.342	14.011	13.729	23.364
Speech or language impairment	3.96	4.708	6.723	9.691	3.804	3.785	3.177	4.515	4.967	5.227	5.226	8.473
Traumatic brain injury	2.663	3.533	4.115	6.324	2.632	2.17	1.630	3.712	3.961	3.802	3.749	5.941
Visual impairment	1.678	2.195	4.493	5.231	2.355	1.82	1.675	3.181	3.072	2.489	2.816	4.994

Source. U.S. Department of Education, National Center for Education Statistics, National Longitudinal Transition Study 2012 (NLTS 2012).

In terms of similarities (RQ1), we found three groupings of disability categories. The first grouping included autism, multiple disabilities, orthopedic impairment, speech or language impairment, and traumatic brain injury. The second grouping included emotional disturbance, intellectual disability, other health impairment, and specific learning disability. The third grouping included hearing impairment and visual impairment. Deaf-blindness was by itself.

These groupings, although similar to some of the groupings based on perceived similarities in characteristics (e.g., Carter et al., 2012; Johnson et al., 2020; Shogren et al., 2014) rather than being data-driven, reflect the similarities in their IEP/transition experiences. The groupings suggest that students in different groupings have different experiences during the IEP/transition process. Although experiences need to be individualized, the findings raise question about whether students with hearing or visual impairments should have different experiences from, for example, those with autism or intellectual disabilities. Ensuring that the basics of students' transition experiences, such as attending meetings, participating in them, and contributing to post-school goals, should be a bottom line requirement for IEP teams.

Our findings for RQ2 confirm that the first grouping of disability categories differs from the second grouping of disability categories, which in turn also differs from the third grouping of disability categories in terms of their transition planning and participation. This finding confirms that researchers should be data-driven in determining how to group disability categories when necessary to have groups with sufficient numbers of students. It also suggests that IEP teams need to be alert to the possibility that different experiences are being provided based on perceptions of groups of disability categories rather than individual student characteristics.

We also found that groupings of disability categories did vary somewhat based on which facet of the data was used (RQ3). Despite considerable consistency across scales, there was no instance for which all the disability categories in one grouping were the same based on the four scales. This means that clustering results (i.e., groupings of disability categories) somewhat depend on which feature of the data is used. For researchers, this means that it is important to look for consistencies across scales when deciding how to group disability categories.

Future Research

Our results indicate that logical groupings of students into a high incidence disability group (e.g., learning disabilities with speech language impairment, other health impairments, and emotional disturbance) may not adequately represent the students. Our groupings were strictly empirical and were different from the groups that Shogren et al. (2014) found for their research on self-determination constructs. The grouping of disability categories seems to vary by not only the feature of the data used but by the topic of the data as well. Although the clusters obtained in this study seemed less logical, they provide evidence that students in certain disability categories had similar experiences during the IEP/transition planning meeting. The reasons why these disability categories had similar experiences is a topic for further research. Understanding that disability category has an impact on the way researchers and professionals attempt to understand and apply special education interventions and practices is important.

School personnel and IEP team members should customize the IEP/transition planning meeting to fit each student's needs and goals. For example, researchers (e.g., Griffin et al., 2014; Johnson et al., 2020; Shogren & Plotner, 2012) have shown students with autism, intellectual disability, and multiple disabilities share similar significant cognitive and developmental limitations in functional, communication, and self-advocacy skills; as a consequence, they experience more challenges in participating and in taking an active role in discussions in IEP/transition planning meetings. Researchers have found that students with higher cognitive levels (e.g., learning disabilities, emotional disturbances, and other health impaired) share greater social and behavioral characteristics (Lane et al., 2006; Trainor et al., 2016). Factors such as these should be exploited for student disability groupings who share common challenges and barriers by developing interventions and strategies to address their needs. Student's needs and goals should drive IEP/transition meetings rather than generalizations about disability categories.

Results shown in Table 7 illustrate where investigators might begin to form more intentional interventions. Although this study provides some additional insight into the relationship between disability category and specific IEP/transition planning participation experiences (i.e., attendance, role, and contribution in meetings), further research is needed to better understand identified interrelationships conceptually as well as empirically.

Limitations

NLTS 2012 data are self-report data and may not accurately reflect reality. For example, when asked whether the youth attended the IEP/transition planning meeting, there was 74.8% consistency in responses of youth and parents. Furthermore, even though NLTS 2012 provided weights to handle the effects of missing data, results of some analyses may need to be accepted with caution (e.g., only 30 students with deaf-blindness had valid responses to some items).

The results from this study are exploratory and should not be interpreted as implying causal relationships. Neither should differences between groups be interpreted as

reflecting differences between disability categories alone because we did not account for possible confounding factors. Because we conducted a secondary data analysis, we had only what was available to analyze. Also, our results are dependent on the statistics we chose. It is possible that results would differ if we used different variables and different statistics. Finally, disability category information was provided by districts. We had no way to verify the accuracy of the diagnoses. Still, because of the size of the sample and the careful sampling to ensure representativeness, the data have power to guide our understanding of IEP/transition planning experiences of students with disabilities, at least at the time the data were collected.

Conclusion

Although our research shows which disability category groups are treated similarly and which are treated differently, the reason for the differences in treatment is unknown. If differences are due to arbitrary factors, then schools need to be more intentional in the experiences that students have during the planning and execution of these meetings. Further study might indicate the causes for differences and possibly lead to interventions to ensure greater equity in outcomes for students regardless of disability category. How to combine groups is of special interest when studying disability categories that have numbers too small to support precise statistical estimates. An implicit assumption when combining groups is that members of the same group are similar. Even when groups are empirically combined, the feature of the data used may lead to different groupings. The process of aggregating data may be more complex than first thought. Thus, any research using groups formed by aggregating categories should provide justification for the grouping.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The research reported here was supported by the Institute of Education Sciences, U.S. Department of Education, through Grant R324A180178 to the University of Minnesota. The opinions expressed are those of the authors and do not represent views of the Institute or U.S. Department of Education.

References

Anderson, T. W. (1984). *An introduction to multivariate statistical analysis* (2nd ed.). John Wiley & Sons.

Barnard-Brak, L., & Fearon, D. D. (2012). Self-advocacy skills as a predictor of student IEP participation among adolescents with autism. *Education & Training in Autism & Developmental Disabilities*, *47*(1), 39–47.

Bloomenthal, A., Haimson, J., Lipscomb, S., Liu, A., Potter, F., & Waits, T. (2017). *National Longitudinal Transition Study 2012 Restricted Use File: Sampling and 2012-2013 Survey Data* [Data set]. National Center for Education Statistics.

Box, G. (1949). A general distribution theory for a class of likelihood criteria. *Biometrika*, *36*(3–4), 317–346. https://doi.org/10.1093/biomet/36.3-4.317

Burghardt, J., Haimson, J., Liu, A. Y., Lipscomb, S., Potter, F., Waits, T., & Wang, S. (2017). *National Longitudinal Transition Study 2012 design documentation* (NCEE 2017–4021). U.S. Department of Education, Institute of Education Sciences, National Center for Education Evaluation and Regional Assistance.

Carter, E. W., Austin, D., & Trainor, A. (2012). Predictors of post-school employment outcomes for young adults with severe disabilities. *Journal of Disability Policy Studies*, *23*(1), 50–63. https://doi.org/10.1177/1044207311414680

Carter, E. W., Trainor, A. A., Sun, Y., & Owens, L. (2009). Assessing the transition-related strengths and needs of adolescents with high-Incidence disabilities. *Exceptional Children*, *76*(1), 74–94. https://doi.org/10.1177/001440290907600104

Chai, T., & Draxler, R. (2014). Root mean square error (RMSE) or mean absolute error (MAE)?—Arguments against avoiding RMSE in the literature. *Geoscientificmodel Development*, *7*, 1247–1250. https://doi.org/10.5194/gmd-7-1247-2014

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Lawrence Erlbaum.

Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika*, *16*(3), 297–334. https://doi.org/10.1007/BF02310555

Gorsuch, R. L. (1983). *Factor analysis* (2nd ed.). Lawrence Erlbaum.

Griffin, M. M., Taylor, J. L., Urbano, R. C., & Hodapp, R. M. (2014). Involvement in transition planning meetings among high school students with autism spectrum disorders. *Journal of Special Education*, *47*(4), 256–264. https://doi.org/10.1177/0022466913475668

Guralnick, M. J. (1999). Second-generation research in the field of early intervention. In M. Guralnick (Ed.), *The effectiveness of early intervention* (pp. 3–22). Paul Brookes.

Hendrickson, A. E., & White, P. O. (1964). PROMAX: A quick method for rotation to oblique simple structure. *British Journal of Statistical Psychology*, *17*(1), 65–70. https://doi.org/10.1111/j.2044-8317.1964.tb00244.x

Individuals with Disabilities Education Improvement Act. (2004). Pub. L. No.108-446, 20 U.S.C. § 1400 *et seq*.

Johnson, D. R., Thurlow, M. L., Wu, Y. C., LaVelle, J. M., & Davenport, E. C. (2020). IEP/transition planning participation among students with the most significant cognitive disabilities: Findings from NLTS. (2012). *Career Development and Transition for Exceptional Individuals*, *43*(4), 226–239. https://doi.org/10.1177/2165143420952050

Joreskog, K. G. (1967). Some contributions to maximum likelihood factor analysis. *Psychometrika*, *32*(4), 443–482. https://doi.org/10.1007/BF02289658

Kaiser, H. F. (1958). The Varimax criterion for analytic rotation in factor analysis. *Psychometrika*, *23*(3), 187–200. https://doi.org/10.1007/BF02289233

Lane, K. L., Carter, E. W., Pierson, M. R. & Glaeser, B. C. (2006). Academic, social, and behavioral characteristics of high school students with emotional disturbances or learning disabilities. *Journal of Emotional and Behavioral Disorders*, *14*(2), 108–117. https://doi.org/10.1177/10634266060140020101

Odom, S. L., Brantlinger, E., Gersten, R., Horner, R. H., Thompson, B., & Harris, K. R. (2005). Research in special education: Scientific methods and evidence-based practices. *Exceptional Children*, *71*(2), 137–148. https://doi.org/10.1177/001440290507100201

Preacher, K. J., & MacCallum, R. C. (2003). Repairing Tom Swift's electric factor analysis machine. *Understanding Statistics*, *2*(1), 13–43. https://doi.org/10.1207/S15328031US0201_02

Shogren, K. A., Burke, K. M., Anderson, M. H., Antosh, A. A., Wehmeyer, M. L., LaPlante, T., & Shaw, L. A. (2018). Evaluating the differential impact of interventions to promote self-determination and goal attainment for transition-age youth with intellectual disability. *Research and Practice for Persons with Severe Disabilities*, *43*(3), 165–180. https://doi.org/10.1177/1540796918779775

Shogren, K. A., Kennedy, W., Dowsett, C., & Little, T. D. (2014). Autonomy, psychological empowerment, and self-realization: Exploring data on self-determination from NLTS2. *Exceptional Children*, *80*(2), 221–235. https://doi.org/10.1177/001440291408000206

Shogren, K. A., & Plotner, A. J. (2012). Transition planning for students with intellectual disability, autism, or other disabilities: Data from the National Longitudinal Transition Study-2. *Intellectual and Developmental Disabilities*, *50*(1), 16–30. https://doi.org/10.1177/001440290707300406

Shogren, K. A., Wehmeyer, M. L., Palmer, S. B., Rifenbark, G. G., & Little, T. D. (2015). Relationships between self-determination and postschool outcomes for youth with disabilities. *The Journal of Special Education*, *48*(4), 256–267. https://doi.org/10.1177/0022466913489733

Trainor, A. A., Morningstar, M. E., & Murray, A. (2016). Characteristics of transition planning and services for students with high-incidence disabilities. *Learning Disability Quarterly*, *39*(2), 113–124. https://doi.org/10.1177/0731948715607348

Tucker, L. (1940). The role of correlated factors in factor analysis. *Psychometrika*, *5*(2), 141–152. https://doi.org/10.1007/BF02287872

Wagner, M., Newman, L., Cameto, R., Garza, N., & Levine, P. (2005). *After high school: A first look at the postschool experiences of youth with disabilities* [A report from the National Longitudinal Transition Study-2 (NLTS2)]. SRI International.

Wagner, M., Newman, L., Cameto, R., Javitz, H., & Valdes, K. (2012). A national picture of parent and youth participation in IEP and transition planning meetings. *Journal of Disability Policy Studies*, *23*(3), 140–155. https://doi.org/10.1177/1044207311425384

Ward, J. H., Jr. (1963). Hierarchical grouping to optimize an objective function. *Journal of the American Statistical Association*, *58*(301), 236–244. https://doi.org/10.1080/01621459.1963.10500845