Cognitive Algebra Underlying Special Education Teachers' and Psychology Students' Attitudes Towards School Inclusion of People with Intellectual Disability

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Abstract: Attitudes towards regular school inclusion of people with intellectual disabilities (ID) are affected by factors such as disability severity, educational level, and teacher experience. Nevertheless, the ways that teachers integrate these factors to form inclusion judgments remains unclear. The current paper explores what systematic cognitive algebra rules are used to cognitively integrate this set of inclusion factors by special education teachers and psychology students. To do so, 469 special education teachers and psychology students were asked to take part in two experimental cognitive algebra studies. In each study, participants had to read a set of school inclusion scenarios and rate the probability that a scenario actor with ID could be successfully integrated into a regular school program. To this purpose, factor effects on successful school inclusion and ID related to individuality, situational aspects, and contextual considerations (e.g., school environment, grade level taught) were explored. Results suggested that participants showed attitudes to school inclusion ranking from light to moderate positive values. Situational factors, as well as context factors, were judged to be more significant than other factors in elementary education. These factors were integrated by following a cognitive summative rule. Overall, judgment for successful school inclusion follows a summative rule to integrate sources of information. This rule is maintained irrespective of the disability under consideration. However, valuation of each source of information does depend on the type of the current study sample. Implications of these results for inclusion of people with disabilities in regular schools are discussed in this paper.

Keywords: Intellectual disability, school inclusion, cognitive algebra, attitudes, special education teachers.

Human life is frequently characterized by disability. A considerable amount of people will experience some kind of disability through their life span. According to the World Health Organization (WHO), there are roughly one billion people living with some kind of disability (approximately 15% of the world's population), and at least 200 million of them have severe functional problems [1].

People with disabilities have less economic income and higher poverty index scores and health vulnerability. Unfortunately, these conditions seem to be enhanced whenever intellectual disability (ID) is considered [1]. Notably, many of these hurdles experienced by persons with ID occur due to social attitudes that promote social exclusion and discrimination, which prevents improvements in their lives [2, 3]. For instance, due to such biased attitudes, persons with ID have fewer opportunities to be enrolled in regular school programs than do people from the general population [1].

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There is a growing interest in academic research regarding the perception and attitudes toward regular school inclusion programs. These academic efforts employ different research methods (quantitative and qualitative), instruments (e.g., scales [4, 5], questionnaires [6], interviews [7]), samples (special education teachers [4], regular education teachers [8], parents of people with ID [9], students [10]), and research locations (e.g., USA [5], Jordan [11], Serbia [6], Australia [12], Pakistan [13]).

Studies regarding attitudes on inclusion of people with special needs in regular school programs has shown that attitude magnitude and direction varies by country [14], through evaluated samples [5, 6] and that overtime, more positive attitudes have become more common [15]. For instance, education institutions from a variety of different countries maintain a more open position to include those with ID into regular school programs (see research from USA [6], Russia [17], India [18], etc.).

The consolidation of a positive view of school inclusion of individuals with ID is difficult. Resistance to the idea of inclusion depends on several contextual factors (e.g., teaching grade [14], educative system [4], etc.). Take, for instance, academic reports from the

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United Arab Emirates [4] suggesting that the type of educative system (regular or especial) and grade level taught (preschool education, primary school, high school) affect teachers' attitudes towards inclusion. In addition, teaching factors (e.g., experience, training, and teacher beliefs [6, 11, 14]) seem to greatly influence attitudes toward school inclusion. Thus, Kalyva et al. [6] reported that teachers from Serbia who had more special education teaching experience showed a more open and positive attitude to school inclusion than did those who had no special education teaching experience. In another study from Jordan, Al-Zyoudi [11] reported that in addition to teaching experience, the type of training that teachers had affected teacher attitudes to school inclusion. In fact, teachers' self-assessed capacities to teach special education [19], as well as the required level of teaching enrolment (e.g., general vs. direct participation), seem to be factors affecting their willingness to endorse school inclusion. Indeed, Scruggs and Mastropieri [20] found that only a small proportion of teachers favouring the inclusion of individuals with ID in regular school programs are willing to include them in their own classrooms.

Teachers' attitudes seem to be affected by another set of factors related to school inclusion (e.g., type of disability, demographic variables). For instance, Al-Zyoudi [11] also reported that Jordanian teachers' attitudes toward school inclusion depend on disability type and severity. Similar reports can be found in other studies (e.g., Cook [21]). Moreover, Leyser et al. [14] concluded that school inclusion criteria are affected by demographic considerations. Alahbabi [4], too, reported that group belongingness had a significant influence on teachers' attitudes towards school inclusion.

Nevertheless, little is known about the cognitive mechanisms underlying attitude formation. A methodological alternative to this research demand can be introduced by considering how cognitive algebraic behaviour underlies attitude behaviour as proposed by the Information Integration Theory (IIT) [22, 23]. The IIT approach focuses on finding cognitive-psychological integration information rules, know as cognitive algebra. Specifically, this approach provides a method of identifying cognitive algebraic rules that people tend to use to systematically integrate psychologically valuated stimuli.

In terms of studying attitudes, the above implies that if two or more factors related to attitudes are psychologically integrated by a person, then an interaction graph obtained from experimental factor manipulation will show a specific visual pattern describing the integration information rule used by this person for attitude formation [24, 25]. Typical cognitive algebraic behaviour seems to be typified by summative, multiplicative, and average rules [26, 27]. Thus, parallel lines patterns in an interaction graph imply the use of cognitive additive rules to factor integration, whereas graph lines showing a fan pattern imply the use of a cognitive multiplicative rule. The use of a cognitive average rule can be inferred by observing a crossover line pattern [22, 23, 28, 39, 30, 31].

By using an IIT approach, it is possible to identify the use of cognitively ruled behaviour underlying judgment formation in many complex psychological domains [32], such as love [33], sexuality [34, 35, 36], medical concerns [37], interpersonal relationships [29], pleasure-related visual and auditory stimuli [38, 31], health [39], bioethics [40], ID and love [41, 24]. Here, we will employ the IIT in the context of school inclusion to explore how people cognitively use or combine individual, situational, and/or contextual factors to elaborate success judgments about regular school inclusion and ID.

METHOD

Measuring different societal groups' attitudes towards school inclusion of individuals with ID is important because these groups determine the educational environment of individuals with disabilities. According to a National Statistic and Geography Institute (INEGI) Report there are about 290 000 people with ID in Mexico [42]. However, only a small number of scientific articles can be found related to school inclusion and ID. This indicates a need for more empirical research to elucidate the cognitive nature of the judgments of school inclusion of individuals with ID. Here, we describe two studies wherein we explored the information integration cognitive mechanisms underlying special education teachers and psychology students' judgment about school inclusion of persons with ID.

First Study

The influence of contextual and individual factors on attitudes towards ID and school inclusion

The first study employed an IIT cognitive algebra design [22, 23, 25] taken from Morales, Lopez,

Charles, Castro, & Sanchez [42]. Here, five sources of information were considered as the independent variables: gender, disability, and severity of disability (individual factors); school environment (contextual factor); and social support (situational factor). Each source was orthogonally combined in a factorial 2 (gender: female vs. male) × 2 (type of disability: physical vs. intellectual) × 2 (severity of disability: light vs. severe) × 2 (school environment: with adaptations vs. without adaptations) × 2 (social support: with vs. without) design. Thus, 32 experimental conditions were obtained. The dependent variable was the study participants' judgment of the likelihood that people with ID could be successfully integrated into regular school programs.

Here, the index of probability for successful school integration was considered as a linear combination of factors:

ESSI= f(w_G gender ∗ w_D type of disability ∗ w_{Se} severity ∗ w_{SS} social support ∗ w_{SE} school environment).

Where ESSI (estimation of successful school inclusion) is an information integration cognitive operation (*) combining weighted information factors (W_i).

Participants

This first study employed a sample of 267 participants; 81 were special education teachers (75 women and 6 men) with an age range of 23 to 56 years old (M = 33.11, SD = 9.7); 186 were psychology students who reported to be interested in the study of disability, with an age range of 17 to 34 years old (M = 21.08, SD = 2.43). Participants lived in Monterrey (Nuevo Leon), a city in northern Mexico. All participants verbally agreed to voluntary participation without economic remuneration.

Instruments

An instrument based on Morales et al. [42] was used. It consisted of 32 vignettes, each describing, in a few lines, a case of school inclusion (experimental scenario obtained from the factor combination previously appointed) of a student with ID or a physical disability (PD). At the end of each scenario, a question was presented asking the participant how likely it was that the student described would be included into a regular school program. The 10-point scale ranged from "non-successful" to "completely successful". A vignette example is provided below:

Caroline has a light intellectual disability. She has trisomy 21 (Down syndrome). She counts with support from her family and a highly favourable social environment. This year she will be enrolled in a regular school program. However, the school has neither specialized personnel nor the necessary equipment for cases like hers.

To what extent do you think Caroline will be successfully included?

Non-successful o-----o-----o-----o-----o-----o-----o-----o-----o-----o-----o-----o Completely successful

Additional information from participants was obtained by using a brief demographic questionnaire (age, gender, education level, and religion).

Procedure

Participants were tested in a group study session. They were required to read each of the 32 scenarios and rate, on a 10-point scale, the probability of successful school inclusion. Scenarios were randomly presented on printed paper cards. The required time to complete the study varied from 25 to 50 minutes, depending on the study participant.

First Study Results

Data analyses were carried out in line with a cognitive algebra approach. This paradigm assumes that if two or more factors were systematically integrated by a cognitive mathematical rule. Then a factor design interaction graph will visually show in a bi-dimensional space, specific data patterns [22, 23, 24]. For instance, summative rules may be revealed as ascendant parallel lines, whereas multiplicative rules might be presented as lines forming a fan pattern. Average rules are typified by crossover patterns. Thus, ANOVA interaction graphs are central to the present analysis.

A 2 (type of group) × 2 (gender) × 2 (type of disability) × 2 (severity of disability) × 2 (social support) × 2 (school environment) mixed ANOVA was carried out. The statistical significance criterion was set to $p < .001$.

Results showed no main effect for type of group, $\eta^2_p = .0001$. The prediction for successful inclusion was

Table 1: ANOVA Results Regarding the Influence of Contextual and Individual Factors on Attitudes about School Inclusion of People with ID

Source	df	MS	df	MS	F	p	η^2
(N= 267) (M= 5.4)							
Group (Gr)	1	0.06	265	31.02	0.002	ns	0.000
Gender (G)	1	0.15	265	1.70	0.089	ns	0.000
Disability (D)	1	1.31	265	2.79	0.469	ns	0.001
Severity (S)	1	1059.65	265	5.30	199.57	0.001	0.429
Social Support (Ss)	1	13299.68	265	13.97	951.66	0.001	0.782
School env.(Se)	1	19126.75	265	14.81	1291.10	0.001	0.829
G*Gr	1	2.50	265	1.70	1.46	ns	0.005
D*Gr	1	15.33	265	2.79	5.47	ns	0.020
S*Gr	1	13.74	265	5.30	2.58	ns	0.009
Ss*Gr	1	7.94	265	13.97	0.56	ns	0.002
Se*Gr	1	2.00	265	14.81	0.13	ns	0.000
G*D	1	0.82	265	1.26	0.65	ns	0.002
G*S	1	0.10	265	1.30	0.07	ns	0.000
D*S	1	3.9	265	1.37	2.88	ns	0.010
G* Ss	1	7.18	265	1.55	4.60	ns	0.017
D* Se	1	7.63	265	1.94	3.92	ns	0.014
S* Ss	1	1.19	265	1.53	0.78	ns	0.002
G* Se	1	1.06	265	1.53	0.69	ns	0.002
D* Se	1	0.80	265	1.53	0.52	ns	0.001
S* Se	1	3.22	265	1.57	2.04	ns	0.007
Ss* Se	1	0.56	265	5.13	0.10	ns	0.000

somewhat positive according to both psychology students and special education teachers (mean of probability of success or M = 5.4). Overall, school environment showed the strongest main effect (η^2_p = .82 versus .78 for social support and .42 for severity). This last result suggests that perception of successful school inclusion is higher whenever a well-adapted school environment is considered (M = 7.10). When a person with ID had social support, the prediction for successful inclusion was more optimistic (M = 6.83) compared to a person who does not have such support (M = 4.12). Additionally, a person with a minor disability was considered to have more chances of successful inclusion (M = 5.86) than one with a severe disability (M = 5.09). Gender and disability had no main effects, that is, study participants assigned around the same probability for school inclusion to women and men no matter if they had an intellectual disability (ID) or a physical disability (PD). No interaction effects were obtained for any factor combination of the design by considering the criterion p < .001. The data pattern in the interaction graph suggests that, in general, study participants integrated factors of disability severity, social support, and school environment by using a summative cognitive rule (see Figure **1**).

As may be observed in Figure **1**, ESSI is a linear function of factor weight combination:

ESSI = *f*(w_{Se} school environment + w_{Ss} social support + w_{Sd} severity of disability)

Second Study

The influence of school factors on attitudes about school inclusion and ID

Since the school factor had a major influence on judgment in the first experiment, a follow-up study was mounted to test how school-specific variables affect teachers' attitudes, as well as how these variables are cognitively integrated with individual attributes (which, in turn, was also evaluated as one of the most relevant

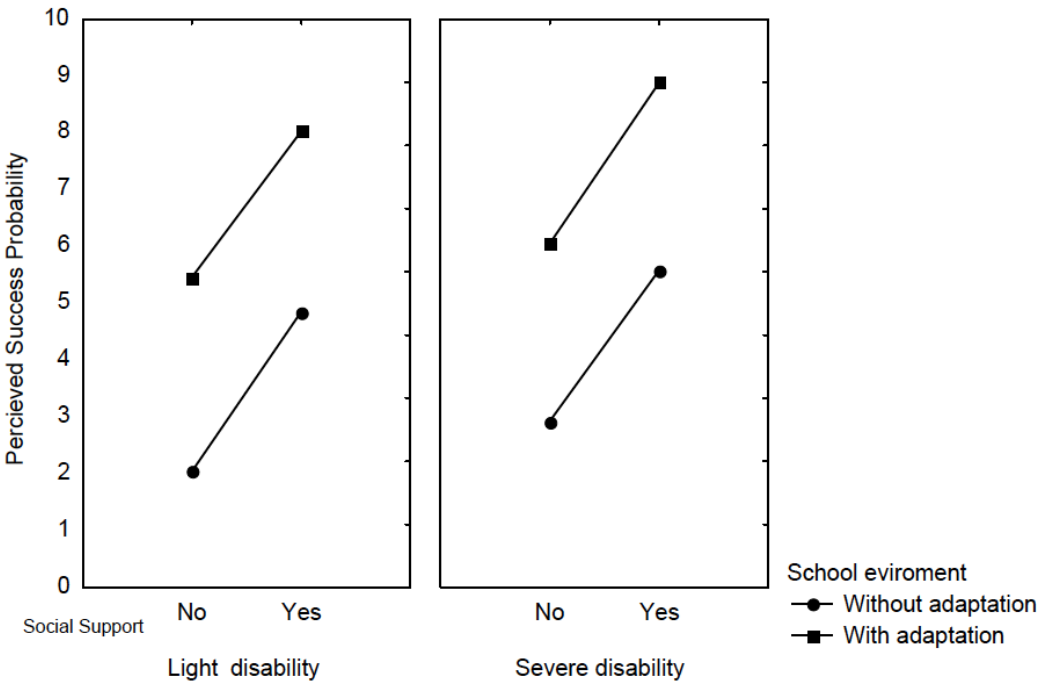

Figure 1: Interaction graph showing the special education teachers' performance over different experimental conditions. The resulting data pattern is a factor combination of school environment, severity of disability, social support and disability.

in the previous study). This research intention is formally expressed below:

ESSI = f(w_G gender ∗ w_{Se} severity of disability ∗ w_{GL} grade level taught ∗ w_{ED} teaching experience)

Again, ESSI is an estimated index of successful school inclusion that is linearly related to the weighted combination (W_i) of factors through a cognitive operation.

An experimental factor design presented by Morales et al. [42] was used to orthogonally combine these four factors with their respective factor levels (2 × 3 × 3 × 2). Thus, 36 experimental conditions were obtained by combining gender (female vs. male) × severity of disability (light vs. moderate vs. severe) × grade level taught (preschool vs. primary education vs. high school) × teaching experience (with experience vs. without experience).

Participants

A total sample of 199 participants was considered. In this study 99 were special education teachers (91 women and 7 men) with an age range of 22 to 56 years old (M = 30.32, SD = 8.37); 100 were psychology students (79 women and 21 men) with an age range of 17 to 28 years old (M = 20.1, SD = 2.2). Participants lived in Monterrey (Nuevo Leon), a city in northern Mexico. All participants gave verbal consent to take part in this study voluntarily, and received no economic remuneration.

Instruments

The instrument employed by Morales et al. [42] was also used in this study, and consisted of 36 vignettes (each representing an experimental condition obtained from factor combinations). Each vignette described a school inclusion scenario of a person with ID. At the end of each scenario, a question was presented asking participants to rate, on a 10-point scale, how likely the described student could be integrated into a school program. The scale ranged from "non-successful" to "completely successful". We provide a vignette example below:

Diana is a child who has a light intellectual disability. Currently, she attends a special education institute. However, soon she will be enrolled into a regular primary school program. The assigned teacher has been trained to handle children with intellectual disability and has experience in handling children with different kinds of disability.

To what extent do you think Diana will have a successful school inclusion?

Non-successful o-----o-----o-----o-----o-----o-----o-----o-----o-----o-----o-----o Completely successful

Procedure

Similar to the first study, a three-phase procedure was carried out. First, verbal consent for voluntary participation was obtained from each participant. A second phase (calibration) consisted of providing verbal instructions to participants. Finally, the experimental phase required each participant to read each vignette and to rate the likelihood of successful school inclusion. Scenarios were randomly presented on printed paper cards.

Second Study Results

A 2 (Group) × 2 (Gender) × 3 (Severity) × 3 (Grade level taught) × 2 (Teaching experience) ANOVA was performed. This design was considered having in mind that gender had no significant main effect in the previous analysis. Statistical significance was set at $p < .001$.

Results showed that judgment for probability of successful inclusion was moderately positive in both groups (M= 6.49). Teachers' and students' judgments were strongly mediated by teacher experience (η^2_p = .66), severity of disability (η^2_p = .62), and grade level taught (η^2_p = .16). However, there was a main effect for the group factor $F(1,195) = 13.713$, $p = 0.001$, η^2_p = 0.065; therefore, Table **2** shows the 2 × 2 × 2 × 2 × 2 ANOVA results for each group. Teachers' results showed relatively high ratings of success (M = 6.1) for a student with ID to be included in a regular school program. This perception was strongly influenced by the teacher experience (η^2_p = 0.73), severity of disability (η^2_p = 0.66), and grade level taught (η^2_p = 0.17).

Note that no significant interaction effects were found for either group. This suggests that both groups use a summative rule to integrate sources of information from teacher experience, severity of disability, and grade level taught (Figure **2**), even when factor weighting was different for both groups. The most highly weighted factor for teachers was severity of disability, whereas students weighted teachers' experience as being most relevant.

Table 2: ANOVA Results for Each Participant Group Regarding the Influence of School Individual and School Factors on Judgment about Successful School Inclusion

Source	df	MS	df	MS	F	p	η^2
<<Special education teachers (N= 99) (M= 6.1) >>							
Gender (G)	1	0.24	96	0.94	0.25	*ns*	0.002
Severity (S)	2	6586.11	192	33.97	193.85	0.001	0.668
Grade level taught (Gl)	2	38.68	192	1.88	20.52	0.001	0.176
Teacher experience (Te)	1	1235.37	96	10.13	121.83	0.001	0.559
G*S	2	0.00	192	0.85	0.00	*ns*	0.000
G* Gl	2	1.60	192	0.82	1.94	*ns*	0.019
S* Gl	4	4.41	384	1.22	3.59	*ns*	0.036
G*Te	1	0.00	96	0.74	0.00	*ns*	0.000
S*Te	2	1.46	192	1.73	0.84	*ns*	0.008
Gl *Te	2	0.96	192	1.00	0.96	*ns*	0.009
<<Psychology students (N= 100) (M= 6.8) >>							
Gender (G)	1	0.013	99	0.75	0.018	ns	0.000
Severity (S)	2	959.58	198	4.85	197.81	.001	0.666
Grade level taught (Gl)	2	56.20	198	2.79	20.12	.001	0.168
Teacher experience (Te)	1	2961.17	99	10.79	274.28	.001	0.734
G*S	2	0.05	198	0.88	0.06	*ns*	0.000
G* Gl	2	2.89	198	0.78	3.69	*ns*	0.035
S* Gl	4	0.85	396	1.10	0.77	*ns*	0.007
G*Te	1	0.46	99	0.78	0.59	*ns*	0.005
S*Te	2	5.98	198	1.70	3.50	*ns*	0.034
Gl *Te	2	0.38	198	1.10	0.35	*ns*	0.003

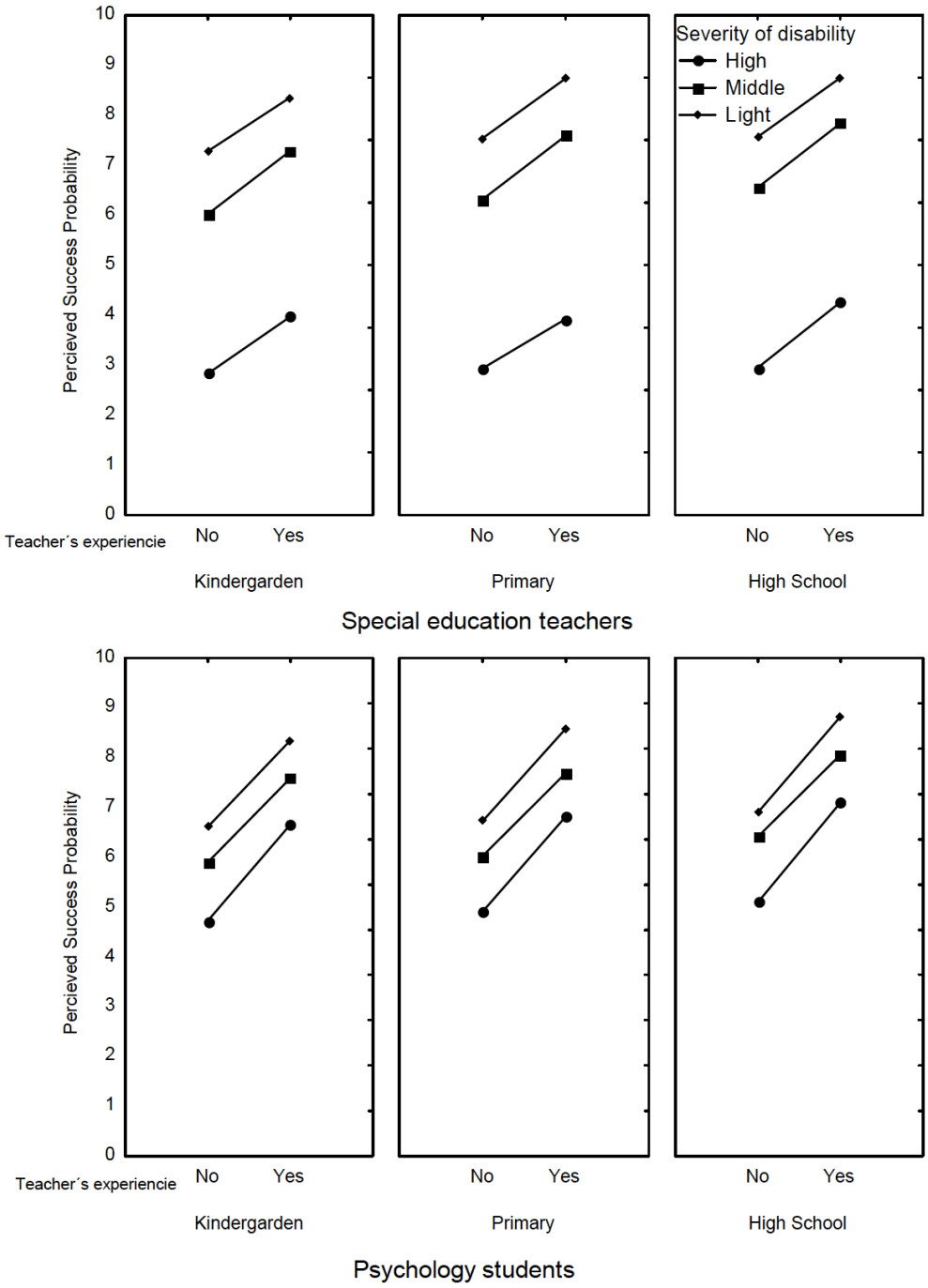

Figure 2: The top panel shows teachers' performance, and the bottom panel shows students´ performance. Both cases show the influence of teacher experience, severity of disability, and grade level taught on judgment of successful school inclusion.

Thus, the estimated index of successful school inclusion for students is:

ESSI = *f* (w_{Te} teacher experience + w_{Sd} severity of disability + w_{Gl} grade level taught).

Whereas the judgment index for teachers is:

ESSI = *f* (w_{Sd} severity of disability + w_{Te} teachers experience + w_{Gl} grade level taught)

DISCUSSION AND CONCLUSIONS

This study explored special education teachers' and psychology students' attitudes about the inclusion of students with ID in regular school programs. Overall, the study results showed a slight-to-moderate positive view of school inclusion across different levels of education. This seems to be in accordance with the academic literature reporting a positive trend in views on school inclusion of students with disabilities. Here,

results suggest that contextual factors (social and school environment: physical adaptations, training, and teaching staff´s competencies) play an important role in judgments about the successful inclusion of people with disabilities (see Table **1**). However, when a person with ID was exclusively evaluated, teachers judged that factors related to disability (e.g., severity of disability) were most significant for school performance. Psychology students, meanwhile, believed that teachers' teaching competence was the most relevant aspect for successful school inclusion of students with ID (see Table **2**). Students had a slightly more positive view of successful school inclusion than teachers did, which seems to be related to the experience factor mediating success expectancies.

With regard to the cognitive integration information mechanisms underlying judgment formation, our results suggest that judgment for successful school inclusion follows a summative rule to integrate sources of information (see Figures **1** and **2**). Particularly relevant to this is the fact that there are different valuations between groups on sources of information regarding disability and school inclusion. Furthermore, our results are directly relevant to real-world education reform, since special education teachers actively participate in school inclusion processes. Their opinions on inclusion are a key factor to consider when guidelines regarding school inclusion and ID are being developed.

The promotion of favourable attitudes about inclusion of people with disabilities in regular schools may benefit from consulting the factor valuation obtained in this study. This academic criterion will bring about life improvements for people with disabilities if it is used as a tool for research on the adaptation of school environments and generation of educative opportunities.

Finally, our results show a number of benefits to using cognitive algebra designs. These designs provide information about attitude magnitude as well as insight regarding the cognitive systematic behaviour underlying perceptions and attitudes about inclusion of students with disabilities. Cognitive algebra experimental designs, like the one presented herein, can be useful to exploring other research domains related to attitudes on disability (e.g., to determine if there is a different cognitive rule underlying attitudes of teachers that is dependent on school environments).

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