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Research article

Evaluation of emotional and psycholinguistic problems in deaf and hard-of-hearing students in the Canary Islands

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ABSTRACT

Objectives: The current study evaluated deaf and hard-of-hearing students' mental health in terms of emotional and behavioral strengths and difficulties, as measured by the SDQ in the Canary Islands. Furthermore, it evaluated the students' psycholinguistic abilities using the Spanish version of the ITPA.
Methods: The Strengths and Difficulties Questionnaire (SDQ) was used to assess school children problems. The Illinois Test of Psycholinguistic Abilities measured student spoken and written linguistic abilities.
Results: Student self-reports yielded different SDQ scores to parent and teacher reports. Student spoken and written linguistic abilities varied according to ten covariates.
Discussion: Perceptions about the mental health of children differed according to the groups studied. Perceptions about student abilities in the classroom were different, particularly the ability to reproduce sequences of complex and non-significant figures by memory.
Conclusion: Two outcomes emerged: a) conduct problems were the SDQ subscale that most distinguished children with cochlear implants from those with hearing aids, and b) tutor and specialist teacher experience appeared as the decisive influencing students' psycholinguistic abilities.

1. Introduction

Deaf and hard of hearing (DHH) students have been supported in the public schools of the Canary Islands (Spain) through a process known as inclusive education. Inclusive education has meant that students with special needs have received regular instruction in the same classroom as their peers (UNESCO, 1994). Furthermore, students using hearing devices (e.g. cochlear implants or hearing aids) have additional support from a hearing and speech specialist (HSS) to close communication gaps in primary, secondary and high school education. This study has started from the assumption that hearing loss has been a meaningful public health issue and that the timely beginning of hearing restoration with listening devices could improve language development and spur social and behavioural changes in individuals. How DHH students have felt about themselves has been perceived as crucial to their school performance. However, research evidence has been inconclusive. Additionally, educational research findings on DHH students in the Canary Islands has been lacking.

First, the population of students using cochlear implants (a neuroprosthesis that bypasses the ear and provides sound stimulation to the brain) or hearing aids (small electronic device that children wear in or behind their ear) has been heterogeneous. Children and adolescents have been different regarding the extent and type of their hearing loss, their age of onset and/or diagnosis, their ability to communicate, their parents' characteristics, and various school influences. Second, the role of mental health in the communication performance of children with hearing devices has been understudied. Research has shown that DHH students who need to communicate orally manifest a withdrawal from social integration in mainstream schools (Bat-Chava et al., 2005). Furthermore, Stevenson et al. (2010) have suggested that behavioural problems have been more common in children who have experienced hearing loss. Any degree of loss has raised the risk for a low level of language acquisition, and lack of language access had negative implications for personal and academic development (Hall, 2017). Other studies have found that developmental language disorders or minor difficulties with mental development (e.g. slow development of gross or fine motor functions, developmental verbal dysphasia, etc.) sometimes has occurred in children with auditory problems (Huttunen and Välimaa, 2010). Third, research concerning effective listening devices for DHH children and adolescents has been rather limited. Studies have found that the

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listening devices have improved by 50% the quality of life of students with hearing loss (Hogan et al., 2011). Fourth, and perhaps more significantly, there has been a distinct lack of appropriate instruments, that might be used to assess mental health and communication difficulties among DHH students.

The influence of the teacher, HSS and home environment has been transmitted to DHH children in a variety of ways. These processes have ranged from the effects of the teachers' expectations, HSS's educational placement and psychological environment created by parents through their child-rearing practices. Each of these processes will be explored in the following paragraphs.

Whether teachers were male or female has been found to be important in terms of their interactions with DHH students in the classroom. However, there has been little evidence to indicate that male and female teachers have differed in their generally traditional and stereotypical treatment of male and female students using assistive listening devices. Teachers might have lower expectations of these children's abilities and potential achievement. Teachers' expectations were inferences that teachers have made about the future behaviour or academic achievement of their DHH students, based on what they currently have known about these students. Some studies of teachers' naturally formed expectations have related such expectations to teacher-student interaction rather than to student outcomes. As Rekkedal (2015) have noted, teacher-student communication and student–student communication have been primary activities in school settings.

A hearing and speech specialist has been a professional which has performed a crucial social function. The working conditions of HSSs have been examined by Billingsley et al. (2020), who have worked to further the research agenda that have supported special educators' work environment. The content knowledge and the skillset necessary for working with children using hearing aids have depended on contextual factors such as the educational placement and the mode of communication used (Veyvoda et al., 2019). According to the empirical research reviewed by these authors, HSSs working in public schools have lacked the specific knowledge and experience they have needed for sufficient hearing restitution and language treatment of children using listening devices.

Among the most important influences on children's academic achievement has been their home environment. Although demographic factors have remained of interest, the major concern has been the analysis of the parental processes whereby demographic and other variables exerted their effects. When demographic factors have been studied, they were those relevant to families, such as mothers' working status, fathers' educational status, and types of parent-child interaction. Parents of DHH children and adolescents often have argued that they communicate effectively with their children. This fact has caused many concerned parents for their children's language acquisition, social functioning, and social-cognitive development. According to Brown and Cornes (2015), the language used at home (either Australian Sign Language, Signed English, or spoken English) has been a significant predictor of mental health problems reported by DHH adolescents.

1.1. Emotional and behavioural difficulties and linguistics abilities

Advances in theory and research have generated substantial conceptual changes in the understanding of the emotional and behavioural problems of DHH children and increased recognition that certain characteristics of students using listening devices can be altered through the home and school environment. Among the most important of these characteristics have been the following: parental expectations (Michael et al., 2019), parental stress (Punch and Hyde, 2010), family involvement and communication (McSherry et al., 2019), student emotional and behavioural difficulties (Wong et al., 2017) and the ability to learn (Stevenson et al., 2010).

The recognition of the alterability of these characteristics has led researchers to study ways of understanding the psychological processes used by the students using hearing devices, as well as modifying learning environments and instructional strategies to accommodate learner differences. Although research has identified numerous variables that are related to differences in students using listening aids, the number of these variables has posed a perplexing challenge to researchers and practitioners. We have divided these variables into two categories: (a) internal to students. We have referred to the psychological and linguistic functions involved in communication (Maggio et al., 2014) and the emotional and behavioural problems (Anmyr et al., 2012). And (b) external to students. We have alluded to parental and teachers' expectations about emotional and behavioural difficulties in children and adolescents with hearing devices (Stevenson et al., 2015).

1.2. Purpose of this study

The current study aimed to unveil the unknown mental health and psycholinguistic abilities status of DHH students in mainstream schools in the Canary Islands. In so far, the perceptions of DHH children, their parents and teachers, and whether they were the same or different from each other had been unidentified. Furthermore, the language communication skills of DHH children in personal, school and family settings had remained unrevealed. An ignorance of the consequences could lead to unfortunate social behaviour in children with cochlear implants or hearing aids and social communication disorders in school and family settings.

Focusing on identifying variables related to emotional and behavioural difficulties and linguistics abilities, we have highlighted a list of research variables that connect student hearing impairment, mental health, and developing social skills. First, student variables. We have included self-control strategies, positive behaviour and ability to make friends with peers, motivation, etc. These variables have fallen under the rubric of emotional and behavioural, and general mental abilities entry characteristics. Second, out-of-school contextual variables. This category has included variables associated with the home and school. They have comprised parental interest in students' homework, teachers and HSSs' participation in school-related activities and home language communication.

Consequently, the objectives of the current study were twofold. First, the evaluation of children's mental health in terms of emotional and behavioural strengths and difficulties, as measured by the SDQ. And, second, the evaluation of children's psycholinguistic abilities using the Spanish version of the ITPA.

2. Materials and methods

2.1. Participants

We have recruited DHH students from the Canary Regional Centre for Educational Statistics. The sample has consisted of 300 children and adolescents aged 4–18 years who used hearing devices and did not have additional disabilities. Each participant and their parents had similar home physical environment. The sample also has comprised teachers ($N = 164$, 55.21%) and HSSs ($N = 133$, 44.78). Sociodemographic data for the 300 children and their parents are presented in Table 1.

2.2. Instruments

Two instruments were used to determine DHH children's emotional and behavioural strengths and difficulties and their psycholinguistic abilities: the SDQ and the ITPA.

The SDQ was a tool for screening positive socialisation behaviour in children aged 3–16 years (Goodman and Goodman, 2009). It existed in several forms to meet the needs of researchers, clinicians and teachers. The students' self-reported version of the SDQ and parent- and teacher-rated equivalent reports have been used in longitudinal data-based experiments, correlational screening methods, prediction models, clinical practices, and school achievement studies (McSherry

Table 1. Summary characteristics of the children and their parents.

Characteristics	CIs		HAs	
	n	%	n	%
Hearing device: Cochlear implant (CI) or Hearing Aid (HA)	187	62.3	113	37.7
Gender of children: Girls/Boys	94/93	50.3/49.7	43/70	38.1/61.9
Age				
4–5 years old	15	8,0	0	0
6–9 years old	64	28,9	34	30,1
10–11 years old	33	17,7	41	36,3
13–16 years old	71	28,0	38	33,6
Causes				
Prenatal	115	61.5	64	56.6
Perinatal	10	5.3	5	4.4
Postnatal	16	8.6	13	11.5
Undetermined	46	24.6	31	27.4
Degree of hearing loss (left ear/right ear)				
Mild <40 dB	17/16	9.1/8.6	32/25	28.3/22.1
Moderate to severe (41/90 dB)	42/29	22.5/15.5	57/63	50.4/55.8
Profound >90 dB	128/142	68.4/75.9	24/25	21.2/22.1
Age of deafness diagnosis				
Prior 6 months	89	47.6	21	18.6
Between 6 months and 1 year	50	26.7	20	17.7
Age 1-2	28	15.0	30	26.5
Age 2-3	14	7.5	11	9.7
Age 4 or more	6	3.2	31	27.4
Age at CI or HA (left ear/right ear)				
Prior 6 months	6/6	4.7/4.3	3/3	4.3/5
Between 6 months and 1 year	13/21	10.2/15.1	9/14	13/23.3
1–2 years	42/52	33.1/37.4	27/19	39.1/31.7
2–3 years	27/35	21.3/25.2	14/12	20.3/20
4 years or more	39/25	30.7/18.0	16/12	23.2/20
School system				
Kindergarten	23	12.3	10	8.8
Elementary	89	47.6	63	55.8
Middle School	65	34.8	39	34.5
Junior and High School	10	5.3	1	0.9
School environment				
Inclusive public	48	25.7	28	24.8
Inclusive public with support	135	72.2	84	74.3
Inclusive private	4	2.1	1	0.9
Prior school performance scores*				
Insufficient (D, F)	13	7	50	44.2
Average (C, C-)	77	41.2	38	33.6
Good (C+)	45	24.1	10	8.8
Remarkable (B+, B, B-)	43	23.0	13	11.5
Excellent (A, A+)	9	4.8	2	1.8
Preferred mode of communication (in family)				
Oral communication	141	75.4	88	77.9
Spanish Sign Language (SSL)	15	8.0	10	8.8
Total communication (oral + sign)	31	16.6	15	13.3
Father education[a]	65/35/19/5	52.4/28.2/15.3/4	18/10/4/0	56.3/31.3/12.5/0
Mother education[b]	64/26/30/4	51.6/21/24.2/3.2	21/5/6/0	65.6/15.6/18.8/0
Father labor status[c]	43/80/1	34.7/64.5/0.8	21/9/2	65.6/28.1/6.3
Mother labor status[d]	47/71/6	37.9/57.3/4.8	12/17/3	37.5/53.1/9.4

Notes:
[b]Preferred mode of communication (in family): Oral communication/Spanish Sign Language (SSL)/Total communication (oral + sign).
[a,b]Father and Mother education: Primary School Diploma/High School graduate/High Education/Vocational education.
[c,d]Father and Mother labor status: Unemployed/Working/Retired or Old age pensioner.
* Performance scores are coded according to a 5-point scale of the Spanish school children assessment ranging from excellent to insufficient (equivalents to grades in the American educational system).

et al., 2019). In this study, all versions of the SDQ asked about 25 attributes, some positive and others negative. The same 25 items were included in questionnaires for completion by the parents or teachers. These 25 items were divided into five subscales of five items each: emotional symptoms, conduct problems, hyperactivity/inattention, peer relationship problems, and pro-social behaviour. It included three response categories for each subscale as 0 = not true, 1 = somewhat true, and 2 = certainly true. We obtained an alpha value of 0.856 and different Cronbach's alpha values for children who used listening devices (0.789), their parents (0.759), teachers (0.616) and HSSs (0.725). These values represented adequate reliability (George and Mallery, 2003).

This study administered the ITPA, fourth edition (ITPA-4) to students who used hearing devices (Kirk et al., 1967). The ITPA-4 assessed the following mutually exclusive abilities: auditory reception, auditory association, verbal expression, visual reception, visual association, manual (or motor) expression, auditory sequential memory, grammatical closure, visual sequential memory, visual closure, and auditory closure. The result of Cronbach's alpha for this study was 0.852, which indicated a reasonable reliability coefficient (George and Mallery, 2003).

2.3. Procedure

Each of the study's participants belonged to the educational system of the autonomous region of the Canary Islands composed of seven main islands. In addition to learning in their assigned mainstream schools, children who used CIs from Gran Canaria regularly attended the Hypoacusis Unit of the University Hospital of Gran Canaria Doctor Negrín. All parents provided informed written consent for their child's participation, and the Clinical Research Ethics Committee of the Canarias Insular Maternal and Child University Hospital approved all ethical and legal dispositions for this study.

Research team members, teachers, and HSSs scheduled individualised SDQ and ITPA test assessment sessions for each student in either a school setting or a hospital. Teachers and HSSs repeated the items using different words (for oral students) or the Spanish Sign Language to the children when they did not understand the meaning of keywords.

Furthermore, HSSs-aided students interpreted the questionnaires via sign language (n = 17). The parents of each child who used listening devices completed the SDQ in their homes. The socio-educational data for the children and their families were collected though a questionnaire filled out by their parents. The teachers' and HSSs' version of the SDQ were used to assess the mental health of the DHH children. Authors did not schedule a response limit to the questionnaires. Data collection lasted approximately one school year.

2.4. Statistical analysis

Data were analysed using the Statistical Package for Social Sciences software (SPSS 16.0). Multivariate variance analysis (MANOVA) was selected to compare children's score assessments with CIs to those with HAs, as well as to their parents', teachers', and HSSs' score assessments on all SDQ subscales.

Authors chose three domains (e.g. student, school, and parents) and assessed 12 specific ITPA abilities within these domains. The MANOVA allowed the comparison of the socio-educational variables of children who used listening devices on some ITPA subtests (representational: auditory-vocal, and visual-motor; automatic: auditory-vocal, and visual-motor). The student-level domain comprised four variables: gender, use of hearing devices, individualised curriculum adaptation (ICA), and previous achievements in school. The school-level domain contained four variables: grade, teacher type (i.e. teacher or HSS), amount of school speech therapy administered (number of hours), and teacher or HSS teaching experience (number of years). The parents' domain included three variables: gender, educational background, and home communication. As the sample was larger than 100, the Kolmogorov-Smirnov test was applied to discover the data's normal distribution. The authors also applied the Box's M test on the equality of covariance matrices. According to Levene's test for values greater than 0.05, homoscedasticity between group variances was found. Finally, Wilks' lambda distribution was provided for the construction of unbiased estimates, determination of the group variances, and estimation of their variances.

3. Results

3.1. Inter-rater agreement between the SDQ of self, parent, teacher, and HSS ratings

The means and standard deviations of all SDQ subscales across the four groups of participants are presented in Table 2 to facilitate the comparison of the results. The ANOVA for the one-way between groups found higher mean scores for children who used CIs on the following subscales: conduct problems (t = 6.876, p < .001, CIs, M = 2.71, SD = .599; HAs, M = 2.13, SD = .840), hyperactivity/inattention (t = 10.226, p < .001, CIs, M = 2.84, SD = .471; HAs, M = 2.07, SD = .831) and peer relationship problems (t = 10.323, p < .001, CIs, M = 2.83, SD = .451; HAs, M = 2.08, SD = .814) than those with HAs. Furthermore, children who used HAs showed higher mean scores on emotional symptoms (t = -5.374, p < .001, CIs, M = 2.42, SD = .788; HAs, M = 2.85, SD = .427) and pro-social behaviour (t = -10.581, p < .001, CIs, M = 1.18, SD = .439; HAs, M = 1.99, SD = .881) than those with CIs.

The ANOVA for the one-way between groups also found higher mean scores for the parents of children who used CIs on the following subscales: conduct problems (t = 4.949, p < .001, CIs, M = 2.84, SD = .545; HAs, M = 2.45, SD = .813); hyperactivity/inattention (t = 5.064, p < .001, CIs, M = 2.84, SD = .545; HAs, M = 2.44, SD = .812), and peer relationship problems (t = 5.140, p < .001, CIs, M = 2.84, SD = .545; HAs, M = 2.43, SD = .822). However, parents of children who used HAs showed higher scores on the pro-social behaviour subscale (t = -5.140, p < .001, CIs, M = 1.16, SD = .545; HAs, M = 1.57, SD = .822).

HSSs of children who used CIs had significantly higher scores than those of children who used HAs on the peer relationship problems subscale (t = 8.92, p < .001, CIs, M = 2.94, SD = .287; HAs, M = 2.23, SD = .858). However, HSSs of children who used HAs had significantly higher scores than those of children who used CIs on the pro-social behaviour subscale (t = -8.54, p < .001, CIs, M = 1.08, SD = .294; HAs, M = 1.75, SD = .846).

Finally, teachers of children who used CIs had significantly higher mean scores on the conduct problems (t = 10.892, p < .001, CIs, M = 2.62, SD = .719; HAs, M = 1.67, SD = .749), hyperactivity/inattention (t = 8.108, p < .001, CIs, M = 2.86, SD = .466; HAs, M = 2.30, SD = .731) and peer relationship problems subscales (t = 8.332, p < .001, CIs, M = 2.89, SD = .401; HAs, M = 2.29, SD = .842) than those children who used HAs. Meanwhile, teachers of children who used HAs had higher score means than those of children who used CIs on the pro-social behaviour subscale (t = -11.884, p < .001, CIs, M = 1.19, SD = .521; HAs, M = 2.12, SD = .832).

3.2. Comparing ITPA results across the three domains

Means and standard deviations of all ITPA subscales across the three domains (e.g. student, school, and parents) are presented in Table 3 to facilitate comparison of the results.

3.2.1. Representational: auditory-vocal

The ITPA's Auditory Reception and Verbal Expression scales assessed a child's ability to express concepts vocally or by gestures and movements. Teenagers with hearing devices who were enrolled in high schools (16–18 years old) produced significantly higher means in Auditory Reception and Verbal Expression than children from primary education (6–12 years old) or young teens from secondary education (12–16 years old). Children with hearing devices who were enrolled in high school produced significantly higher means in Auditory Reception (M = 37.60,

Table 2. MANOVA results according to the type of hearing device (CI/HA) used by students on SDQ subscales, and the perceptions of their parents, HSSs and teachers.

SDQ	CIs		HAs		t
	M (Min-Max)	SD	M (Min-Max)	SD	
SDQ STUDENTS					
Emotional Symptoms	2.42 (2.32–2.51)	.79	2.85 (2.73–2.98)	.43	-5.37, $p = .003$
Conduct Problems	2.71 (2.61–2.81)	.59	2.13 (2.00–2.26)	.84	6.88, $p = .018$
Hyperactivity/Inattention	2.84 (2.75–2.93)	.47	2.07 (1.95–2.19)	.83	10.23, $p = .000$
Peer Relationship Problems	2.83 (2.75–2.93)	.45	2.08 (1.97–2.19)	.81	10.32, $p = .001$
Prosocial Behaviour	1.18 (1.09–1.27)	.44	1.99 (1.87–2.11)	.88	-10.58, $p = .000$
MANOVA $\lambda = .48$ $F = 63.77$, $p = .000$, $\eta^2_p = 0.098$					
SDQ PARENTS					
Emotional Symptoms	2.18 (2.06–2.30)	.90	2.26 (2.10–2.41)	.75	
Conduct Problems	2.84 (2.75–2.93)	.55	2.45 (2.33–2.57)	.81	4.95, $p = .003$
Hyperactivity/Inattention	2.84 (2.75–2.93)	.55	2.44 (2.32–2.56)	.81	5.06, $p = .018$
Peer Relationship Problems	2.84 (2.74–2.94)	.55	2.43 (2.31–2.56)	.82	5.14, $p = .000$
Prosocial Behaviour	1.16 (1.07–1.26)	.55	1.57 (1.44–1.69)	.82	-5.14, $p = .000$
MANOVA $\lambda = .91$ $F = 6.94$, $p = .000$, $\eta^2_p = 0.086$					
SDQ HSSs					
Emotional Symptoms	2.16 (2.02–2.31)	.88	2.08 (1.88–2.28)	.84	
Conduct Problems	2.65 (2.53–2.76)	.76	2.64 (2.48–2.80)	.48	
Hyperactivity/Inattention	2.48 (2.36–2.61)	.85	2.56 (2.39–2.73)	.50	
Peer Relationship Problems	2.94 (2.85–3.04)	.28	2.23 (2.16–2.36)	.85	8.92, $p = .003$
Prosocial Behaviour	1.08 (.99–1.17)	.29	1.75 (1.62–1.88)	.84	-8.54, $p = .000$
MANOVA $\lambda = .57$ $F = 32.09$, $p = .000$, $\eta^2_p = 0.045$					
SDQ TEACHERS					
Emotional Symptoms	2.26 (2.13–2.38)	.83	2.27 (2.11–2.42)	.91	
Conduct Problems	2.62 (2.52–2.73)	.72	1.67 (1.54–1.81)	.75	10.89, $p = .013$
Hyperactivity/Inattention	2.86 (2.78–2.94)	.47	2.30 (2.19–2.41)	.73	8.11, $p = .027$
Peer Relationship Problems	2.89 (2.81–2.94)	.40	2.29 (2.18–2.40)	.84	8.33, $p = .000$
Prosocial Behaviour	1.19 (1.09–1.28)	.52	2.12 (1.99–2.24)	.83	-11.88, $p = .000$
MANOVA $\lambda = .50$ $F = 58.06$, $p = .000$, $\eta^2_p = 0.049$					

SD = 5.441) and Verbal Expression (*M* = 40.80, *SD* = 5.789) than those from primary or secondary grades. Students who did not have ICAs obtained higher mean values on the Auditory Reception scale (*M* = 29.02, *SD* = 12.596) as well as for the Verbal Expression scale (*M* = 38.47, *SD* = 12.084) compared to those who did (*M* = 29.10, *SD* = 15.275 and *M* = 30.67, *SD* = 15.478). Deaf and hard-of-hearing students without a type of teacher support obtained a higher mean value (*M* = 39.14, *SD* = 8.961) in the ITPA's Auditory Association, than those DHHs students with the support of teachers or HSSs. When a teacher had between four and six years of teaching experience, students scored significantly higher on the Auditory Reception (*M* = 30.17, *SD* = 10.099) and Auditory Association (*M* = 40.44, *SD* = 9.470) subtests. If specialists had between four and six years of teaching experience, children obtained significantly higher mean values (*M* = 40.86, *SD* = 8.896) on the Auditory Association subtest. Significant differences were found in children of mothers with vocational training studies on the Auditory Reception (*M* = 30.80, *SD* = 5.750) and Verbal Expression subtests (*M* = 35.70, *SD* = 8.367) compared with children of mothers with lower academic backgrounds.

3.2.2. Representational: visual-motor

The ITPA's Representational: Visual-motor evaluated the ability to obtain meaning from visual symbols, choosing, from a set of drawings, the one that was similar to the drawing-stimulus. Children who did not receive specific support from teachers or HSSs scored significantly lower on the Visual Reception (*M* = 37.36, *SD* = 7.990) and Manual Expression subtests (*M* = 33.80, *SD* = 7.085) than their counterparts who did. Students with outstanding academic achievements (*M* = 37.78, *SD* = 4.868) scored significantly better on the Manual Expression subtest than other students with lower educational attainments. When teachers had between four and six years of experience, students obtained better results (*M* = 38.56, *SD* = 5.944) on the Visual Reception and Manual Expression subtests (*M* = 37.69, *SD* = 7.451). When the specialists had between four and six years of experience, children obtained higher scores on the Visual Reception subtest (*M* = 44.86, *SD* = 7.081). Children with highly educated fathers (High Education degrees) had significantly higher means in the children's Visual Reception subtest (*M* = 32.53, *SD* = 11.485) than those with fathers who had low levels of education (Vocational Education, High School graduation, unschooled, and Primary School Diploma).

3.2.3. Automatic: auditory-vocal

The ITPA's Automatic: Auditory-vocal evaluated the ability to produce a word from partially pronounced words (complementary test). Statistically significant differences were found between the Manual Expression subtest scores for children using CIs (*M* = 31.97, SD = 12.871) and the Grammatical Closure subtest scores for children using HAs (38.76, *SD* = 4.994). Children had significantly higher means in the Grammatical Closure (*M* = 35.13, *SD* = 10.905) and Visual Reception (*M* = 45.44, *SD* = 4.690) subtests when the specialists had between four and six years of experience. Children with highly educated fathers had significant differences in the Auditory Sequential Memory (*M* = 27.00, *SD* = 13.563) subtest than those whose fathers had low levels of education. Significant differences were found in the mode of communication used at home: children who used sign language at home had significantly higher means in the Visual Sequential Memory subtest (*M* = 40.70, *SD* = 6.250) than children who used oral or bilingual communication, and bilingual students showed significantly higher means results on their Visual Closure subtest scores (*M* = 33.06, *SD* = 14.034) than those students who used sign or oral language.

3.2.4. Automatic: visual-motor

The ITPA's Automatic: Visual-motor assessed the child's ability to identify known animals or objects from an incomplete representation of them, in a relatively complex context. Children with outstanding academic achievement had significantly higher means in their Visual Sequential Memory ($M = 40.22$, $SD = 4.893$) and Visual Closure ($M = 41.56$, $SD = 4.558$) scores than other students with lower educational attainments. Finally, children who used sign language at home had significantly higher means in the Visual Sequential Memory scores ($M = 40.70$, $SD = 6.250$) than children who used oral or bilingual communication, while children who used oral communication at home were significantly higher means in Visual Closure scores ($M = 39.01$, $SD = 9.136$) than the students who used sign or bilingual communication.

4. Discussion

This study investigated the mental health problems and language abilities of DHH students who used hearing devices. It aimed to identify the SDQ's areas of consistency and differences between these students and their parents, teachers, and HSSs, and to assess the psycholinguistic abilities of children and adolescents who used CIs and HAs. The current study was one of the few to investigate mental health in children with CIs or HAs in terms of strengths and difficulties. Findings indicated that the students with CIs, their parents, and teachers agreed on three mental health perceptions – conduct problems, hyperactivity/inattention, and peer problems –, while students with HAs, their parents, their teachers and HSSs' perceptions about the mental health of children agreed on pro-social behaviour.

4.1. Emotional and behavioural difficulties

Some of the findings shown here were consistent with similar results from the literature. The results of this study were confirmed by previous studies which showed that children who used hearing devices were more likely to exhibit emotional and behavioural problems (Stevenson et al., 2015). In this study, children who used CIs had higher mean scores than children who used HAs in three of the SDQ's subscales: conduct problems, hyperactivity/inattention, and peer relationship problems. Furthermore, children who used HAs were found to have higher mean scores regarding emotional symptoms and pro-social behaviour than their counterparts

Table 3. MANOVA results for variables of students with hearing devices and the ITPA subtests.

ITPA subtests		
Representational: Auditory-vocal		
MANOVA	*t/F*	*M*
Grade $\Lambda = .91$, $F = 3.32$, $p < .001$, $\eta^2_p = .048$	*Auditory Reception: F* (3.78), $p < .05$ *Verbal Expression: F* (5.31), $p < .001$	P (25.53); S (27.61); High School/VE (37.60) P (29.77); S (26.39); High School/VE (40.80)
ICA $\Lambda = .93$, $F = 5.3$, $p < .001$, $\eta^2_p = .075$	*Auditory Reception: t* (-0.675), $p < .05$	ICA (29.10); nICA (29.02) ICA (30.67); nICA (38.47)
Teacher Type $\Lambda = .89$, $F = 2.59$, $p < .05$, $\eta^2_p = .038$ *Teacher's years of experience* $\Lambda = .90$, $F = 2.32$, $p < .05$, $\eta^2_p = .034$ *HSS's years of experience* $\Lambda = .90$, $F = 2.15$, $p < .05$, $\eta^2_p = .032$ *Mother's studies* $\Lambda = .82$, $F = 3.24$, $p < .001$, $\eta^2_p = .062$	*Auditory Association: F* (6.37), $p < .001$ Auditory *Reception* *Auditory Association* *Auditory Association* Auditory *Reception* *Verbal Expression*	HSS (35.27); SSSL (35.67); HSS/SSSL (25.55); WS (39.14) <3 (28.01), 4–6 (30.17), 7–9 (19.75), >10 (22.18) <3 (30.10), 4–6 (42.13), 7–9 (40.44), >10 (33.83) <3 (35.14), 4–6 (40.86), 7–9 (39.88), >10 (32.86) U (30.83), Pr (21.65), HS (27.33), HE (30.25), VE (30.80) U (26.78), Pr (25.25), HS (29.53), HE (32.95), VE (35.70)
Representational: Visual-Motor		
Teacher Type $\Lambda = .90$, $F = 2.33$, $p < .05$, $\eta^2_p = .034$	*Visual Reception: F* (4.57), $p < .010$ *Manual Expression: F* (5.20), $p < .010$	HSS (35.08); SSSL (36.25): HSS/SSSL (28.83); WS (37.36) HSS (32.44); SSSL (30.92); HSS/SSSL (24.55); WS (33.80)
Previous Achievement $\Lambda = .89$, $F = 1.88$, $p < .05$, $\eta^2_p = .037$ *Teacher's years of experience* $\Lambda = .85$, $F = 3,45$, $p < .05$, $\eta^2_p = .052$ *HSS's years of experience* $\Lambda = .90$, $F = 2.44$, $p < .05$, $\eta^2_p = .036$ *Father's studies* $\Lambda = .83$, $F = 3.24$, $p < .001$, $\eta^2_p = .062$	*Manual Expression: F* (4.82), $p < .001$ *Visual Reception: F* (8.20), $p < .001$ *Manual Expression: F* (4.52), $p < .05$ *Visual Association F* (4.572), $p < .05$ *Visual Reception: F* (4.817), $p < .001$	I (30.31); S (29.06); G (30.86); R (37.46); O (37.78) <3 (26.90), 4–6 (38.56), 7–9 (37.69), >10 (35.61) <3 (26.03), 4–6 (37.69), 7–9 (32.78), >10 (31.86) <3 (32.71), 4–6 (44.86), 7–9 (34.98), >10 (35.41) U (29.41), Pr (22.62), HS (24.00), HE (32.53), VE (30.58)
Automatic: Auditory-Vocal		
Students with HD $\Lambda = .85$, $F = 8.36$, $p < .001$, $\eta^2_p = .146$ *HSS's years of experience* $\Lambda = .81$, $F = 3.480$, $p < .001$, $\eta^2_p = .035$ *Father's studies* $\Lambda = .87$, $F = 1.70$, $p < .05$, $\eta^2_p = .034$ *Home communication* $\Lambda = .87$, $F = 3.61$, $p < .001$, $\eta^2_p = .069$	*Manual Expression: t* (-4.35), $p < .001$ *Grammatic Closure: t* (-0.64), $p < .05$ *Grammatic Closure: F* (8.044), $p < .001$ *Visual Reception: F* (3.353), $p < .05$ *Auditory Sequential Memory F* (3.07), $p < .05$ *Visual Sequential Memory: F* (3.68), $p < .05$ *Visual Closure: F* (10.50), $p < .001$	CI (31.97); HA (38.76) CI (36.64); HA (37.74) <3 (16.57), 4–6 (35.13), 7–9 (28.75), >10 (19.82) <3 (37.77), 4–6 (45.44), 7–9 (36.84), >10 (35.83) U (20.65), Pr (19.98), HS (18.13), HE (27.00), VE (25.33) S (40.70), O (33.60), B (34.00) S (28.30), O (39.01), B (33.06)
Automatic: Visual-Motor		
Previous Achievement $\Lambda = .79$, $F = 3.00$, $p < .001$, $\eta^2_p = .058$	*Visual Sequential Memory: F* (5.17), $p < .001$ *Visual Closure: F* (2.80), $p < .05$	I (39.13); S (31.13); G (37.18); R (32.16); O (40.22) I (31.80); S (39.32); G (35.66); R (37.41); O (41.56)
Home communication $\Lambda = .87$, $F = 3.62$, $p < .001$, $\eta^2_p = .069$	*Visual Sequential Memory: F* (3.69), $p < .05$ *Visual Closure: F* (10.50), $p < .001$	S (40.70); O (33.60); B (34.00) S (28.30); O (39.01); B (33.06)

Notes:
Grade: P (Primary), children (6–12 years old); S (Secondary), young teens (12–16 years old); High School/VE (Vocational Education), teenagers (16–18 years old).
ICA (Individualised Curriculum Adaptation), nICA (non-ICA).
Teacher Type: Teacher or HSS [SSSL (Specialist in Spanish Sign Language)] WS (Without support).
Previous Achievement: I (Insufficient), S (Sufficient), G (Good), R (Remarkable), O (Outstanding).
Studies: U (unschooled), Pr (Primary School Diploma), HS (High School graduation), HE (High Education), VE (Vocational Education).

who used CIs. This result was important for the end goal of improving the socialisation of children with CIs because emotional health and pro-social behaviour affected children's abilities to engage in positive, empathetic, co-operative, and socially responsible interactions and relationships. Additionally, children with HAs showed elevated prevalence across dimensions of behavioural difficulties, inattention and on indicators of peer communication confusions.

These differences were further borne out by the parents' scores and were comparable to previous research results (Anmyr et al., 2012). Both children who used CIs and their parents were in close agreement on externalising problems on social and emotional learning. Alongside parents' concern for their children's social lives came particular tensions around communicative language. We mainly attributed this anxiety to the language access which had negative implications for learning. As Hall (2017) assured, lack of language included cognitive delays, mental health difficulties, and lower quality of life. Both children who used HAs and their parents obtained higher mean scores on the pro-social behaviour subscale than children who used CIs and their parents. Pro-social behaviour was a social behaviour that benefited other people, such as helping, sharing, or cooperating. This emergent finding contrasted data found in another study. Michael et al. (2019) asserted that parents of children with CIs reported lower levels of hyperactivity/inattention and higher levels of pro-social behavior compared to parents of children with HAs.

For this reason, implanted students who did not exhibit emotional competence and pro-social behaviours experienced difficulties when developing social and emotional abilities such as being able to distinguish and cope emotions, set and accomplish positive goals, understand the perceptions of others, sustain positive relationships and make responsible decisions; simultaneously, other studies have indicated that children and teenagers who were deaf or hard of hearing were at risk and might experience difficulty in developing social and emotional skills (Luckner and Movahedazarhouligh, 2019). This study's findings regarding the parents of children who used hearing devices needed assistance to improve communication skills to cope with implanted children's threats of social rejection and exclusion (Wong et al., 2017; Cagulada and Koller, 2020).

Finally, HSSs of children who used CIs had scored significantly higher on the peer relationship problems, emotional symptoms and conduct problems subscales than children who used HAs. However, the latter had scored significantly higher on the pro-social behaviour and hyperactivity/inattention subscales than the former. The authors cautiously have interpreted this result to mean that students who used HAs participated in pro-social behaviour, such as helping and sharing with their peers, more frequently after engaging in cooperative learning activities, which provided students with more opportunities to generalise the social skills they learnt. It was important to note that the teachers and HSS of children with CIs perceived the same weaknesses in these children: conduct problems and peer relationship problems. Additionally, both types of educators pointed out that children with HAs had a higher mean in pro-social behaviour.

The analyses presented in this paper suggested that children and adolescents from Kindergarten to High School with CIs and HAs were likely to show a moderate rate of emotional and behavioural difficulties. The SDQ conduct problems and peer relationship problems subscales showed a consistent pattern of more difficulties for children with CIs. The estimate was significant for student self-descriptions, parents, teachers and HSSs. Meanwhile, the SDQ pro-social behaviour subscale scored highest among children with HAs, according to the student self-descriptions and the perceptions of parents, teachers and HSSs.

4.2. Spoken and written linguistic abilities of children who use hearing aids

The current study examined the Illinois Test of Psycholinguistic Abilities (ITPA) applied to children with CIs or HAs. The ITPA was a psychodiagnostic instrument devised to assess theoretically discrete and basic cognitive skills.

The findings showed that children and adolescents with CIs or HAs had different means in ITPA subtests according to the following domains and variables: student-level (use of CIs or HAs, ICA plans, and previous achievements), school-level (teacher type) and parents' domain (studies and mode of communication used at home).

Concerning student-level variables, children who used hearing devices perceived that they possessed various psycholinguistic abilities such as the ability to reproduce sequences of complex and non-significant figures by memory after observing such a sequence for a short time. In this study, children with HAs achieved higher mean scores. Changes in skills were attributable either to the school's efforts or children's age-related growth. Thus, vocational education children who used hearing devices differed from younger students in their ability to obtain meaning from orally presented material. Moreover, they were verbally more fluent insofar as they expressed a greater number of concepts orally. Children who actively participated in their ICA plans were better able to obtain meaning from orally presented resources and had higher oral fluency scores than students who were not engaged in the learning process. However, children who did not complete their ICA plans showed greater ability to visually report ideas and had higher mean scores on the ITPA in full. Students also showed differences in their ability to categorise animals or recognise objects from an unfinished or incomplete representation of said object. Therefore, children who had outstanding scores were generally better able to express themselves non-verbally, to recognise known organisms or items from an incomplete illustration, and to replicate visually presented structures of words, numbers, letters, and symbols.

Regarding school-level variables, HSSs improved the academic performance of children who used hearing aids. Compared to teachers, HSSs better developed children's ability to obtain meaning from oral or visual material. We argued that this outcome was due to the fact that HSSs spent more time with children who used hearing aids in a variety of different settings (including auditory-oral classes, sign-support rooms, self-contained classes for the DHH, and hospital resource rooms). Additionally, HSSs shared therapy techniques with teachers, developing a kind of a specialised community therapy. Teachers' professional experience had an evident effect on students with hearing devices; furthermore, when an HSS had between four and six years of teaching experience, implanted children improved in the ITPA's Auditory Association and Visual Reception subtests.

Considering the parents' domain (gender, educational background, and home communication), children with highly educated fathers were different than those students with fathers who had low levels of education in their ability to comprehend similarities in visual stimuli and used their short-term memory to recall conversations or instructions. On the other hand, mothers with vocational education studies marked a difference in children who used hearing aids in their ability to draw consequences from orally presented material, compared with children of mothers with lower academic backgrounds.

5. Conclusion

The results obtained from the subjects surveyed proved that SDQ Conduct Problems was the mental health issue, which most significantly distinguished children with CIs from those with HAs. Children in this study self-reported their SDQ score—an approach which posed several

obstacles to the validity of the results (including, in the case of children, the need for enough literacy to understand the questionnaire). Furthermore, tutors contributed to differences between children with CIs or HAs on six subscales of ITPA. Authors advocated additional demographic information regarding the children's families, and direct observations of the children's classroom behaviour. Furthermore, we encouraged school models that endorse children's abilities to understand the meaning of orally presented curriculum materials in class teaching and reduce behaviour-related problems needed to promote children's well-being, healthy development, and transferable learning. ACI instructional programs and relationships with younger students with CIs or HAs, parents and other adults, should be emphasised so that initial attempts at self-regulated cognitive activities and psycholinguistic abilities could be supervised. We suggested expand the scope of the practices that could help educators respond to student with hearing devices, embrace inclusive approaches, such that mainstream schools could enable all Spanish children with deaf and hard-of-hearing to find positive pathways to adulthood.

Declarations

Author contribution statement

Olga María Alegre, Luis Miguel Villar Angulo: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

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Additional information

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