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**Clinical practice in childhood dysarthria – an online survey of German-speaking speech-
language pathologists**

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Abstract

Purpose: This survey study aimed to establish current clinical practices of German-speaking speech-language pathologists (SLPs) regarding their assessment and treatment of communication disorders in children with neurological conditions, with a particular focus on the management of childhood dysarthria.

Method: A 23-question cross-sectional online survey was disseminated to practicing SLPs in Germany, Austria and Switzerland via relevant professional bodies. SLPs were invited to provide information on their current assessment and treatment practices. Demographic data including case load and clinical settings were also gathered to contextualize practices.

Results: One hundred two SLPs responded to the survey, of which 68 valid responses were analyzed. German-speaking SLPs comprehensively assess and treat various aspects of overall communication, language and swallowing functions in children with neurological conditions. Speech motor aspects did not represent a main intervention focus. In cases where the dysarthric component was targeted, specific approaches for childhood dysarthria were rarely used. Instead, SLPs reported using approaches developed for speech disorders other than dysarthria.

Conclusions: German-speaking SLPs working with children with neurological conditions use various assessment and treatment methods to support children's communication. However, dysarthria-specific approaches were not an established part of clinical practice. Results of the survey highlight the need for access to relevant developments in German, and for evaluation of current curricula for SLP students and continuing education opportunities for practicing clinicians.

50 **Keywords:** neurological conditions, childhood dysarthria, assessment, treatment, speech-
51 language pathologists

52

Introduction

53 Communication disorders are common in children with neurological conditions, with
54 dysarthria being one of the most frequently encountered communication disorders in this
55 group. The predominant cause of childhood dysarthria is cerebral palsy (CP), with up to 90%
56 of children with CP also having dysarthria (Bax et al., 2006; Mei et al., 2014; Nordberg et al.,
57 2013). Dysarthria usually manifests itself on all functionally relevant speech subsystems, that
58 is, respiration, phonation, articulation and resonance, as well as prosody. As a result,
59 perceptual deviations of speech features can occur to varying degrees in any one or several of
60 these components, causing heterogeneous impairment profiles (Duffy, 2020; Haas et al.,
61 2021; Workinger & Kent, 1991). As part of the dysarthric impairment, children's
62 communication skills are also often impacted, e.g., through reduced intelligibility (e.g., Haas
63 et al., 2022; Hustad et al., 2012; Mei et al., 2014). Dysarthria can therefore significantly affect
64 children's educational attainment, as well as their social interaction and communicative
65 participation (e.g., Mei et al., 2015).

66 As a consequence of the multiple ways in which dysarthria can impact a child's life,
67 and also due to the high prevalence of the disorder, children with dysarthria represent a
68 significant client group for speech-language pathologists (SLPs). However, the clinical care of
69 children with dysarthria comes with considerable challenges for SLPs. General issues
70 encountered by all SLPs working with this medically complex client group relate to the
71 limited availability of assessment and treatment options. This can render evidence-based
72 decision-making regarding the most effective clinical management challenging. Beyond these
73 general challenges, there are also country-specific issues that have the potential to compound
74 the identified challenges around the clinical decision-making for this group including
75 language barriers in terms of access to existing information as well as professional-
76 educational considerations. SLPs in German-speaking countries face all the above-mentioned

77 challenges; using the German-speaking context to exemplify how SLPs assess and treat
78 childhood dysarthria, this study aims to understand current SLP practices in Germany, Austria
79 and Switzerland. In the following, the general challenges for SLPs working with this client
80 group will be elucidated, followed by country-specific challenges.

81 **General challenges**

82 Childhood dysarthria frequently occurs in the context of complex medical conditions
83 (e.g., traumatic brain injury, CP, genetic syndromes), with most children presenting with
84 multiple disabilities affecting speech, gross motor functions, and sensory and cognitive skills.
85 Dysarthria is also frequently accompanied by language and swallowing difficulties, which
86 may require clinical intervention. Prioritization of some treatments may therefore be
87 indicated. In addition, intervention is provided in a range of clinical facilities, which may
88 differ in terms of service provision, leading to variation regarding treatment intensity,
89 frequency, and duration.

90 Another challenge encountered by SLPs is a lack of research in the field. Dysarthria
91 research is traditionally focused on adults; the topic of childhood dysarthria is relatively new.
92 Knowledge about the clinical picture and prognosis of childhood dysarthria is still emerging,
93 with the majority of articles on which current knowledge is based being published over the
94 last ten years (e.g. Allison & Hustad, 2018; Boliek & Fox, 2017; Haas et al., 2021; Hustad et
95 al., 2019; Kuschmann & Lowit, 2021; Levy et al., 2021; Mei et al., 2014; Nordberg et al.,
96 2013; Pennington, Roelant, et al., 2013; Schölderle et al., 2022). And as some of the most
97 common textbooks on dysarthria do not yet consider children as a client group (English:
98 Duffy, 2020; German: Ziegler & Vogel, 2010), it can be challenging for SLPs to acquire
99 knowledge specific to childhood dysarthria.

100 Selecting appropriate assessment and treatment for children with dysarthria is also
101 difficult, as the range of materials specifically developed or evaluated for childhood dysarthria

102 is limited. Until now, there have been two assessment tools specifically designed or adapted
103 for children, only available in German (i.e., the Bogenhausen Dysarthria Scales – Childhood
104 Dysarthria, BoDyS-KiD, Haas et al., 2020) or Dutch (i.e., the pediatric Radboud Dysarthria
105 Assessment, p-RDA, Ruessink et al., 2022). Both tools have been discussed in research
106 articles but have yet to be published by an established press company. In terms of treatment, a
107 few approaches (i.e., the *Speech Intelligibility Treatment* (SIT; Levy et al., 2021), the *Speech*
108 *Systems Approach* (SSIT; Pennington et al., 2010; Pennington, Roelant et al., 2013), or the
109 *Lee Silverman Voice Treatment for Children* (LSVT LOUD® for Kids; Boliek & Fox, 2017;
110 Fox & Boliek, 2012) have recently been developed or adapted for children with dysarthria.
111 The evidence base of these approaches is primarily limited to single case studies and group
112 studies with a small number of participants. As a result, clinical guidelines provide very little
113 guidance for SLPs on effectively assessing and treating children with dysarthria.

114 **Country-specific challenges**

115 In addition to the above challenges faced by all SLPs working with children with
116 dysarthria, there are country-specific challenges. Firstly, except for a few tools, almost all
117 specific assessment and treatment materials for childhood dysarthria are only available in the
118 language they were developed in – which is English for the most part (exceptions are the
119 BoDyS-KiD in German and the p-RDA in Dutch). For the German context, this means that
120 most speech materials, instructions, and guidelines need to be translated to be accessible to all
121 SLPs.

122 Secondly, research findings on childhood dysarthria are frequently published in
123 English-language journals only. This can be a barrier to accessing the evidence base by SLPs
124 in non-English speaking countries including Germany, Austria and Switzerland and may
125 mean that new approaches are not adopted as quickly.

126 Finally, as indicated above, most of the assessment and treatment approaches are
127 relatively recent developments. Professional education curricula may not yet reflect these
128 developments. In addition, SLPs in German-speaking countries are trained on dysarthria in
129 the context of neurological conditions associated with adulthood, whereas childhood
130 dysarthria is not a compulsory component of the professional curriculum. It is therefore at the
131 discretion of each SLP course whether to include childhood-dysarthria related teaching
132 content, leading to considerable variation in whether and how much German, Austrian and
133 Swiss SLPs learn about childhood dysarthria as part of their training. This means that SLPs
134 working with this client group may need to familiarize themselves with the materials through
135 self-study or continuing professional development (CPD) events.

136 Given the challenge of complex disorders and limited knowledge and tools, it is
137 natural to wonder how SLPs provide clinical care to children with dysarthria. In 2015 Watson
138 and Pennington conducted a survey that aimed to establish how SLPs working in the UK
139 assess and treat communication difficulties in children with CP. They report results from 265
140 SLPs from the UK who had a widely varying number of children and young people with CP
141 on their caseloads. Participants were asked which standardized tests they used in relation to
142 different communicative domains (e.g., receptive language, speech) and whether they
143 supplemented their assessment and treatment with additional unpublished methods.
144 Communicative interaction, and participation were the areas the respondents of their survey
145 most commonly focused on. Motor speech functions and related communication parameters
146 (such as intelligibility) were assessed less frequently. Only a minority of the respondents used
147 standardized dysarthria tests or published scales for the estimation of intelligibility, even
148 though intelligibility was identified as one relevant area of treatment. Altogether, SLPs
149 reported using a wide variety of published tests, but most commonly reported using
150 observation or assessment screenings they had developed themselves. The most important

151 aspects for treatment were dysphagia, alternative and augmentative communication
152 (AAC)/interaction and receptive language (Watson & Pennington, 2015).

153 A recent study by Iuzzini-Seigel et al. (2022) on differential diagnosis of childhood
154 apraxia of speech and childhood dysarthria complements these findings. The authors
155 conducted a web-based survey, in which 359 SLPs from the US participated. Besides
156 demographic data and information on their caseloads, respondents were asked about their
157 confidence in differentially diagnosing childhood apraxia of speech and childhood dysarthria.
158 Sixty percent of respondents reported low or no confidence in diagnosing dysarthria in
159 children, and 40% reported that they tended not to make this diagnosis as a result (Iuzzini-
160 Seigel et al., 2022).

161 These results provide us with a snapshot of service provision in the UK and the US,
162 but as different countries structure their health care systems and treatment options differently
163 (Ruggero et al., 2012), results from anglophone countries may not readily be applicable to
164 other nations. The present study aimed to determine how children with dysarthria are assessed
165 and treated by SLPs in German-speaking countries. Using an online survey, we wanted to
166 gain insights into current clinical practices, with a particular focus on what assessment and
167 treatment approaches SLPs are familiar with, and which ones they use in their everyday
168 practice. A better understanding of German-speaking SLPs' knowledge of a field that is
169 primarily communicated through English-language journals will allow us to understand
170 clinical decision making around the management of childhood dysarthria in a non-English
171 context, and to identify ways of improving access to the current evidence base, with the
172 ultimate goal of improving service provision for this group.

173 **Method**

174 An online cross-sectional survey was developed to establish current clinical practice
175 by SLPs working with children with dysarthria in Germany, Austria and Switzerland. Ethical

176 approval to conduct the survey was granted by the Medical Faculty's Ethics Committee of the
177 Ludwig Maximilian University of Munich, Germany. The questionnaire was designed in
178 accordance with the Checklist for Reporting Results of Internet E-Surveys (CHERRIES;
179 Eysenbach, 2004), and distributed using Qualtrics software (Qualtrics, Provo, UT).

180 **Survey respondents**

181 The survey targeted qualified, practicing SLPs in Germany, Austria or Switzerland,
182 currently or previously (in the past five years) working with children with neurological
183 conditions, who might have dysarthria as a result of their medical conditions. No inclusion
184 criteria were set with regard to the clinical setting in which the SLPs work or the extent of
185 their professional experience, as the aim was explicitly to present as broad a picture as
186 possible. One hundred two SLPs accessed the survey, and 72 completed it (completion rate:
187 0.71). Among the participants were clinicians from all three German-speaking countries, i.e.,
188 Germany, Austria and Switzerland. Consistent with consent procedures, incomplete online
189 questionnaires were excluded from the subsequent analyses. Responses by four SLPs, who
190 reported not having worked with children with neurological conditions in the past five years,
191 were removed. The results, therefore, report the responses of 68 SLPs.

192 **Recruitment and procedure**

193 SLPs in Germany, Austria and Switzerland were invited to take part in the survey. The
194 speech and language profession in Germany, for instance, is heterogeneous with several
195 routes to becoming an SLP, which include non-academic and academic routes. Both routes
196 grant eligibility to work as an SLP [with children with developmental language disorders as](#)
197 [well as persons with dysarthria. However, they may differ in terms of the duration of training](#)
198 [and the professional title.](#) The non-academic route is a 3-year apprenticeship-type professional

199 education at a vocational college that allows graduates to use the title Logopädin¹. As part of
200 the academic route, a Bachelor of Arts or Science degree is obtained at university within 3 to
201 3.5 years. As different study programs focus on different areas of specialization, graduates
202 hold a range of different professional titles (i.e., Sprachtherapeutin, Klinische Linguistin,
203 Patholinguistin, Sprachheilpädagogin). In the following, we will use the term speech-language
204 pathologist (SLP) to refer to all practicing clinicians that completed the survey, irrespective of
205 their professional title.

206 Depending on their educational journey, SLPs can be members of different
207 associations and professional bodies. In the absence of a national register and to reach as
208 many practicing SLPs as possible, all relevant associations and professional bodies were
209 approached and asked to distribute information about the survey to their members via
210 respective mailing lists, webpages and membership magazines. This was granted by all
211 associations except the Swiss national one. The survey was further advertised through
212 relevant social media channels. In addition, an internet search was conducted to find SLP
213 centers specializing in the management of children with neurological conditions, and we
214 contacted them directly with an invitation to take part in the survey. The survey was available
215 online between 1st November and 31st December 2021 and could be accessed directly via a
216 link.

217 Participants accessing the survey were provided with a participant information sheet
218 on the first page of the questionnaire and were then asked to consent to taking part in the
219 survey before proceeding. Survey participation was voluntary, and respondents were able to
220 withdraw their consent at any time by closing the survey. No personal identifiable information

¹ In German, female gender is expressed by the morphological marker *-in*. In the following, we will use the female form to represent all genders.

221 was collected, to preserve respondents' anonymity, and no incentives to complete the survey
222 were offered.

223 **Questionnaire design**

224 The main aim of the survey was to investigate SLPs' current clinical practices
225 regarding childhood dysarthria. However, given the fact that this topic is a specialist area,
226 which is not a compulsory element of the SLP curriculum in German-speaking countries we
227 have decided to approach the topic from a broader angle by asking all SLPs working with
228 children with neurological conditions to participate in the survey. This approach was taken to
229 increase the response rate to the survey and include all those SLPs who might work with
230 children who may have childhood dysarthria.

231 The questions were developed by the research team through an iterative design process
232 and were informed by current clinical guidelines and a review of existing literature.

233 Preliminary versions of the questionnaire were piloted with six practicing and research SLPs
234 with experience of working with children with neurological conditions and/or in designing
235 survey questionnaires related to the SLP profession. Their feedback resulted in minor changes
236 to some questions and answer choices, to improve clarity and focus of the questions.

237 The survey was comprised of 23 questions. First, respondents were asked to provide
238 demographic data including case load information, work setting, and number of years worked
239 with children with neurological conditions. The main part of the survey focused on current
240 assessment and treatment practices. In this section, participants were first asked about their
241 general management of children with neurological conditions (e.g., Which aspects do you
242 focus on in the assessment of children with neurological conditions?), before focusing
243 specifically on childhood dysarthria (e.g., Which diagnostic instruments do you use to assess
244 *speech function* in children with neurological conditions?). Considering that there are only
245 very few specific assessment and treatment approaches for childhood dysarthria, we listed

246 instruments and methods related to the topic (e.g., the Frenchay Dysarthria Assessment for
247 adults, treatment programs for speech sound disorders) as additional options. Further, SLPs
248 were surveyed about their confidence when working with children with neurological
249 conditions as well as childhood dysarthria. We also asked how satisfied they were with
250 existing materials for assessment and treatment of childhood dysarthria. Appendix I lists all
251 questions of the survey and provides additional information about the answering options (e.g.,
252 the listed assessment and treatment methods).

253 The survey primarily consisted of a combination of closed binary and multiple-choice
254 questions as well as Likert-scale questions. Not all respondents answered all questions, as skip
255 logic was applied to some of the responses. In addition, most questions allowed more than one
256 answer. The survey took about 15 minutes to fill in and had to be completed in one sitting.

257 **Data storage and analysis**

258 Survey responses were collected anonymously. As part of consent procedures on the
259 first page of the questionnaire, participants agreed, by completing the survey and submitting
260 the answers, to their responses being stored. Responses were stored in Qualtrics (Qualtrics,
261 Provo, UT) and cleaned – i.e., incomplete surveys and answers by respondents who reported
262 not having worked with children with neurological conditions in the past five years were
263 removed – before transferring the data to a university-based server for subsequent analysis.
264 Raw data was exported and analyzed using Microsoft Excel and Statistical Package for Social
265 Sciences (SPSS) Version 27 (IBM Corp., 2020). Descriptive statistics were used to examine
266 the data. This included frequency calculation for assessment and treatment practices as well as
267 respondents' characteristics. If percentages were calculated for questions, these were based on
268 all answers given for each question. In a few selected instances, we complemented the
269 descriptive analyses by different test statistics. That is, rank correlations were used to analyze
270 relationships between variables (e.g., number of assessment tools used with participants'

271 confidence and satisfaction), and Mann-Whitney-U-tests were completed when subsets of
272 participants were compared on a group level (e.g., participants who were trained vs. not
273 trained on childhood dysarthria). Most questions further provided the option to select ‘other’
274 to add detail to responses. In cases where this option was selected, authors EH and TS jointly
275 checked whether the answer might match existing response categories.

276 **Results**

277 **Professional experience and education**

278 Sixty-eight percent of the participants had become SLPs on a non-academic pathway
279 i.e., they selected Logopädin as professional title. The remaining responses were distributed
280 across all options of academic titles (e.g., Sprachtherapeutin, Sprachheilpädagogin). Several
281 participants selected more than one answer, indicating that they had more than one
282 professional qualification.

283 The largest group of respondents (56%) specified that they worked in an independent
284 speech and language therapy practice, followed by rehabilitation center/clinic (24%). The
285 other options (e.g., special needs care, kindergarten, hospital) were selected less frequently.
286 Again, some participants selected more than one option, indicating a combination of part-time
287 jobs across one or more workplaces.

288 The participants’ overall professional experience indicated by the number of years
289 working as an SLP varied widely. Years of work experience ranged from zero (i.e., four
290 months in one case) to 35 years, with a median of eleven years. Accordingly, both newly
291 qualified professionals and highly experienced therapists filled in the questionnaire.

292 In addition to overall professional experience, we determined the participants’
293 experience of working with children with neurological conditions. Interestingly, the two
294 largest subgroups of participants had either only incidental contact or a very high degree of
295 experience with children with neurological conditions: 30% indicated meeting 0-20 children

296 throughout their career, while 25% had seen more than 200. The other options were selected
297 less frequently (20-50 children: 10%; both 50-100 and 100-200 children: 17%).

298 We also aimed to establish to what extent neurological communication disorders in
299 children were covered as part of respondents' professional education (cf. Fig. 1).

300 - insert Figure 1 around here -

301 The most frequently covered topics as part of the educational curriculum were
302 childhood apraxia of speech, AAC, childhood dysphagia, and childhood aphasia (all ranging
303 between 40 and 50%). Only 15 participants (22%) had classes on childhood dysarthria.
304 Neurological voice or fluency disorders in children were addressed even less frequently.
305 About 19% of the respondents indicated that none of the above topics on neurological
306 communication disorders in children were covered as part of their professional education.

307 As regard to childhood dysarthria, there was no evident difference in academic vs.
308 non-academic settings: Nine of the 47 non-academic SLPs (i.e., 19%) and seven of all 33
309 participants with academic education (21%) reported that they had classes on childhood
310 dysarthria as part of their professional training. Results also showed that it seemed to make no
311 difference how long ago the teaching had taken place. Respondents indicating that childhood
312 dysarthria had been covered in their professional training had about 12 years of professional
313 experience, whereas those who indicated that it had not been part of their curriculum had 13.5
314 years of work experience.

315 When asked about how they kept up to date with assessment and treatment methods
316 for children with neurological conditions, almost all respondents indicated attending specific
317 CPD courses (94%) or in-house CPD events as well as discussions with colleagues (97%).
318 Other options selected frequently were attending conferences, internet searches, and the use of
319 textbooks (62%, 69%, and 78%, respectively), whereas social media was consulted by only

320 35% of the participants. Published papers in German-language journals were read twice as
321 often as those in English journals (80% vs. 40%).

322 **Characteristics of children on SLPs' caseload**

323 Participants reported assessing and treating children of all age groups, i.e., from
324 infancy to adolescence. Forty-seven per cent of the participants treated infants (age 0-1). The
325 vast majority of participants worked with children of kindergarten (2-5 years, 91%) and
326 primary school age (6-10 years, 87%). Sixty-nine per cent reported working with children in
327 early adolescence (11-14) and 60% indicated treating children above age 14. Note that
328 multiple answers were allowed. Responses regarding the diagnoses of children treated by the
329 respondents are shown in Figure 2.

330 - insert Figure 2 around here -

331 The most frequent etiologies seen in clinical practice were genetic syndromes (94%),
332 cerebral palsy (87%), epilepsy (82%), and malformations such as polymicrogyria or
333 microcephaly (71%). Interestingly, 79% of the participants indicated that they treated children
334 with a suspected neurological condition or an unknown neurological etiology. Additional
335 alternative answers were given, e.g., brain injury resulting from near drowning incidents,
336 infantile stroke, shaking trauma and neuromuscular disease.

337 We further asked the participants which communication disorders they addressed in
338 their work with children with neurological conditions (cf. Fig. 3).

339 - insert Figure 3 around here -

340 With 96%, most participants reported that they treated language difficulties. Other
341 communication disorders that were frequently addressed included speech sound disorders,
342 childhood apraxia of speech, and dysphagia (chewing/feeding/swallowing disorders).
343 Seventy-eight per cent of the participants further indicated treating childhood dysarthria.

366 The next sections focus on aspects of the questionnaire that dealt specifically with
367 speech motor skills in the context of childhood dysarthria. First, participants were asked about
368 the global domains that they assess with regard to speech (cf. Fig. 5).

369 - insert Figure 5 around here -

370 Among the speech subsystems (i.e., respiration, voice, resonance, articulation, and
371 prosody), there was a clear focus on articulation, which was assessed by 91% of the
372 participants, whereas resonance was assessed by 28% of the participants only. A small
373 number of respondents determined the overall severity and undertook a dysarthria syndrome
374 classification (47 and 29%, respectively). Regarding parameters related to communication in
375 everyday life, participants strongly focused on intelligibility and impact of the speech disorder
376 on social participation (93 and 88%, respectively), while naturalness was rarely assessed
377 (22%).

378 The participants were further asked about their methodological approaches to the
379 assessment of motor speech skills (see Fig. 6).

380 - insert Figure 6 around here -

381 Case history, gathered either from the child or family/carers/guardians (90 and 65%),
382 as well as observation of the child (99%) played an important role in the diagnostic process
383 (see first three graphs in Fig. 6). In terms of direct approaches, auditory-perceptual analyses
384 prevailed, whereas mention of instrumental assessment was less prevalent (90 vs. 10%). Sixty
385 percent of SLPs used standardized tests to assess motor speech skills; tools for estimating
386 communication and questionnaires were applied less often (46 and 40%, respectively).

387 Figure 7 illustrates which published instruments were used by the respondents to
388 assess motor speech disorders.

389 - insert Figure 7 around here -

390 Overall, instruments for the assessment of articulatory skills were used most
391 frequently and by a majority of participants (54-69%, see Fig. 7), mirroring the clear focus on
392 articulation in the assessment process (cf. Figure 5). Only one respondent did not use at least
393 one of the three articulation-related measures. Tools for specific dysarthria assessment, on the
394 other hand, were used less commonly, ranging from as little as 1% for the AMDNS to 31%
395 for the Bogenhausen Dysarthria Scales. Twenty-seven (i.e., 40%) of the respondents did not
396 use any of the listed tools for dysarthria assessment. However, seven respondents (i.e., 10%)
397 indicated that they used self-developed materials. Surprisingly, the adult BoDyS version was
398 used slightly more often than BoDyS-KiD, which was developed for children specifically (see
399 Fig. 7). Even less often than specific dysarthria tools, participants used instruments for the
400 assessment of communication and participation. The CFCS was used by just under one third
401 of the respondents, whereas all other instruments were rarely applied (between 7-13%).
402 Notably, 56% used none of the given options. Only four of these respondents stated that they
403 used self-developed or other tools.

404 The total number of used assessment tools varied widely within the group (0-10
405 instruments). We were interested in whether there were associations between the use of
406 different instruments and the respondents' specific work experience and education. We found
407 a significant yet small link to specific experience in the field of neurological conditions in
408 children (i.e., between number of used tools and number of treated children with neurologic
409 conditions; $r = .32$, $p < .05$). A Mann-Whitney-U-Test showed no difference between
410 participants who had vs. had not learned about childhood dysarthria during their professional
411 education as to how many assessment instruments they used in clinical practice.

412 **Treatment of motor speech function**

413 This section provides information on the methods and published tools that were used
414 by our respondents to treat motor speech disorders. Figure 8 shows the types of methods our
415 respondents employed in the treatment of motor speech difficulties.

416 - insert Figure 8 around here -

417 In terms of speech subsystems treatment, the articulatory subsystem was targeted by
418 the majority of respondents (i.e., 90%). The remaining subsystems were also identified as
419 treatment targets, albeit to a lesser extent (ranging from 26% for resonance to 68% for
420 respiration). Methods of bio-feedback did not play an important role in the participants'
421 clinical approaches (see Fig. 8). In contrast, measures in the field of AAC were amongst the
422 most frequently employed methods (analogous as well as electronic devices, all ranging
423 >80%). Only three respondents did not use any methods of AAC. Also, communication
424 strategies and activities relating to everyday life skills were often employed (70%). Working
425 with parents and carers (as in communication partner training) was also considered important
426 (81%) as were holistic approaches to treatment (e.g., Bobath, Castillo Morales, 68%).
427 Compensatory techniques and prosthetic measures were less relevant (29% and 10%,
428 respectively). About one third of SLPs indicated using nonspeech oro-motor exercises.

429 Figure 9 illustrates the specific published treatment approaches and protocols that
430 were used by our respondents to treat motor speech difficulties.

431 - insert Figure 9 around here -

432 Figure 9 shows a markedly heterogenous picture (for explanations on the answering
433 options, see Appendix I). Among the three most commonly used approaches were two
434 directed at phonology (minimal pair treatment with 51% and P.O.P.T. with 60%) as well as
435 phonetic placement therapy (50%). Importantly, the results show that approaches developed
436 or adapted for children with childhood apraxia of speech were used by a substantial number of

437 respondents. For example, TAKTKIN (a German approach based on similar principles to
438 PROMPT) was used by 43%, and VEDIT by 44%. Among all queried approaches, those
439 specifically developed for childhood dysarthria were selected the least. Speech Intelligibility
440 Treatment (SIT) and Speech Systems Intelligibility Treatment (SSIT) were not selected at all,
441 only LSVT® (including voice exercises based on the principles of LSVT®) was used by 32%
442 of the respondents. Three SLPs (4%) indicated that they did not use any of the listed
443 approaches nor any other speech related treatment protocol.

444 **Respondents' perception of confidence and satisfaction in the assessment and** 445 **treatment of children with dysarthria**

446 Half of the participants were very or rather confident about dysarthria assessment in
447 children (10% and 40%, respectively), the other half indicated they were not confident (35%),
448 or not confident at all (15%). The results regarding the respondents' confidence in their
449 dysarthria treatment were similar (very confident: 10%, rather confident: 44%, rather not
450 confident: 36%, not confident at all: 10%).

451 The vast majority expressed dissatisfaction with available assessments: 60% were
452 rather dissatisfied, 11% even very dissatisfied. Twenty-seven percent were rather satisfied,
453 and only 2%, i.e., one person, expressed they were very satisfied. Satisfaction regarding
454 treatment options was even lower (very satisfied: 0%, rather satisfied: 21%; rather
455 dissatisfied: 70%, very dissatisfied: 9%).

456 There were significant correlations between the number of used assessment tools (see
457 above) with both the participants' confidence ($\rho = -.29$, $p < .05$) and their satisfaction ($\rho = .32$,
458 $p < .01$) regarding their use and the availability of assessment approaches, respectively.

459 Since LSVT® (or methods based on its principles) was the only approach used that
460 was specific to childhood dysarthria, we analyzed the confidence and satisfaction of the group

461 of 22 respondents familiar with LSVT®. Interestingly, their confidence was higher compared
462 to the total group of 68 participants: 23% were very confident (vs. 10% in the total group),
463 50% rather confident (vs. 44%), 27% rather unconfident (vs. 35%) and no one indicated being
464 not confident at all (vs. 10% in the total group). Regarding their satisfaction with available
465 treatment approaches, they were rather similar to the entire group (very satisfied: 0% of both
466 groups, rather satisfied: 18 vs. 21%, rather dissatisfied: 77 vs. 70%, very dissatisfied: 5 vs.
467 9%).

468 **Discussion**

469 Our study sought to determine the practices of SLPs in German-speaking countries
470 regarding the assessment and treatment of children with neurological conditions, with a
471 particular focus on the management of childhood dysarthria. Results will be discussed against
472 the background of the German SLP landscape, e.g., (continued) education.

473 **Demographic profile of the respondents**

474 In our study, SLPs from all three German-speaking countries, i.e., Germany, Austria
475 and Switzerland, participated. They indicated a range of professional titles and worked in a
476 range of clinical facilities. The participants' specific experience working with children with
477 neurological conditions varied widely. Although the overall sample size indicates that our
478 results may not be representative, the responses do reflect the varied nature of the SLP
479 landscape in German-speaking countries.

480 In terms of education, it was confirmed that childhood dysarthria is not a compulsory
481 part of the SLP curriculum in German-speaking countries. Only 22% of the respondents
482 covered the topic as part of their clinical professional education. The lack of relevant training
483 seems to be an issue irrespective of whether SLPs gained their degree via an academic or non-

484 academic route. Our results further show that more recent graduates did not cover this topic
485 more frequently than SLPs who have worked for longer in the profession.

486 In order to further their knowledge on management options for children with
487 neurological conditions, respondents predominantly relied on specific CPD courses and in-
488 house events. Most CPD courses are offered by workforce training providers in German-
489 speaking countries, however, they are expensive and the options for specialist areas such as
490 childhood dysarthria are very limited. Most respondents keep up to date with the latest
491 evidence base through published papers in German-language journals. This suggests that
492 reading scientific texts in a different language may be a barrier for some of the respondents.
493 For others, access to English journals may be an issue, as these are not generally available to
494 SLPs.

495 **Children on SLPs' caseloads & focus of assessment and treatment**

496 The survey respondents work with children with different neurological conditions.
497 Some of the most frequently selected diagnoses (e.g., cerebral palsy, genetic syndromes, brain
498 malformations) are associated with a high prevalence of childhood dysarthria (Mei et al.,
499 2014), which mirrors the finding that 78% of respondents indicated assessing and treating
500 dysarthria in children with neurological conditions.

501 Overall, SLPs reported that they address various aspects of speech, language, overall
502 communication skills, and swallowing and chewing functions in children with neurological
503 conditions. This indicates that this group of children receives a comprehensive assessment and
504 treatment of their speech, language and communication needs when they are referred to SLP
505 services. Speech motor aspects (e.g., motor functions of the speech subsystems, fluency) did
506 not represent a main focus for assessment and treatment, with language functions, and
507 especially language comprehension, being identified as more relevant aspects. This replicates
508 findings from Watson and Pennington (2015), who found that receptive and expressive

509 language, along with communication interaction, were identified as key areas when working
510 with children with CP.

511 In this context, it has to be considered that comprehensive assessment and treatment of
512 childhood dysarthria requires cognitive and linguistic abilities, which may have to be
513 established prior to targeting the dysarthric component of speech. And given the range of
514 communication and swallowing difficulties frequently associated with complex disorders,
515 other aspects of speech, language and swallowing may have to be targeted first to provide the
516 best possible support and development in all areas. Over time, treatment goals may be
517 adjusted to take into account developmental changes, which may allow for a greater focus on
518 the dysarthric component of speech.

519 **Assessment of motor speech function**

520 Focusing specifically on speech, respondents indicated that articulation, intelligibility
521 and the impact on communication participation were the domains they assessed most
522 frequently. This finding shows that, in line with the International Classification of
523 Functioning, Disability and Health framework (ICF; WHO, 2001), most SLPs consider the
524 key domains of functioning and disability, namely body functions and structures, as well as
525 activity and participation, in their assessment of speech motor functions.

526 In terms of speech subsystems, there was a clear focus on articulation, which
527 represents the key determinant of speech intelligibility (Haas et al., 2022). This finding
528 suggests that targeting articulation is likely one of the primary avenues through which SLPs in
529 Germany, Austria and Switzerland aim to improve intelligibility in children with dysarthria.
530 Moreover, a detailed analysis of articulation is indispensable for differentiating childhood
531 dysarthria from other motor speech disorders, such as childhood apraxia of speech. In their
532 recent attempt to provide guidelines for differential diagnosis, Iuzzini-Seigel et al. (2022) list
533 a number of articulatory parameters, for instance, that are to be accounted for.

534 Classification of dysarthria syndromes, commonly applied to adults with dysarthria,
535 was considered less relevant for children. There is evidence that dysarthria syndromes are less
536 clear cut in children than, for instance, in adults with CP, as developmental speech
537 characteristics overlap with symptoms of dysarthria (Schölderle et al., 2021). Thus, the
538 classification of dysarthria syndromes may only play a minor role when determining the
539 treatment focus for children with dysarthria.

540 Among the most commonly used methodological approaches were observations and
541 auditory-perceptual analyses of speech subsystem functioning. This mirrors findings from
542 Watson and Pennington (2015), who found that observation was one of the main ways to
543 assess the speech of children with CP. Auditory-perceptual evaluations of speech constitute
544 the gold standard in the clinical assessment of dysarthria in adults (Duffy, 2020), and our
545 findings show that a similar approach has been adopted in the assessment of children's
546 speech.

547 Although 78% of respondents said they focused on dysarthria in the children they
548 treated, relatively few dysarthria-specific instruments were used. The most frequently applied
549 test to assess speech motor functioning with just over 30% was the BoDyS, a tool developed
550 for adults with dysarthria. This is interesting, as BoDyS-KiD, a test specifically developed for
551 the assessment of childhood dysarthria containing age norms (Haas et al., 2021; Schölderle et
552 al., 2020) is available. However, response frequencies for this tool were lower than that for
553 the adult version. It is likely, though, that lack of access - at the moment the tool can only be
554 obtained via email from the authors – has played a role here. Given that 90% of SLPs reported
555 using auditory-perceptual analyses to determine the key features of dysarthria, it is surprising
556 to see the limited use of standardized tests for assessing it.

557 In contrast, SLPs generally reported using a wide range of standardized tests to
558 evaluate the articulatory component. In this context, it is essential to highlight that the tools

559 for articulation assessment listed in our questionnaire are tools developed for children with
560 developmental language disorders. Also, while articulation analyses may be an important
561 component, they cannot substitute for comprehensive dysarthria assessment covering all
562 speech subsystems. As Iuzzini-Seigel et al. (2022) indicate, examination of parameters such
563 as respiration and resonance could also support the differentiation of childhood dysarthria
564 from other pediatric motor speech disorders.

565 In terms of communication, our results show further discrepancy between the
566 perceived importance of some areas for intervention and their actual assessment. For instance,
567 only a small group of respondents rated intelligibility - identified as a key area for assessment
568 and treatment - by means of available rating scales (e.g., the Viking speech scale, see
569 Pennington, Virella, et al. (2013), the Intelligibility in Context Scale – German version, see
570 Neumann et al. (2017)). The lack of specific speech intelligibility testing has been reported in
571 other surveys (Miller & Bloch, 2017; Watson & Pennington, 2015).

572 There is a possibility that the scarce use of specific instruments for dysarthria and
573 communication assessment might be related to the fact that dysarthria is not a compulsory
574 part of professional education in German-speaking countries. However, results showed that
575 the presence or absence of professional training in childhood dysarthria did not affect how
576 many assessment instruments respondents used for the purposes of dysarthria assessment. In
577 this context, it is important to note that many of the instruments (e.g., BoDyS-KiD, see Haas
578 et al. (2021), the Intelligibility in Context Scale – German version, see Neumann et al. (2017))
579 have only recently become available or been translated into German, respectively. They may
580 therefore not have been covered as part of their professional education at the time they were
581 in training.

582 Encouragingly, though, a significant link was found between the use of assessment
583 tools and specific experience in the field of neurological conditions in children, with SLPs

584 who treated a high number of children being aware of a greater number of tools and
585 assessment instruments. It is likely that they have acquired relevant knowledge of childhood
586 dysarthria, as children with neurological conditions represent a significant part of their
587 caseload, which led to specialized knowledge pertaining to this group of children.

588 **Treatment of motor speech function**

589 Speech subsystems treatment represented a major part of respondents' practice with
590 children with dysarthria. Similar to the results on assessment, a specific focus was placed on
591 articulation. As indicated above, it is likely that articulation is targeted to improve speech
592 intelligibility for those children who can express themselves using speech.

593 Another highly frequent treatment focus was the use of AAC measures to enable
594 children who are non-verbal or very severely dysarthric to communicate. This included
595 communication boards, books and electronic devices as well as sign language, which were all
596 used by over 80% of the SLPs surveyed. The strong treatment focus on AAC devices, which
597 is in line with results obtained from SLPs in the UK (Watson & Pennington, 2015), was
598 expected due to the complex nature of neurological conditions and the high number of non-
599 verbal children in, e.g., children with cerebral palsy (Nordberg et al., 2013). Overall, the
600 respondents indicated that establishing communication strategies and enhancing everyday
601 communication were major goals of their treatment, and this is reflected in their approach to
602 treatment. The fact that SLPs aim to enable children to communicate by all possible means is
603 very welcome news in light of communication being a fundamental human right (McEwin &
604 Santow, 2018).

605 In terms of general treatment approaches, a range of patterns emerged. First, the
606 results showed that some approaches that were employed have a weak evidence base. For
607 instance, a substantial number of the respondents used non-speech oro-motor exercises. This
608 was also reported by Watson and Pennington (2015) for British SLPs, although a follow-up

609 study showed a significant reduction in the use of oro-motor exercises to improve speech
610 intelligibility (Pennington, 2021). While undoubtedly relevant in neuropsychiatric assessment
611 and differential diagnosis, non-speech movements have been shown to be inadequate as
612 treatment exercises to improve speech (Lee & Gibbon, 2015). For other approaches, such as
613 holistic ones such as Bobath or Castillo Morales, studies of their efficacy regarding speech are
614 still pending.

615 Second, with regard to specific speech treatment, a considerable number of SLPs
616 reported using approaches originally developed for speech disorders other than dysarthria
617 (e.g., phonological speech sound disorder, apraxia of speech) - which is not to say that these
618 methods cannot be adjusted to children with dysarthria in a meaningful way. In fact, a single
619 case study by Korkalainen et al. (2022) recently demonstrated that Rapid Syllable Transition
620 Treatment (ReST), a treatment originally designed for children with CAS, can improve
621 speech accuracy in children with dysarthria due to CP.

622 Despite this potential clinical benefit of treatment options designed for other
623 populations, our finding that specific approaches for childhood dysarthria were hardly ever
624 applied is still a matter of concern. None of the respondents reported using the Speech
625 Intelligibility Treatment (SIT; Levy et al., 2021) or the Speech Systems Approach (SSIT;
626 Pennington et al., 2010; Pennington, Roelant, et al., 2013). Only the Lee Silverman Voice
627 Treatment (LSVT®), an approach originally evaluated for adults but with some evidence for
628 efficacy in children (Boliek & Fox, 2017; Fox & Boliek, 2012), was used by a third of the
629 respondents. This picture overall implies that the SLPs surveyed were either not familiar with
630 relevant treatment approaches for childhood dysarthria or they did not consider them suitable
631 for clinical use. Various reasons might account for this. As outlined before, the lack of
632 educational training on childhood dysarthria in German-speaking countries may limit the
633 knowledge of pertinent treatment methods among SLPs. Most approaches have been

634 introduced only recently (e.g., SIT, see Levy et al., 2021) and are described in English alone.
635 This, in combination with the fact that most German-speaking SLPs do not engage with
636 English research articles might explain why some of the dysarthria approaches have yet to
637 take hold in clinical practice. One additional fact that cannot be neglected is that some
638 treatment approaches, such as LSVT®, require SLPs to be certified, which is time-consuming
639 and costly. Overall, most dysarthria-specific approaches will have to be further developed
640 (e.g., translated) and adapted to achieve greater dissemination among clinicians in German-
641 speaking countries.

642 **Respondents' perception of the clinical status quo & clinical implications**

643 The survey established that the respondents use a wide range of different assessment
644 and treatment methods varying in scope and methodological concept. However, the
645 dysarthria-specific approaches were not yet established in clinical practice. This ties in with
646 our finding that, overall, the respondents lacked confidence in assessing and treating
647 childhood dysarthria and expressed their dissatisfaction with the available diagnostic tools and
648 treatment materials. Having said this, our data also give some first indications on how to
649 improve the situation for clinicians. For instance, SLPs were more confident and satisfied
650 with assessment options the more they had assessment tools with which they were familiar.
651 This highlights the need to better equip German-speaking SLPs with tools to assess, and
652 approaches to treat, childhood dysarthria using an evidence-based approach. This can be
653 accomplished through a) curriculum changes that will render childhood dysarthria a
654 compulsory topic for SLP programs, and b) greater availability and a more comprehensive
655 range of CPD courses for practicing SLPs. Our results are also a mandate to ensure SLPs in
656 Germany, Austria and Switzerland have access to recent developments through disseminating
657 (inter)national research findings via articles and textbooks written in German.

658 **Limitations & Conclusion**

659 One major limitation of this study is the sample size, which is relatively small, despite
660 our best efforts to find SLPs that specialized in neurological disorders in children, including
661 contacting all relevant professional bodies, using social media channels and well as
662 approaching specialist centers. Having explored all the various options it seems unlikely that
663 we would have been able to recruit the necessary larger sample of German-speaking SLPs,
664 which would have allowed us to compare subgroups or to relate different variables to each
665 other in a more comprehensive way. Moreover, the nature of the design chosen to collect the
666 data is prone to biases, which means that the results may not be a true reflection of speech and
667 language therapy services in German-speaking countries. Sampling issues and selection bias
668 have to be considered: participants self-selected to complete the survey, and it is likely that
669 those with a particular interest in this group were more inclined to respond to it. Validity of
670 responses may also be an issue, as the survey relied on respondents' reports of their clinical
671 practice. However, it is difficult to ascertain whether the reports reflect their actual practice.

672 In conclusion, this study is the first to provide a comprehensive account of current
673 clinical practices of German-speaking SLPs in the assessment and treatment of children with
674 neurological conditions, in particular childhood dysarthria. The study identified that current
675 evidence-based practice approaches to dysarthria management have yet to become established
676 in clinical practice, and elucidates reasons behind the slow uptake of these approaches. The
677 survey highlights a greater need for better access to relevant literature and information in
678 German in order to disseminate current developments. It also calls for tailored CPD
679 opportunities related to childhood dysarthria and curriculum changes as part of SLPs'
680 professional education. Overall, changes are required at educational and individual
681 professional level in German-speaking countries - with efforts and input needed from
682 researchers, educators and clinicians alike - to advance clinical practice for this group of
683 children.

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688 **Data Availability Statement**

689 The datasets generated and analyzed during the current study are available from the
690 corresponding author on reasonable request.

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866

Figure captions

867 **Figure 1.** Topics that were part of the participants' professional education. All options refer to
 868 children. AAC = augmentative and alternative communication.

869 **Figure 2.** Diagnoses of the children treated by the participants of the survey.

870 **Figure 3.** Occurrence of communication disorders of the children with neurological
 871 conditions treated by the participants. Bold marking highlights childhood dysarthria – the
 872 focus of the questions in the main part of the survey.

873 **Figure 4.** Domains the participants most often focus on in their everyday work in the
 874 assessment (dark gray bars) and treatment (light gray bars) of children with neurological
 875 conditions. AAC = augmentative and alternative communication. Bold markings highlight the
 876 speech motor related response options.

877 **Figure 5.** Global domains participants assess regarding children's speech function.

878 **Figure 6.** Methodological approaches used by participants to assess children's speech
 879 function.

880 **Figure 7.** Published assessment tools used by participants to assess children's motor speech
 881 function. Note that tools are grouped in three different domains (i.e., articulation, dysarthria,
 882 communication & participation). PDSS = Patholinguistische Diagnostik bei

883 Sprachentwicklungsstörungen (Kauschke & Siegmüller, 2010); PLAKSS =

884 Psycholinguistische Analyse kindlicher Sprechstörungen (Fox-Boyer, 2014); AMDNS =

885 Aachener Materialien zur Diagnostik Neurogener Sprechstörungen (Schnitker et al., 2011);

886 BoDyS = Bogenhausener Dysarthrieskalen (Ziegler et al., 2018); BoDyS-KiD =

887 Bogenhausener Dysarthrieskalen – Kindliche Dysarthrien (Haas et al., 2021); FDA =

888 Frenchay-Dysarthrie-Untersuchung (Enderby & Palmer, 2012); UNS = Untersuchungsbogen

889 Neurogener Sprech- und Stimmstörungen (Breitbach-Snowdon, 2003); CFCS =

890 Communication Function Classification System (Hidecker et al., 2011); VSS = Viking

891 Speech Scale (Pennington, Virella, et al., 2013); KommPaS = Kommunikative Parameter für
892 Sprechstörungen (Lehner & Ziegler, 2021); ICS-G = Skala zur Verständlichkeit im Kontext
893 (McLeod et al., 2012; German version: Neumann et al., 2017); FOCUS-G = Fokus auf die
894 Kommunikation von Kindern unter sechs (German version: Neumann et al., 2017; Thomas-
895 Stonell et al., 2010). For explanations of the tools see Appendix I.

896 **Figure 8.** Methods and tools used by participants to treat motor speech difficulties. Note that
897 methods of three different specific domains (i.e., treatment of speech subsystems,
898 biofeedback, AAC = augmentative and/or alternative communication) are depicted. The
899 “other methods” section contains methods that could not be assigned to a specific domain.

900 **Figure 9.** Published treatment approaches used by participants to treat motor speech
901 difficulties. Metaphon (Howell & Dean, 1994); P.O.P.T. = Psycholinguistisch orientierte
902 Phonologie-Therapie (Fox-Boyer, 2022); PLAN = Materialien zur Therapie nach dem
903 Patholinguistischen Ansatz (Kauschke & Siegmüller, 2021); phonetic placement (e.g.,
904 Marchant et al., 2008); TAKTKIN® = Taktil-kinästhetische Stimulationsmethode (Birner-
905 Janusch, 2009); NF!T = Neurofunktionstherapie (Rogge, 2013); VEDiT® = Therapieansatz
906 zur Behandlung von Verbaler Entwicklungsdyspraxie (Schulte-Mäter, 2010); KoArt®
907 (Becker-Redding, unpublished); LAX VOX® (e.g., Tyrmi & Laukkanen, 2017); LSVT® =
908 Lee-Silverman-Voice-Treatment (Boliek & Fox, 2014; Fox & Boliek, 2012); SIT = Speech
909 Intelligibility Treatment (Levy et al., 2021); SSIT = Speech Systems Intelligibility Treatment
910 (Pennington et al., 2010; Pennington, Roelant, et al., 2013). For explanations of the treatment
911 approaches see Appendix I.