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Addressing phonological memory in language therapy with clients who have Down syndrome: Perspectives of speech–language pathologists

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Abstract

Background—Phonological memory (PM) plays a significant role in language development but is impaired in individuals with Down syndrome (DS). Without formal recommendations on how to address PM limitations in clients with DS, it is possible speech–language pathologists (SLPs) find ways to do so in their practices.

Aims—This study asked if and how SLPs address PM in language therapy with clients who have DS. It also asked about SLPs' opinions of the importance, practicality and difficulty of addressing PM in clients with DS.

Methods & Procedures—SLPs participated in an online survey that asked if they address PM in clients with DS and, if so, how often and with which techniques. The survey also asked SLPs to rate their opinions of addressing PM in clients with DS with Likert scales. To contrast clients with DS, SLPs were asked about their practices and opinions with clients who have specific language impairment (SLI) and autism spectrum disorders (ASD). SLPs were recruited through e-mails sent from state organizations and researchers. To compare SLPs' practices and opinions across client types, frequency analyses and analyses of variance (ANOVAs) were run.

Outcomes & Results—In all, 290 SLPs from 28 states completed the survey. Nearly all SLPs were currently practising at the time data were collected, and all worked with at least one of the three client types. Findings indicated SLPs less often addressed PM and used less variety when addressing PM with clients who have DS compared with clients who have SLI or ASD. Further, SLPs considered it less important, less practical and more difficult to address PM in clients who have DS when compared with clients who have SLI, whereas a similar pattern was found with clients who have ASD.

Conclusions & Implications—SLPs' opinions could be one reason they under-address PM with clients who have DS. Other reasons include there are no evidence-based practice (EBP) guidelines on this topic, and there is not enough familiarity with the DS phenotype among SLPs. Future research on ways to address PM in clients with DS successfully are essential so that EBP guidelines can be established and language therapy can be made more effective.

Keywords

phonological memory; speech and language pathologists; speech and language therapy; Down syndrome; autism spectrum disorders (ASD); specific language impairment (SLI)

Introduction

Down syndrome (DS) is the most prevalent childhood genetic disorder and cause of intellectual disability, occurring in about one of every 700 live births in the United States each year (Parker *et al.* 2010). The syndrome is characterized by a triplicate of the 21st chromosome, which causes a variety of outcomes including cognitive and language difficulties. These difficulties lead to challenges in communication, which create barriers to full community inclusion. Because of its distinctive physical features and straightforward chromosomal diagnosis, DS is usually confirmed before or shortly after birth. Once DS is confirmed, slow intellectual and language development can be expected, and early intervention is strongly recommended. Early language intervention is widely utilized, followed by speech and language therapy throughout childhood. Nevertheless, by the time they are adolescents, individuals with DS are usually far behind in language development, even relative to their cognitive abilities (Abbeduto *et al.* 2007). Thus, effective language intervention is crucial for children with DS. In the present paper, we raise the issue that phonological memory (PM) may be an important factor that is not universally addressed by speech–language pathologists (SLPs) in language therapy with clients who have DS.

DS language profile

Although language in general is significantly delayed in individuals with DS, there is a distinct profile of relative strengths and weaknesses (Abbeduto *et al.* 2007). This profile exists against a background of susceptibility to compromised hearing, phonological and articulatory function (Austeng *et al.* 2013, Kent and Vorperian 2013), which can have a significant impact on speech and language development and function. Distinctive aspects of the DS language profile include better receptive language skills than expressive language skills and better vocabulary than syntax. However, receptive syntax and expressive vocabulary are usually very limited. Compared with their non-verbal cognitive level, individuals with DS are often significantly lower in expressive vocabulary, expressive syntax and receptive syntax (e.g., Abbeduto *et al.* 2003, Finestack *et al.* 2013, Martin *et al.* 2013). In contrast, they are often similar in receptive vocabulary to their non-verbal cognitive level (Næss *et al.* 2011). In spite of relatively stronger receptive vocabulary, poor syntax skills compromise discourse comprehension, and with so many weak expressive skills language production often consists of brief simple statements that convey only basic meaning.

Down syndrome and PM

In addition to language, PM is a well-documented cognitive/linguistic impairment associated with DS (Silverman 2007). PM refers to short-term memory for speech sound information and is also called verbal or auditory short-term memory. In research studies, it has most often been measured using digit or word span tasks in which participants listen to lists of digits or words and repeat them back immediately in the same order. It has also been

measured using non-word repetition tasks in which participants listen to pronounceable non-words and repeat them back immediately. Often the number of digits/words in the list or the number of phonemes/syllables in the non-word increases until performance declines.

A great deal of previous research has established that PM is delayed in individuals with DS beyond developmental level and intelligence expectations. Participants with DS consistently perform more poorly on PM tasks than typically developing (TD) children matched for mental age, non-verbal ability or receptive vocabulary. They also perform more poorly than age- and IQ-matched participants with other forms of intellectual disability (Jarrold *et al.* 2000). A meta-analysis of studies comparing PM in groups with DS and TD groups matched on non-verbal ability reported an aggregate effect size of $g = -1.24$, indicating that participants with DS performed well over a standard deviation (SD) below TD participants (Næss *et al.* 2011). This meta-analysis showed that, as indicated by effect size, the impairment in PM is more severe than that for expressive vocabulary ($g = -0.67$) and receptive syntax ($g = -1.03$). Studies that have focused on non-word repetition also have reported impaired performance by participants with DS (Laws and Bishop 2003).

Importantly, the difficulty in PM is not accounted for by poor hearing or speech articulation, though these are characteristics of DS (Jarrold *et al.* 2002). Several researchers have investigated the underlying mechanisms for PM difficulty in individuals with DS, but no clear picture has emerged. For example, the impairment does not seem related to failure to rehearse, as group differences are apparent even when neither group is rehearsing (Jarrold *et al.* 2000). Nor is the impairment explained by unusually fast rate of memory decay, failure to use linguistic support or poor phonemic discrimination (Brock and Jarrold 2004, Purser and Jarrold 2005). Though no clear mechanisms have been identified to account for poor PM in individuals with DS, there is no disputing the distinct and characteristic limitation in PM performance among those with DS.

PM and language

For many years researchers have suggested the importance of PM is that it facilitates language development. Language learning requires processing sequences of speech sounds and internalizing structural aspects of the sounds. To build a knowledge base of words and to understand how the order of morphemes and words affects larger meaning requires one to hold phonological information in memory. If PM is good, allowing more information to be held at one time, it seems this should facilitate language learning. However, if PM is highly limited, as it is in individuals with DS, it seems this would limit language learning.

In typical development, there is evidence that PM is linked to language development. Most of this research has focused on vocabulary knowledge and suggests PM at age 4 years is causally linked to vocabulary knowledge at age 5 years, though a reciprocal relation may take place beginning at age 5 (Gathercole *et al.* 1992). Also, there appears to be a link between PM and learning of the phonological form of new words by young children age 5–8 years (Jarrold *et al.* 2009), and between PM and expressive language in young children age 4–5 years (Adams and Gathercole 1996).

In individuals with DS, previous studies have shown PM as measured by non-word repetition or digit span is correlated with language after controlling for non-verbal ability. This includes receptive vocabulary, receptive syntax and expressive syntax (Estigarribia *et al.* 2010, Laws 1998, Miolo *et al.* 2005, also Jarrold *et al.* 2009, Mosse and Jarrold 2008). In addition, these relations have borne out longitudinally in analyses that suggest PM has an influence on later language skills. For example, Laws and Gunn (2004) followed 33 participants with DS longitudinally over 5 years (aged 5–19 years at Time 1 and aged 10–24 years at Time 2). They found that after controlling for non-verbal ability and Time 1 language measures, early non-word repetition predicted later receptive vocabulary and, for younger participants, receptive syntax.

Language intervention for children and adults with DS

Most larger randomized control trials (RCTs) examining language intervention with individuals with DS have focused on naturalistic language approaches for toddlers or preschool-age children. Most of the naturalistic language interventions have involved training parents to interact with their children by being responsive to children's communication attempts rather than being directive. Studies showed parents successfully learned to interact with their children in social language contexts according to training (Kaiser and Roberts 2013, Yoder and Warren 2002), child communication behaviours increased during interactive sessions at least for some children (Fey *et al.* 2006, Yoder and Warren 2002), and parent plus therapist intervention produced better child communication outcomes than therapist-only intervention (Kaiser and Roberts 2013). However, studies generally have not shown significant improvements on standardized language tests (Kaiser and Roberts 2013). Further, positive outcomes for children with DS may depend on subtle aspects of therapy (e.g., allowing approximations and providing clearer corrective feedback), training level of therapists and dosage of intervention (Fey *et al.* 2006, Yoder and Warren 2004, Yoder *et al.* 2014).

In addition to studies examining naturalistic interventions in young children with DS, two RCT studies used more direct approaches to improving language in older children with DS. Burgoyne *et al.* (2012) tested a 20-week school-based reading/language intervention for children with DS age 5–10 years. The language strand focused on vocabulary, with explicit instruction on day 1 followed by games, expression, writing and review on days 2–5 of each week. Children in the intervention group gained more in expressive vocabulary for taught words, but not in receptive vocabulary for taught words or in standardized vocabulary measures. Sepulveda *et al.* (2013) tested a therapist-administered intervention that focused on specific grammatical targets in an one-on-one interactive and game-like manner. After 3.5 months of bi-weekly therapy, the intervention group gained more than the control group on standardized tests of syntax, semantics and morphology, though not pragmatics. A few single case studies using more direct approaches to language intervention in older children or adults have shown improvements in expressive syntax and story comprehension (Hewitt *et al.* 2005, Lecas *et al.* 2011).

Several authors have suggested the need to address memory limitations in language intervention for individuals with DS. For example, Yoder and Warren (2004) suggested poor

PM in DS might be a factor affecting slower language development of young children who have DS compared with children who have intellectual disability but not DS. They suggested that due to their PM limitations, children with DS may require more language input to develop language skills. Hewitt *et al.* (2005) also recognized PM limitations could impede language learning in individuals with DS. They suggested naturalistic interventions alone might not provide enough repetition; the addition of a more structured intervention component providing the needed repetition could improve outcomes (they used a hybrid approach in their small *N* study with adults learning grammatical structures). McDuffie *et al.* (2008) suggested visual supports could be used in language intervention to address PM limitations. If PM is limited, there will be more immediate forgetting of speech input; this can be addressed by repetition of speech input or by presentation of visual material that is consistent with the speech input.

A few researchers have included elements in their interventions that address PM limitations. These include structured elicitations and increased repetition (Chapman *et al.* 2006, Hewitt *et al.* 2005), as well as maximized visual support (Burgoyne *et al.* 2012, Lecas *et al.* 2011, Sepulveda *et al.* 2013). However, few empirical investigations have been done to determine whether these additions have actually made the interventions more effective. Thus, there are no evidence-based practice (EBP) guidelines for addressing PM limitations in clients with DS (see the American Speech and Hearing Association's Compendium of EBP Guidelines and Systematic Reviews and the Institute of Education Science's What Works Clearinghouse). Buckley and Le Prevost's (2002) EBP guidelines for speech and language therapy suggest SLPs working with individuals who have DS should be knowledgeable of the important role of PM in language development, as well as limitations in PM associated with DS. However, they do not offer specific recommendations on *how* to address PM limitations in language therapy.

In perhaps the only direct experimental test of the effect of PM support in a language acquisition task, Chapman *et al.* (2006) examined fast-mapping performance of participants with DS, comparing them with TD participants matched for receptive syntax. Researchers manipulated the number of oral repetitions of objects named by the experimenter (four versus one) and whether or not participants were required to repeat object names (two versus zero times). It could be argued both of these manipulations provide PM support. Repetitions improved production of novel object names similarly for both groups, especially when elicited production was not required. Neither repetitions nor elicited production affected comprehension of novel object names, though repetitions improved speed of response for participants with DS only. These results provide partial support for incorporating memory support into language intervention for individuals with DS (see also Kay-Raining Bird *et al.* 2000).

Without formal recommendations on how to address PM limitations in language therapy with clients who have DS, it is possible SLPs find ways to do so in their practices. However, no research has examined the actual language therapy practices and strategies used by SLPs with clients who have DS. Thus, in the present study we surveyed SLPs in 28 states plus the District of Columbia, asking if and how they address PM in their own work with clients who have DS. We also asked SLPs their opinions about the importance, practicality and difficulty

of doing so. To provide a contrast, we asked the same questions in relation to clients with specific language impairment (SLI) and autism spectrum disorders (ASD). These childhood developmental disorders are more common than DS but both involve language and communication difficulties. Though both are quite heterogeneous, SLI is clearly associated with PM limitations to the extent that PM is considered a clinical marker for SLI (Conti-Ramsden *et al.* 2001). In contrast, for ASD, PM limitations occur only in a subgroup and with less severity compared with SLI (Taylor *et al.* 2014). Thus, it might be expected that the degree to which SLPs address PM in their language therapy would be similar for clients with DS and SLI, and less for clients with ASD. Also, it might be expected that SLPs view it as more important to address PM with clients who have DS or SLI than clients who have ASD. Their views on practicality and difficulty of addressing PM, however, could be different.

Method

Participants

The starting sample consisted of 425 SLPs from 28 states plus the District of Columbia who both consented to participate and worked with individuals who have DS, SLI and/or ASD. Of these, 290 completed the entire survey. The following demographic information derives from the last two sections of the Speech–Language Pathology Survey described below, labelled *Your Training* and *Your Practice*. The final sample of 290 drew from three north-eastern states (5.2%), seven western states (16.2%), eight mid-western states (31.4%), and ten southern states plus the District of Columbia (47.2%). Participants' final degrees were most often master's degrees (91%), with 92% of their degree programmes being accredited by the Council on Academic Accreditation in Audiology and Speech–Language Pathology (CAA) of the American Speech–Language–Hearing Association (ASHA). Also, 94% of SLPs had received their Certificate of Clinical Competence (CCC), and 97% were practising speech–language therapy at the time they completed the survey. Ninety-two per cent practised full time for all or part of their careers, and the mean number of years practising was 19 (range = 0–50). The majority practised primarily in school settings (69%). More detail on SLPs' practices and clients are included in table 1.

Procedure

Participants were recruited in one of two ways. First, researchers e-mailed or telephoned each state's Speech–Language–Hearing Association. Associations were asked if they could distribute the survey link, along with brief correspondence regarding the purpose of the survey, to the SLPs on their listserv. All 50 state associations were approached this way, plus the District of Columbia. Of these, 20 state associations agreed to distribute the survey. Second, researchers individually e-mailed all SLPs from participating states who were listed on the public ASHA directory. This e-mail stated that those SLPs who had already completed the survey (i.e., if they had received it through their state association's listserv) should not do so a second time. In some cases SLPs contacted had moved out of state, thus the final number of states represented was 28.

Once contacted, SLPs were able to click a link embedded in an e-mail that sent them directly to the Speech–Language Pathology Survey on Survey Monkey. Here, SLPs were able to

consent electronically to participating in the survey, and only those who provided consent continued to the survey questions. Following consent, SLPs read descriptions for each section and answered survey questions. The survey contained skip logic; for instance, if SLPs checked 'No' to having addressed PM with clients who have DS, then the survey skipped the questions regarding how they addressed PM in their therapy with this client type. Those SLPs who were directed to every question in the survey answered 52 questions. Once SLPs completed the survey, they were given permission to contact researchers with any questions and thanked for their participation. The survey took 15–30 min to complete.

Speech–Language Pathology Survey

The Speech–Language Pathology Survey was created for the unique purposes of this study. The survey consisted of five sections in the following order: Your Clients; Addressing Phonological Memory; Opinions on Addressing Phonological Memory; Your Training; and Your Practice:

- *Your Clients:* 12 questions in this section asked SLPs about (1) the ages of clients with whom they had worked, (2) whether they had worked with clients who had DS, SLI and/or ASD, (3) how recently they had worked with these client types, and (4) how many clients of each type they had worked with over their careers.
- *Addressing Phonological Memory:* This section began with a definition of PM. Then 18 questions asked SLPs if and how they address PM in language therapy with each of the three client types (DS, SLI and ASD). SLPs were first asked the degree to which they addressed PM for each client type (regularly, occasionally or never). Those SLPs who answered regularly or occasionally to these questions were then asked how they addressed PM in their language therapy with each client type. Response alternatives included (1) use exercises to expand PM directly, (2) use techniques to compensate for PM limitations, (3) teach strategies to clients, teachers or caregivers to address PM limitations, and (4) other. Respondents were encouraged to elaborate on each of the techniques they utilize by providing specific examples.
- *Opinions on Addressing Phonological Memory:* Nine questions asked SLPs how important, practical and difficult they thought it was to address PM with each of the three client types (DS, SLI and ASD). All SLPs were invited to answer these opinion questions, regardless of whether they worked with each client type or whether they addressed PM in their language therapy with any of the client types. Answers were in the form of five-level Likert scales. For importance, levels consisted of 'Not At All Important', 'Not Important', 'Moderately Important', 'Important' and 'Very Important'. For practicality, levels consisted of 'Not At All Practical', 'Not Practical', 'Moderately Practical', 'Practical' and 'Very Practical'. For difficulty, levels consisted of 'Very Easy', 'Easy', 'Moderate', 'Difficult' and 'Very Difficult'.
- *Your Training:* Six questions asked SLPs about their degrees, including final type received, programme in which received, and whether or not the attended

programme was accredited by the CAA of ASHA. SLPs were then asked if they had received their CCC and, if so, in which year.

- *Your Practice:* Seven questions asked SLPs about their current practice if still employed or their previous practice if no longer employed. Specifically, they were asked how many years they had practised and if they had practised full or part time. Lastly, SLPs were asked to identify all the employment settings in which they had worked and the settings in which they had worked the most time. Answers included universities, schools, hospitals, offices of other health practitioners, nursing care facilities, home healthcare services, individual and family services, outpatient care centres, child day-care centres and private practices.

Results

Do SLPs address PM with clients who have DS?

Of the 290 SLPs who completed the survey, 267 reported they had worked with clients who have DS, 258 reported they had worked with clients who have SLI, and 281 reported they had worked with clients who have ASD. A total of 227 SLPs reported they had worked with all three client types. Figure 1 shows the percentage of SLPs who worked with each client type and who responded that they regularly, occasionally or do not address PM with each client type. Almost half of SLPs who worked with clients who have DS reported they addressed PM occasionally or regularly. However, of the three client types, those with DS were the least likely to have PM addressed in language therapy. Clients with SLI were the most likely to have PM addressed, and those with ASD were in the middle.

A one-way repeated measures analysis of variance (ANOVA) was performed to compare Likert ratings across client type, based on the subsample of SLPs who worked with all three client types ($n = 227$). Responses were coded as follows: *Yes, Regularly* = 1; *Yes, Occasionally* = 2; and *No* = 3; *Not Sure* responses were treated as missing. This analysis confirmed that SLPs addressed PM to different extents with different client types, $F(2, 390) = 62.40$, $p < .001$, $\eta^2 = .242$ (a large effect). Pairwise comparisons using the LSD criterion indicated SLPs addressed PM more for clients with SLI (mean rating = 1.84, SD = 0.76) than for clients with DS (mean rating = 2.37, SD = 0.72) or ASD (mean rating = 2.21, SD = 0.77; $ps < .05$). They also addressed PM more for clients with ASD than for clients with DS ($p < .05$).

How do SLPs address PM with clients who have DS?

Nearly all SLPs who reported they address PM in their language therapy with clients who have DS, SLI and/or ASD (or were unsure) endorsed one or more of the three broad options offered in the survey, and a small minority endorsed the Other option (table 2). Each of the options was endorsed by well over half of those SLPs who addressed PM: (1) exercises to expand PM directly, (2) techniques to compensate for PM limitations, and (3) teaching clients, teachers and/or parents to address PM limitations. This was true for all client types. Nevertheless, there appeared to be some trends in the data. First, SLPs were somewhat less likely to use exercises to expand PM for clients with DS (60.7%) than for clients with SLI

(75.9%) or ASD (73.2%). Second, SLPs were less likely to use techniques to compensate for PM limitations for clients with DS (67.5%) than for clients with SLI (78.9%) or ASD (75.8%). Third, SLPs were less likely to teach clients, teachers or parents to address PM limitations for clients with DS (65.8%) or SLI (65.8%) than for clients with ASD (74.5%). Lastly, SLPs were less likely to report using all three techniques with clients who have DS (27.8%) than with clients who have SLI (45.2%) or ASD (43.0%).

The survey asked SLPs who address PM to provide examples of how they do so. Table 3 shows the variety of methods listed by SLPs for ‘Expand’, ‘Compensate’ and ‘Teach’ approaches with clients who have DS. The most common method for expanding PM directly with clients who have DS was using or teaching repetition (33.3%), followed by working on sounds, and memorizing songs or using music/rhythm. The most common method of compensating for PM limitations of clients with DS was using visual aids or visual strategies (68.7%), followed by using or teaching gestures or signs. The most common method for teaching clients, teachers and/or parents to address PM limitations of clients with DS was to teach the use of visual supports (42.2%), followed by teaching cuing or prompting, and teaching the use of repetition.

What are SLPs’ opinions of addressing PM with clients who have DS?

Regardless of whether SLPs worked with clients who have DS, SLI or ASD, they were encouraged to give their opinions about addressing PM in language therapy with these client types. Figure 2 shows mean ratings of importance, practicality and difficulty for each type.

Importance

On average SLPs considered it moderately important to address PM with clients who have DS or ASD but very important to address PM with clients who have SLI. Ratings of importance differed significantly across client types, $F(2, 568) = 64.58, p < .001, \eta^2 = .185$ (a large effect), based on the subset of participants who rated all three client types on importance ($n = 285$). In pairwise comparisons using the LSD criterion, SLPs judged it more important to address PM for clients with SLI than for clients with DS or ASD, $ps < .001$, and roughly equally important to address PM for clients with DS and ASD, $p = .141$.

Practicality

SLPs considered it moderately practical to address PM with clients who have DS or ASD but very practical to address PM with clients who have SLI. Ratings of practicality differed significantly across client types, $F(2, 556) = 76.34, p < .001, \eta^2 = .215$ (a large effect), based on the subset of participants who rated all three client types on practicality ($n = 279$). Pairwise comparisons using the LSD criterion indicated practicality ratings were significantly higher for clients with SLI than for clients with DS or ASD, $ps < .001$, though they were more similar for clients with DS and ASD, $p = .463$.

Difficulty

SLPs considered it moderately difficult to address PM with clients who have DS and ASD but moderately easy to address PM with clients who have SLI. Ratings of difficulty differed significantly across client types, $F(2, 564) = 37.94, p < .000, \eta^2 = .119$ (a medium effect),

based on the subset of participants who rated all three client types on difficulty ($n = 283$). Pairwise comparisons using the LSD criterion indicated SLPs considered it easier to address PM with clients who have SLI than with clients who have DS or ASD ($ps < .001$), but they saw no difference in difficulty between clients with DS and clients with ASD, $p = .339$.

Consistency across and within client type

Correlations showed SLPs who rated the importance, practicality or difficulty of addressing PM as high for one client type also tended to rate these factors high for other client types. Importance ratings correlated moderately across client types, $rs = .574-.583$, $ps < .001$, as did practicality ratings, $rs = .507-.528$, $ps < .001$. Correlations for difficulty ratings across client types were somewhat weaker but still in the moderate range, $r = .387-.437$, $ps < .001$. Within each client type, SLPs' ratings of importance, practicality and difficulty of addressing PM followed a distinct pattern. Importance and practicality correlated strongly within each client type, $rs = .736-.778$, $ps < .001$; importance and difficulty correlated weakly, $rs = .137-.264$, $ps < .05$; and practicality and difficulty did not correlate except in the case of a weak correlation in clients with SLI, $r = .197$, $p < .01$.

Are there individual differences in the tendency to address PM?

Correlations showed SLPs who address PM in one client type tended to do so in other client types. The Likert ratings of addressing PM correlated moderately across each pair of client types ($rs = .544-.591$, $ps < .001$). Also, SLPs who felt it more important, more practical and less difficult to address PM with clients who have DS were more likely to actually address it, based on their self-report of these variables. However, these relationships were generally weak ($rs = -.300-.167$, $ps < .05$). Correlations for clients with SLI and ASD were similar, though the strongest set was for clients with SLI.

Indicators of experience were also correlated with tendency to address PM. The number of years practising was weakly but significantly related to tendency to address PM, with those practising longer more likely to address PM with clients who have DS, $r = -.185$, $p < .01$; SLI, $r = -.127$, $p < .05$; and ASD, $r = -.218$, $p < .01$. The number of clients with DS, SLI or ASD was also examined in relation to tendency to address PM. The number of clients was reported in categories (1–5, 6–15, 16–30, 31–50 and 50+). The frequencies of SLPs falling into these five categories differed greatly by client type, with the vast majority of SLPs having worked with 15 or fewer clients with DS and over 50 clients with SLI. There was a more even distribution of SLPs across the categories for clients with ASD (table 1). For each client type, rate of addressing PM varied significantly across these categories (table 4): DS, $F(4, 236) = 5.05$, $p < .01$; SLI, $F(4, 243) = 2.64$, $p < .05$; and ASD, $F(4, 260) = 6.22$, $p < .01$. For clients with DS and ASD, SLPs who had worked with 31–50 clients were more likely to address PM than any of the other groups ($ps < .05$ based on LSD post-hocs). For clients with SLI, SLPs with over 50 clients were more likely to address PM than those with 6–15 clients, $p < .01$, and marginally more likely to address PM than those with 1–5 clients, $p = .055$, and 16–30 clients, $p = .071$. Thus, SLPs who are more experienced working with clients of a particular type were more likely to address PM with clients of that type.

Discussion

The purpose of the present study was to determine if and how SLPs address PM in their therapy with clients who have DS because this client type is known to have substantial PM limitations. Additionally, this study explored SLPs' opinions of the importance, practicality and difficulty of addressing PM in clients with DS. To do so, we surveyed SLPs who provide therapy to clients with DS, SLI and/or ASD. Questions related to clients with SLI and ASD were included to provide a contrast to those with DS, as SLI has been consistently linked with PM limitations whereas ASD has been less often linked with PM limitations.

Under-addressing PM in language therapy with clients who have DS

In spite of evidence that PM is important to language learning and is an area of severe weakness in individuals with DS, few SLPs regularly address PM in their language therapy with clients who have DS. They are much more likely to address PM with clients who have SLI (who also have PM limitations), and they are even more likely to address PM with clients who have ASD (who do not typically have PM limitations). This pattern suggests SLPs are under-addressing PM in language therapy with clients who have DS. Further, even when SLPs are addressing PM with clients who have DS, they are using a limited number of techniques to do so, more limited than they use with clients who have SLI or ASD.

One possible reason for under-addressing PM with clients who have DS is that doing so is viewed as less important, less practical and/or more difficult for this client type. Given that PM limitations are clearly associated with DS and SLI, and less so with ASD, the opinions expressed by SLPs were somewhat surprising. Possibly, the relative ratings of importance, practicality and difficulty across client types had to do less with specific limitations in PM than with the overall impact of each disability. For example, nearly all individuals with DS have intellectual disability, while only about one-third of those with ASD (Baio 2014) and none of those with SLI have intellectual disability. Thus, in individuals with DS, there are delays in all areas of cognitive development—not just in language—and the delays can be severe. This could reduce SLPs' opinions on the importance and practicality of addressing PM in language therapy with clients who have DS when they perhaps could be prioritizing broader goals like intelligibility and comprehension. It could also increase SLPs' opinions on the difficulty of addressing PM. In individuals with ASD, there are also delays in many areas of development, but not all cases are severe. In contrast, there are fewer areas of delay in individuals with SLI, so addressing PM in language therapy may stand out as more important, more practical, and less difficult for this client type. Perhaps future studies could support this conclusion by asking SLPs about their language therapy with groups with intellectual disabilities caused by aetiologies other than DS relative to a group with DS.

A second possible reason for under-addressing PM with clients who have DS is that SLPs do not always have the training to do so. There are very few intervention studies focusing on addressing PM in language therapy with clients who have DS, and consequently, no EBPs to guide SLPs. SLPs are left to come up with their own solutions to PM limitations in their clients with DS. Thus, in the present study SLPs who had practised more years were more likely to address PM than those who had practised for fewer years. Also, those who were more familiar with DS (having worked with more clients who have DS) were more likely to

address PM for clients with DS than those who were less familiar with DS. In the absence of EPBs, knowledge of the DS phenotype could be particularly helpful to SLPs in finding ways to address PM in their clients who have DS. This information could be incorporated into speech–language pathology training programmes.

Ways of addressing PM in language therapy with clients who have DS

Despite no formal recommendations on how to address PM in language therapy with clients who have DS, the present study showed some SLPs have found ways to do so nonetheless. Their reported practices could be helpful to other SLPs who work with clients with DS. Also, these practices could be empirically tested in research studies. Perhaps some of them will become the EBPs of the future.

The most common methods used to *expand PM directly* with clients who have DS included using or teaching repetition, working on sounds, and memorizing songs or using music/ rhythm. Both Hewitt *et al.* (2005) and Chapman *et al.* (2006) stressed the particular importance of repetition in language intervention with clients who have DS, suggesting it could improve outcomes. Although some researchers have studied ways of directly expanding PM using repetition (Connors *et al.* 2008), ways of enhancing phonemic awareness (Cleave *et al.* 2011), and ways of improving music skills (Edenfield and Hughes 1991), there is little research on relating these techniques to language learning (but see Chapman *et al.* 2006). Thus more research is needed that embeds these techniques into language intervention and evaluates their impact on language outcomes.

The most common methods SLPs used *to compensate for PM limitations* with clients who have DS included making use of visual supports or strategies and using or teaching gestures or signs. Both McDuffie *et al.* (2008) and Burgoyne *et al.* (2012) stressed the importance of maximizing visual support in language intervention with clients who have DS, again suggesting these supports could improve outcomes. However, the impact of doing so has rarely been empirically tested. In one study, Kay-Raining Bird *et al.* (2000) found that, in a novel word learning task, preschoolers with DS showed more vocal imitation and greater comprehension of words under vocal + sign presentation compared with vocal- or sign-only presentation. Although this study was limited in sample size, it suggests visual support in the form of sign might indeed accelerate language learning for clients with DS. However, more empirical evidence is needed.

Lastly, the most common methods SLPs used *to teach clients, teachers and/or parents* to address PM limitations with clients who have DS included teaching the use of visual supports, cuing or prompting, and repetition. Thus it appeared some SLPs were teaching others how to use similar methods as those they were practising themselves in order to improve language intervention outcomes in clients with DS. This approach is consistent with naturalistic language intervention models, which emphasize teaching parents to implement language therapy (Fey *et al.* 2006, Yoder and Warren 2002). Although it has been empirically demonstrated that adding a parent component enhances child outcomes (Kaiser and Roberts 2013), this has not yet been shown in relation to PM-focused techniques.

Limitations and suggestions for future research

The results of the present study should be interpreted in light of certain limitations. First, the response rate was unknown given the number of SLPs on each state's list-serv who worked with clients who have DS, SLI and/or ASD was unknown (i.e., the number invited to participate in the survey). Second, the sample was somewhat imbalanced in terms of geographic area of the United States. Although all US geographic regions were represented (with the exception of Alaska and Hawaii), nearly half the sample was drawn from ten southern states plus the District of Columbia. However, other demographic characteristics of the sample were as expected: a very high percentage with terminal master's degrees from CAA-accredited programmes, a very high percentage holding CCC and currently practising speech-language therapy, and the majority practising primarily in school settings. Further, there was a very wide range of experience as indicated by number of years practising.

A second limitation of the present study is that the measures used were self-report, which introduces certain vulnerabilities. For example, SLPs might have felt as though the survey presented addressing PM as being the correct or better practice than not addressing PM. SLPs might have felt pressured to respond that they do address PM in their language therapy because this response might have seemed more acceptable. This scenario would lead to an overestimate of SLPs' rate of addressing PM in their language therapy, though perhaps equally for each client type. Further, insofar as self-report measures are sensitive to participants' memory accuracy, SLPs might have misremembered details of therapy they had provided to client types and reported these details inaccurately. Or, they might not have recognized some of the techniques they use as addressing PM limitations. These scenarios would lead to an underestimate of SLPs' rate of addressing PM in their language therapy, though perhaps equally for all client groups. In future research, more direct measures (e.g., observation) could be used to tap actual practices. However, survey research provides an economical start to answering basic questions.

Limitations of this study can be addressed in future research. However, more importantly, research is needed on effective ways of addressing PM in language therapy with clients who have DS. These include ways of directly expanding clients' PM abilities within the context of language therapy; ways of supporting PM limitations through the visual modality; and ways of teaching effective strategies to clients, parents and teachers. We believe it will prove important that these types of practices be incorporated into language therapy—not addressed in an isolated manner. And their impact must be addressed empirically so they can be translated into EBP guidelines. Though there is a clear need for methodologically sound, fully powered RCT studies on which EBP guidelines can be based, smaller-scale pilot studies will be needed first to flesh out feasibility. Given that so little research currently exists, there is much work to do.

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What this paper adds?**What is already known on this subject?**

Very little is known about if or how SLPs address PM in language therapy with clients who have DS. This information should be determined because PM plays a significant role in language development but is impaired in clients with DS.

What this paper adds?

This study found SLPs less often address and use less variety when addressing PM in clients with DS relative to other client types, perhaps because they view this practice as less important, less practical and more difficult in clients with DS. However, some SLPs have found ways to address PM in clients with DS, and these practices could be tested to establish EBP guidelines and, ultimately, make language therapy more effective in clients with DS.

Figure 1. Percentage of SLPs addressing PM in language therapy regularly, occasionally or not at all across client type.

Figure 2.
Mean opinion ratings for importance, practicality and difficulty of addressing PM with different client types (with standard error bars).

Table 1SLPs' clients ($N = 290$)

	Clients who have DS	Clients who have SLI	Clients who have ASD
Number of SLPs providing therapy to each client type			
<i>Have you provided language therapy to any clients who have ...? Check all that apply:</i>			
Yes, currently providing therapy	125	190	228
Yes, previously provided therapy	188	111	112
No, never provided therapy	22	33	8
Percentage of SLPs providing therapy at different intervals, by client type ^a			
<i>How recently have you worked with clients who have ...?</i>			
Within the past year	54.3	78.3	84.2
Within the past 5 years	25.1	14.3	9.7
Within the past 10 years	15.4	5.4	4.7
Within the past 25 years	4.9	1.4	1.4
25+ years	0.4	0.4	0.0
Percentage of SLPs who worked with different numbers of clients, by client type ^b			
<i>Approximately how many clients with ...have you worked with over your career?</i>			
1–5 clients	45.1	8.2	8.2
6–15 clients	34.7	11.3	26.1
16–30 clients	10.8	13.2	31.4
31–50 clients	4.1	12.5	15.7
50+ clients	5.2	54.9	18.6

Notes: SLP = speech–language pathologist; DS = Down syndrome; SLI = specific language impairment; ASD = autism spectrum disorder.

^aPercentages were computed from the number of participants who provided therapy to the client type and answered the question ($Ns = 267, 258$ and 279).

^bPercentages were computed from the number of participants who provided therapy to the client type and answered the question ($Ns = 268, 257$ and 280).

Table 2

Among SLPs who address PM, the percentage who use expand, compensate and/or teach strategies with each client type

	Clients who have DS		Clients who have SLI		Clients who have ASD	
	N = 117	N = 80 ^a	N = 199	N = 80 ^a	N = 149	N = 80 ^a
Expand	60.68	65.00	75.88	83.75	73.15	70.00
Compensate	67.52	72.50	78.89	82.50	75.84	83.75
Teach	65.81	63.75	65.83	72.50	74.45	83.75
Other	6.84	8.75	5.53	6.25	4.03	6.25

Notes: SLP = speech-language pathologist; PM = phonological memory; Expand = exercises to expand PM directly; Compensate = techniques to compensate for PM limitations; Teach = teaching clients, teachers and/or parents to address PM limitations; DS = Down syndrome; SLI = specific language impairment; ASD = autism spectrum disorder.

^aFor the sample with N = 80, all SLPs have addressed PM with all three client types.

Table 3

Per cent of SLPs reporting use of various methods to address PM with clients who have DS

Expand (N = 60)			Compensate (N = 67)			Teach client, teacher, caregiver (N = 64)		
Method	%	Method	%	Method	%	Method	%	Method
Use/teach repetition	33.3	Use visual aids/strategies	68.7	Teach use of visual supports	42.2			
Work on sounds	20.0	Use/teach gestures and signs	17.9	Teach cuing/prompts	29.7			
Memorize songs, use music/rhythm	18.3	Reduce information load	11.9	Teach use of repetition	20.3			
Expand commands	11.7	Use music, rhythm or rhyme	11.9	Teach how to minimize information	14.1			
Memorize personal information	11.7	Provide/encourage repetition	11.9	Use schedules, calendars, labels	14.1			
Use visual or tactile cues	8.3	Work on general memory skills	10.4	Teach methods to family and teachers	9.4			
Expand story recall elements	6.7	Use reminders or cues (not visual)	10.4	Invite teacher/caregiver to therapy sessions	7.8			
Increase demand for PM in therapy	1.7	Other	13.4	Teach use of music/rhythm/gesture/sign	7.8			
Other	6.7			Teach how to converse with client	7.8			
				Encourage shared book reading/storytelling	6.3			
				Give information to parents/teachers	6.3			
				Teach/encourage sound play	4.7			
				Teach direct expansion of PM	4.7			

Notes: Percentages are based on those SLPs who addressed PM with clients who have DS, used Expand, Compensate or Teach methods, and offered one or more examples. Percentages do not add up to 100% because several SLPs offered more than one example.

DS = Down syndrome; PM = phonological memory; SLP = speech-language pathologist.

Table 4

Mean ratings for addressing PM by number of clients for each client type

Number of clients	Clients who have DS		Clients who have SLI		Clients who have ASD	
	N	Mean rating (SD)	N	Mean rating (SD)	N	Mean rating (SD)
1–5	104	2.54 (0.67)	20	2.05 (0.76)	20	2.65 (0.67)
6–15	86	2.35 (0.63)	27	2.11 (0.70)	72	2.35 (0.70)
16–30	26	2.38 (0.85)	33	1.97 (0.73)	82	2.27 (0.79)
31–50	11	1.64 (0.51)	32	1.81 (0.69)	40	1.75 (0.74)
50+	14	2.21 (0.70)	136	1.71 (0.74)	51	2.16 (0.81)
Total	241	2.39 (0.69)	248	1.83 (0.74)	265	2.22 (0.78)

Notes: Addressing PM was scored on a 1–3 scale, with 1 = Yes regularly, 2 = Yes occasionally and 3 = No. 'Not sure' responses were treated as missing.
PM = phonological memory; DS = Down syndrome; SLI = specific language impairment; ASD = autism spectrum disorder.