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Computer-assisted assessment and intervention

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From the editors

Anna O'Callaghan and Jane McCormack


This issue of the *Journal of Clinical Practice in Speech-Language Pathology* focuses on "Computer assisted assessment and intervention". As such, it showcases developments in speech-language pathology (SLP) research and clinical practice in response to the technological advances of recent years.

Finch, Clark and Hill explored whether the use of tablet computers had the potential to increase the intensity of therapy for adults with aphasia. In their pilot trial, Finch and colleagues described the improvements made by two participants in naming items as a result of the intervention, and reported different benefits and challenges to engaging with technology for treatment.

Other contributors examined the use of computer programs for intervention with children. Washington and Warr-Leeper examined the effectiveness of a computer-based intervention targeting expressive grammar in preschool children with specific language impairment. They found children who participated in the intervention demonstrated greater improvements in grammatical complexity and morpheme use, compared to children who received no intervention. Similarly, Seiler, Leitão and Blosfelds evaluated the effectiveness of a computer-based program for addressing orthographic processing in three children with word identification difficulties. Preliminary findings were positive and have encouraged the authors to conduct further research with a larger sample of children.

Within this issue of *JCPSLP*, regular columns also focus on technology in practice. In her "Webwords" column, Bowen introduced apps for use in speech-language pathology intervention and highlighted the importance of evaluating these apps, particularly in terms of the evidence available to support their use. As one example of the proliferation of apps available for clinical practice, Winkworth provided a description of her "Top 10" iPad and iPhone apps suitable for the treatment of clients with voice disorders. She has used these clinically with success but warns of the need to exercise caution when choosing and using apps, given the lack of external evidence for many. Sutherland contributed the "What's the evidence?" column, reviewing the evidence that exists to support communication interventions using mobile devices for children with autism spectrum disorder (ASD). Again, he emphasised the limited research currently available showing the effectiveness of mobile technologies for children with ASD. Given the great consumer interest in such technologies, research into the effectiveness of these apps would be timely.

The world of information technology is certainly advancing and expanding at a rapid rate. We, as speech pathologists, are readily embracing the innovations this technology offers us, but we are wary of the need to apply them with caution.

Other papers in this issue explore a range of other interesting clinical topics. Freedman explored the impact of semantic and phonological neighbourhood density on preschool children's naming accuracy. Washington, Oddson, Robertson, Rosenbaum, and Thomas-Stonell described the test-retest and inter-rater reliability of a new clinical outcome measure, based on the International Classification of Functioning Disability and Health – Children and Youth. Steel, Rose and Eadie developed a clinical tutorial to provide speech-language pathologists with six key considerations when assessing complex sentences in children with language impairment.

We have enjoyed reading all of the contributions to this issue of *JCPSLP* and hope that you do as well. We hope you are encouraged to explore alternative modes of undertaking assessment and intervention within your research and clinical practice and to consider sharing the results in future issues of *JCPSLP*!

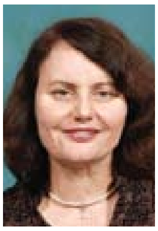
Contents

Using computer-based therapy as an adjunct to standard anomia therapy

Emma Finch, Kathy Clark and Anne J. Hill

KEYWORDS
ANOMIA
APHASIA
CLINICAL RESEARCH
COMPUTER THERAPY
TABLET COMPUTER

THIS ARTICLE HAS BEEN PEER-REVIEWED


Emma Finch (top), Kathy Clark (centre) and Anne J. Hill

Computer-based therapy has the potential to increase the intensity of therapy for individuals with aphasia. The aim of our project was to investigate the effectiveness of providing computer-based aphasia therapy as an adjunct to standard speech pathology treatment approaches in the inpatient rehabilitation ward setting. Secondary aims were to 1) investigate the frequency and length of usage of the self-directed computer therapy exercises by participants, and 2) investigate participants' attitudes towards computer-based therapy, and whether these attitudes changed following a block of self-directed computer-based therapy. Two participant cases will be presented. Both participants displayed improved naming of treated items, and a non-significant change in general language function. The benefits and challenges encountered implementing computer-based therapy research in a hospital rehabilitation setting will also be discussed. The current paper suggests that computer-based aphasia therapy delivered by a tablet computer may have potential as a useful adjunct to standard clinical practice; however, a number of factors need to be considered before embarking on the implementation process.

Stroke is currently the second highest cause of death in Australia and a leading source of disability (National Stroke Foundation, 2010). Evidence suggests that up to 38% of stroke patients will experience aphasia, an acquired language disorder (Pedersen, Jorgensen, Nakayama, Raaschou, & Olsen, 1995) with debilitating social and psychological implications. Given Australia's ageing population, there is increasing pressure on speech pathology services to meet these demands within existing staffing and funding levels. One health care area where this is experienced particularly strongly is in the adult hospital rehabilitation setting. As a result, there is a need to rapidly develop new service delivery models to meet this need. A potential solution to this critical problem may be the use of computer-based therapy.

Computer-based therapy has a number of potential benefits, including the potential to increase therapy intensity without a simultaneous increase in face-to-face clinician time (Adrian, Gonzalez, Buiza, & Sage, 2011). This is particularly relevant for aphasia therapy, as research suggests that high intensity therapy may be associated with positive communication outcomes (Bhogal, Teasel, & Speechley, 2003; Denes, Perazzolo, Piani, & Piccione, 1996); however, the optimal intensity remains unknown (Brady, Kelly, Goodwin, & Enderby, 2012). At a patient level, other potential benefits of computer-based therapy include the ability to provide mass exposure to items and a range of multi-sensory tasks; and a high level of self-direction with patients being able to control their own progress through the tasks, receive specific online feedback about task performance and select how to do the therapy (Adrian, Gonzales, & Buiza, 2003). At a service delivery level, computers can be used to extend the length of time that patients receive rehabilitation (Fink, Brecher, Sobel, & Schwartz, 2005) and enable rural and remote patients to receive a speech pathology service without a clinician being physically present.

Despite the numerous benefits, a number of potential challenges to implementing computer-based therapy clinically have also been identified. These potential challenges include limited access to computers, financial costs associated with purchasing and maintaining technological equipment, and patients (especially older patients) viewing computers as intimidating (Fink et al., 2005). It has also been suggested that clinical time constraints may be a challenge as time is required to master the technology; however, once mastered it is generally found that computer-based therapy can be time efficient for clinicians (Fink et al., 2005; Mortley, Wade, & Enderby, 2004).

Overseas research has demonstrated that computer-based therapy may be an effective rehabilitation approach for people with naming difficulties associated with aphasia (Adrian et al., 2011; Archibald, Orange, & Jamieson, 2009; Mortley et al., 2004; Wade, Mortley, & Enderby, 2003). Yet to date minimal research has investigated the effectiveness of computer-based aphasia naming therapy within an Australian hospital rehabilitation context. Furthermore, most previous research into computer-based therapy has focused on patients in the chronic stage of recovery (e.g., Adrian et al., 2011; Archibald et al., 2009; Mortley et al., 2004; Wade et al., 2003). There has been limited research into the effects of computer-based therapy for patients during the earlier recovery stage. Of this limited body of research, the studies by Laganaro, Di Pietro, and Schnider (2003 and 2006) looked at providing computer-based anomia therapy as an adjunct to standard speech pathology intervention in very small patient numbers and used unsupervised practice of computer tasks at scheduled times with a speech pathologist available for assistance. Additionally, in Laganaro et al. (2006) the computer-therapy was conducted over a short period of time (one week of therapy for each of the two stimulus lists). There are no reports of research that has investigated the use of tablet computers with self-directed therapy schedules.

Tablet computers present a number of benefits over more conventional desktop computers and laptops. For example, tablet computers offer the ability to increase therapy accessibility (beyond that of a desktop computer), as the tablet can be used in virtually any location including at the patient's bedside and any time, including over the weekend; thus, negating the need to organise computer room bookings. Another advantage of tablet computers is that they often weigh less than laptop computers and can easily be transported home with patients. The touch screen input of a tablet computer may provide an easier input mode than traditional keyboards or mice for patients with fine motor limitations. However, it is also possible that this new way of navigating (i.e., using a touch screen) may be more difficult for some individuals, at least during the learning phase.

The aim of our project was to investigate the effectiveness of providing computer-based aphasia therapy as an adjunct to standard speech pathology treatment approaches in the inpatient rehabilitation ward setting. Secondary aims were to 1) investigate the frequency and length of usage of the self-directed computer therapy exercises by participants, and 2) participants' attitudes towards computer-based therapy, and whether these attitudes changed following a block of self-directed computer-based therapy.

Methodology

Participants

Participants were recruited from the inpatient rehabilitation services at a tertiary hospital. Inclusion criteria included a primary diagnosis of mild to moderate anomic aphasia and cognitive status adequate to learn to use the program (with the aid of an aphasia-friendly guide). Potential participants were excluded if they presented with global aphasia, moderate-severe comprehension difficulties, moderate-severe apraxia of speech, or moderate-severe cognitive problems. It was anticipated that 10 inpatient rehabilitation patients would be recruited over approximately 10 months. Recruitment was slower than anticipated in the clinical environment due to a number of factors including difficulties obtaining consent (either from patients with aphasia or their relatives) and unexpected discharges or transfers to other facilities resulting in cessation of the program. Due to slow recruitment, outpatient rehabilitation patients were also approached. However, over the course of 12 months only eight individuals were identified as potential participants by their treating clinicians, of which five consented and undertook baseline assessment. Scheduling issues with other rehabilitation services led to three participants withdrawing from the study; thus only two participants completed all assessments and a short therapy block (P1 and P2).

P1 was a 53-year-old male who experienced a left thalamic and internal capsule haemorrhage on 30 March 2011 secondary to hypertension. P1 had been previously employed as the manager of a store, but had not been working for approximately 3 months prior to his stroke. At the time of entry into the study (approximately 10 months post-stroke), P1 was attending weekly outpatient speech pathology rehabilitation services. P1 reported that he had not used a computer previously.

P2 was a 65-year-old male who experienced a left posterior cerebral artery infarct extending to middle cerebral artery territory on 16 February 2012 while in intensive care for a spinal injury resulting from a fall, which affected upper and lower limbs. P2 was employed as a civil engineer at the time of his hospital admission. At the time of P2's entry into the study (approximately 1 month post-stroke), P2 was an inpatient in the spinal rehabilitation ward with limited communication therapy from acute services. P2 reported that he had used a computer extensively prior to the study including for work, leisure, Skype, banking and email.

Procedure

Ethical clearance was obtained from the Queensland Health Metro South Human Research Ethics Committee and the University of Queensland Medical Research Ethics Committee.

Participants completed an initial assessment session, a block of computer-based therapy (originally designed to be up to 2 months long), and a final assessment session. The initial and final assessment sessions involved the Western Aphasia Battery (WAB; Kertesz, 1982), a 200-item naming battery (Whiting, Chenery, Chalk, & Copland, 2007), and a customised questionnaire about participants' previous use of computers, and their attitudes and confidence towards using computers. The questionnaires included items about how comfortable participants felt using a computer (visual analogue scale ranging from not comfortable through to very comfortable), whether participants had used a computer in the past (yes/no; if yes – what had they used a computer for in multiple choice format), and whether they liked doing therapy on their own (visual analogue scale ranging from dislike through to like). The post questionnaire included additional items about whether participants needed help to use the computer (yes/no), whether participants felt that the computer therapy was helpful (yes/no), whether participants would be happy using a computer for therapy again (yes/no), whether participants would be happier having all their therapy with a speech pathologist (yes/no), and what participants liked and disliked about computer therapy (free text responses). From the 200 naming battery, 24 items that were named incorrectly were randomly selected as target items. The treated items were then randomly divided into two lists (each of 12 items) for input into the computer-based exercises. The lists were limited to sets of 12 items at a time as this was the maximum number of items allowed by the software program StepByStep©. The two sets of 12 items were treated consecutively.

The computer-based therapy exercises were provided on a Motion CL900 tablet computer loaded with StepByStep home version 4.5 software (Mortley et al., 2004). StepByStep was selected for this study because of its capacity for customisation of tasks and the fact that it was developed specifically for independent use by individuals with aphasia (Mortley et al., 2004). The program consists of a large battery of tasks (e.g., word–picture matching, repetition, oral and written naming) and stimulus items (photos of items and actions with corresponding written and auditory labels, and sentence-based cues). The clinician can create a customised therapy program for each patient by selecting specific tasks and stimulus items based on individual's language profile, and then alter the level of difficulty as the patient progresses (Mortley et al., 2004). The program also enables the clinician to input other photos, enabling the creation of a personally relevant therapy program.

In the current study the exercises were specifically selected for each patient based on their individual naming difficulties. The tasks selected for P1 involved confrontation naming, written-word picture matching, and typing the names of items when given picture and the number of letters in the name. The tasks for P2 involved anagrams, confrontation naming, typing the names of items when given the picture and the number of letters in the name, written-word picture naming, and selecting the first letter of the name when given the picture. Each tablet computer was loaded with a selection of five exercises at a time, each of which contained a number of hierarchal steps. Participants were offered the opportunity for new exercises to be added weekly. Participants were instructed to practise the exercises for least 30 minutes per day but with no practice restriction. Participants were taught how to use the tablet and StepByStep during an initial session (written aphasia-friendly information was also provided about how to use the tablet) and were contacted weekly by the researchers. Accuracy and frequency of use data were automatically recorded by StepByStep.

Results

P1

P1's WAB scores on entry into the study are provided in Table 1. P1 named 176/200 items correctly on the 200 item naming test. P1 was loaned the tablet computer to take home, during which time he maintained his one session per week at the outpatient clinic. Unfortunately, scheduling issues led to P1's therapy block being much shorter than originally planned, with just two weeks completed. Frequency of usage data downloaded from StepByStep revealed that P1 spent a total of 58.1 minutes using the program over four sessions. On immediate post-therapy assessment, P1 scored 181/200 on the 200 item naming test, with 18/24 of the target items named correctly (compared to 0/24 during the initial assessment). On the WAB, P1 displayed slightly improved scores on the repetition and spontaneous speech subtests but declined slightly on the auditory-verbal comprehension and naming and word finding subtests, resulting in a slightly increased overall aphasia quotient (see Table 1). These changes were not clinically significant.

Analysis of the pre-post questionnaire revealed that P1 was slightly more confident using a computer after the study (66/100mm on a visual analogue scale vs. 70/100mm), but decreased slightly in terms of liking to do therapy on his own (78/100mm vs. 74/100mm). P1 reported that he was happy to use a computer again for therapy (64/100mm), but was slightly happier having all of his therapy with a clinician (68/100mm). P1 reported that despite no previous experience with using computers, he did not require assistance to use the tablet. Overall, P1 reported that he thought the computer therapy was helpful. When asked whether there was anything that he liked or did not like about the computer therapy, P1 wrote: "The computer was helpful and also knowledgeful. The system … could have been wider. The computer was good in lessons and performed a task I needed."

Table 1. Pre-post Western Aphasia Battery results

Subtest	P1		P2	
	Pre	Post	Pre	Post
Spontaneous speech (20)	14.0	16.0	17.0	17.0
Auditory-verbal comprehension (10)	9.9	9.1	9.75	10.0
Repetition (10)	9.9	10.0	10.0	10.0
Naming and word finding (10)	8.8	8.3	8.5	9.1
Aphasia quotient (100)	85.2	86.8	90.5	92.2

Note. Maximum possible scores are provided in brackets

P2

P2's WAB scores on entry into the study are provided in Table 1. P2 named 147/200 items correctly on the 200-item naming test. P2 was loaned the tablet computer for 9 weeks, but experienced two interruptions of approximately 2 and 3 weeks due to battery issues that required servicing from the supplier. As a result, frequency of use data was unable to be obtained, although P2 reported to the researchers that he had not completed the requested daily amount of therapy. Following the block of computer therapy, P2 received a score of 189/200 on the 200-item naming test, with 22/24 target items named correctly (compared with 0/24 during the initial assessment). On the WAB (Kertesz, 1982), P2 displayed slightly improved scores on the auditory-verbal comprehension and the naming and word finding subtests, leading to a slightly improved overall aphasia quotient (see Table 1). These changes were not clinically significant.

Analysis of the pre-post questionnaire revealed that P2 became less confident using a computer after therapy (95/100mm on a visual analogue scale vs. 83/100mm) and decreased in terms of liking to do therapy on his own (97/100mm vs. 75/100mm). Despite this, P2 reported that he was very happy to use a computer again for therapy (97/100mm) and was less happy having all of his therapy with a clinician (77/100mm). P2 reported that he needed some assistance using the computer (usually from his spouse) and that overall the computer therapy was helpful. "Instructions were good. Told us what to do. Became a bit boring using the same images."

Discussion

Overall, both participants displayed improved naming of treated items, and a non-significant improvement in general language scores. This pattern of results suggested that item-specific improvements in naming occurred, rather than a broad improvement in general language function. This is not overly surprising, as the therapy program specifically targeted naming of a limited set of items, and the frequency of self-directed therapy was too low to affect a change. Furthermore, although participants improved in their naming of items, they were both in the relevantly early stages of recovery post-stroke and with the natural fluctuations in aphasia severity, it is difficult to entirely exclude the possibility of fluctuations in everyday language performance influencing the results. This confound could have been minimised if the research design used multiple baseline assessment along with treated and untreated naming lists. The potential influence of the traditional interventions that the participants were also receiving cannot be discounted and future research should make use of research designs that isolate treatment effects.

One of the most interesting findings of the study was that despite participants being provided with unlimited access to the computer-based aphasia therapy, participants used the program much less than expected and requested by the researchers. These findings are in contrast to the literature which reports higher intensity of use of the StepByStep therapy program (Mortley et al., 2004). The reasons for the current study's results remain unclear, although P2 did report some boredom with the tasks and the interruptions due to technical problems may have discouraged ongoing use. It is also important to note that P2 had a busy rehabilitation schedule within the spinal unit. In the case of P1 his lack of experience using computers may have led to his limited use of the tablet for therapy. However, despite not using the program as much as directed P1 reported being able to complete the therapy on the tablet independently, as well as increased willingness to use technology. Some important considerations for further studies and clinical practice utilising self-directed therapy will be issues of saliency of tasks and individual motivation.

Overall, the participants reported enjoying completing the therapy program on the tablets. Interestingly, P1 who had not previously used a computer reported increased confidence with computers, whereas P2 who had previously used a computer extensively reported being less confident with computers following the program. It is possible that in the case of P1, using the computer program reduced some of his apprehension about computers, while P2 may have become more aware of his current functional limitations, with respect to technology compared to his previous ease of use. P2 also reported needing assistance from his spouse. It is an interesting sidenote that P2 did go on to purchase his own mobile touch device after completing the study.

From the perspective of the speech-language pathologist who programmed the therapy tasks, there were a couple of initial challenges in using the StepByStep program. While the tablet computer had an adequate screen resolution for the therapy program, its 10-inch screen was slightly too small for easy touch use when inputting the therapy tasks. A larger screen (e.g., 12-inch) would overcome this and reduce the time taken to input the therapy items. Another challenge was that only 12 stimulus items were able to be included in the exercises at any given time. This limitation resulted in more frequent changes to therapy tasks in order to maintain participant interest and progress. This in turn had implications for scheduling sessions.

As with other devices loaned to patients, issues of infection control and insurance presented themselves in this study. Closely related to this were the warranties for the tablets to ensure that any breakdowns were repaired at no cost to the hospital. However, it is important to note that the tablet used in this study was the first with the Windows operating system to be released in Australia, and inherent within that is the potential for emerging technology to experience more technical problems.

The implementation of clinical research can be difficult. In the case of this study clinical realities and technical problems overwhelmed the research design and the study was not undertaken as originally planned. Difficulties with recruitment and the time constraints of a full clinical load may lead to recruitment to research projects receiving a lower priority. Consideration also needs to be given to natural fluctuations in participant recruitment and to the potential of some disorders (e.g., stroke) to experience seasonal variations in incidence (Saloheimo, Tetri, Juvela, Pyhtinen, & Hillbom, 2009). The likelihood of successful study completion can be maximised through careful design of clinical research projects with the recruitment and scheduling of participants embedded into the clinical pathway.

Conclusion

Overall, both participants displayed improved naming of treated items, and a non-significant improvement in general language scores, suggesting that item-specific improvements in naming occurred, rather than a broad improvement in general language function. Interestingly, despite unlimited access to the program and tablet, participants used the program less than expected. Nevertheless, participants displayed positive reactions to the computer program StepByStep and to the use of a computer tablet for delivering therapy. Both participants reported being willing to use computer-based aphasia therapy again. The current paper suggests that computer-based aphasia therapy delivered by a tablet computer may have potential as a useful adjunct to standard clinical practice; however, a number of factors need to be considered before embarking on the implementation process.

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References

Adrian, J. A., Gonzalez, M., & Buiza, J. J. (2003). The use of computer-assisted therapy in anomia rehabilitation: A single case report. *Aphasiology*, *17*(10), 981–1002.

Adrian, J. A., Gonzalez, M., Buiza, J. J., & Sage, K. (2011). Extending the use of Spanish Computer-assisted Anomia Rehabilitation Program (CARP-2) in people with aphasia. *Journal of Communication Disorders*, *44*, 666–677.

Archibald, L. M. D., Orange, J. B., & Jamieson, D. J. (2009). Implementation of computer-based language therapy in aphasia. *Therapeutic Advances in Neurological Disorders*, *2*(5), 299–311.

Bhogal, S. K., Teasell, R., & Speechley, M. (2003). Intensity of aphasia therapy, impact on recovery. *Stroke*, *34*, 987–993.

Brady, M. C., Kelly, H., Godwin, J., & Enderby, P. (2012). Speech and language therapy following stroke. *Cochrane database of systematic reviews*. Issue 5. Art. No.: CD000425. doi: 10.1002/14651858.CD000425.pub3.

Denes, G., Perazzolo, C., Piani, A., & Piccione, F. (1996). Intensive versus regular speech therapy in global aphasia: A controlled study, *Aphasiology*, *10*(4), 385–394.

Fink, R., Brecher, A., Sobel, P., & Schwartz, M. (2005). Computer-assisted treatment of word retrieval deficits in aphasia, *Aphasiology*, *19*(10–11), 943–954.

Kertesz, A. (1982). *The Western Aphasia Battery*. Stratton, New York: Psychological Corporation.

Laganaro, M., Di Pietro, M., & Schnider, A. (2003). Computerised treatment of anomia in chronic and acute aphasia: An exploratory study. *Aphasiology*, *17*(8), 709–721.

Laganaro, M., Di Pietro, M., & Schnider, A. (2006). Computerised treatment of anomia in acute aphasia: Treatment intensity and training size. *Neuropsychological Rehabilitation: An International Journal*, *16*(6), 630–640.

Mortley, J., Wade, J., & Enderby, P. (2004). Superhighway to promoting a client-therapist partnership? Using the Internet to deliver word-retrieval computer therapy, monitored remotely with minimal speech and language therapy input, *Aphasiology*, *18*(3), 193–211

National Stroke Foundation (2010). *Facts, figures and statistics*. Retrieved from www.strokefoundation.com.au/facts-figures-and-stats

Pedersen, P. M., Jorgensen, H. S., Nakayama, H., Raaschou, H. O., & Olsen, T. S. (2011). Aphasia in acute stroke: Incidence, determinants, and recovery. *Annals of Neurology*, *38*, 659–666.

Saloheimo, P., Tetri, S., Juvela, S., Pyhtinen, J., & Hillbom, M. (2009). Seasonal variation of intracerebral haemorrhage in subjects with untreated hypertension. *Acta Neurologica Scandinavica*, *120*, 59–63.

Wade, J., Mortley, J., & Enderby, P. (2003). Talk about IT: Views of people with aphasia and their partners on receiving remotely monitored computer-based word finding therapy, *Aphasiology*, *17*(11), 1031–1056.

Whiting, E., Chenery, H. J., Chalk, J., & Copland, D. (2007). Dexamphetamine boosts naming treatment effects in chronic aphasia. *Journal of the International Neuropsychological Society*, *13*, 972–979.

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Growth in expressive grammar following intervention for 3- to 4-year-old preschoolers with SLI

Karla N. Washington and Genese Warr-Leeper

This study analysed grammatical development in a sample of 3- to 4-year-olds with specific language impairment (SLI) over time. The authors sought to determine if expressive grammar intervention resulted in accelerated gains in morphosyntax to "within normal limits" performance in expressive grammar for this age group. For this analysis, spontaneous language outcomes following expressive grammar intervention were compared between preschoolers receiving intervention (n = 22) and those not receiving intervention, no intervention waitlist-controls (n = 12). We examined: (a) growth in grammatical complexity and morpheme use, and (b) per cent error rates in three grammatical categories. We found that intervention was more effective than no intervention in facilitating accelerated performance for grammatical complexity, growth in morpheme use, and lower per cent error rates in targeted grammatical categories. This study provides evidence that expressive grammar intervention is associated with accelerated development in grammar skills for preschoolers with SLI.

KEYWORDS
EXPRESSIVE GRAMMAR INTERVENTION
GROWTH
PRESCHOOLERS
SPECIFIC LANGUAGE IMPAIRMENT
SPONTANEOUS LANGUAGE

THIS ARTICLE HAS BEEN PEER-REVIEWED

Karla N. Washington (top) and Genese Warr-Leeper

Specific language impairment (SLI) is characterised by persistent difficulty in acquiring age-appropriate language skills, despite having normal nonverbal IQ and no known secondary impairments (Leonard, 1998). Grammar deficits are considered a diagnostic feature of SLI (Cleave & Rice, 1997). Finite verb forms, including auxiliary *is*, *are*, *am*, pose challenges because these carry obligatory marking for tense and agreement, and are often omitted in productions (Cleave & Rice, 1997). Finite verb endings (e.g., *ing*) and other functor words (e.g., *articles*) are also vulnerable to omission (Cleave & Rice, 1997). It is hypothesised that children with SLI experience specific processing limitations that impact on their language learning ability (Archibald & Gathercole, 2007; Leonard et al., 2007). For example, poor short-term memory within the phonological loop can affect these children's ability to establish well-specified phonological representations for specific language forms, e.g., finite verbs (Leonard et al., 2007). These difficulties can affect the speed of information processing and the ability to maintain the information presented, resulting in the observed production omissions (Leonard et al., 2007).

Interventions addressing grammar deficits in preschoolers with SLI have been successfully implemented (Leonard, Camarata, Pawlowska, Brown, & Camarata, 2006; 2008; Yoder, Molfese, & Gardner, 2011). However, we also know that intervention for expressive grammar deficits may be more effective if there are no corresponding receptive language impairments (Law, Garrett, Nye, & Dennis, 2012), suggesting that for children with primary deficits in expressive grammar, positive outcomes following intervention are possible.

The authors of the current paper explored the effectiveness of expressive grammar intervention compared to no intervention in facilitating grammar development in 3- to 4-year-olds with expressive SLI. Children were assigned to computer-assisted intervention, table-top intervention, and a waitlist-control group (Washington, Warr-Leeper, & Thomas-Stonell, 2011). A newly developed computer program, *My Sentence Builder*, designed for use with preschoolers with SLI with primary expressive grammar deficits (Washington & Warr-Leeper, 2006), was utilised for the computer-assisted intervention. Visual support was provided by colour-coded screens containing pictures for subjects, verb actions, and objects in target sentences (i.e., present progressive). For table-top intervention, objects in play, together with books and picture cards with actions providing visual supports were used to facilitate grammatical productions in a drill-play format.

Both interventions resulted in significantly higher total scores for spontaneous language samples, calculated using Developmental Sentence Scoring (DSS; Lee, 1974), at 3 months and at 6 months post-intervention compared to no intervention. The authors concluded that accelerated development in grammatical complexity occurred for preschoolers enrolled in intervention compared to waitlist-controls (Washington et al., 2011). However, differences between intervention and no intervention for the magnitude of growth in grammar skills that occurred and was maintained over time was not explored in the 2011 study. This type of analysis would yield important information on whether the intervention resulted in accelerated gains in grammatical development in preschoolers with SLI and thus provide stronger support for this intervention.

Table 1. Preschoolers' pre-test characteristics

	Total sample (n = 34)	Computer-assisted (n = 11)	Table-top (n = 11)	No intervention (n = 12)
Age-range	3;6 to 4;11	3;11 to 4;6	4;2 to 4;10	3;6 to 4;11
Gender-distribution	Female = 7 Male = 27	Female = 3 Male = 8	Female = 3 Male = 8	Female = 1 Male = 11
Receptive-word (PPVT-IIIB)	101.85 (4.88)	103.64 (5.71)	102.73 (3.77)	99.42 (4.30)
Receptive-sentence (CELF-P)	101.21 (6.95)	103.36 (8.65)	100.36 (8.10)	99.75 (2.90)
Expressive -SPELT-P	*10.26 (3.97)	*10.09 (2.30)	*12.27 (3.38)	*8.58 (4.99)
Expressive-DSS	*4.84 (.82)	*4.81 (1.08)	*5.21 (.66)	*4.51 (.54)
Expressive-MLU	*5.26 (.76)	*5.17 (.73)	*5.62 (.75)	*5.01 (.70)
Nonverbal IQ (KBIT-2 matrices subtest)	109.15 (10.10)	112.27 (12.35)	108.45 (9.61)	106.92 (8.24)

*Raw score.

Note. Means reported with standard deviations in parentheses. Standard scores are reported for all measures, except for expressive-language. Receptive-word (PPVT-IIIB; Dunn & Dunn, 1997), receptive-sentence (CELF-P; Wiig, Secord, & Semel, 1992), expressive-SPELT-P (Werner & Krescheck, 1983), expressive-DSS (Lee, 1974), expressive-MLU (Brown, 1973; Miller, 1981), nonverbal IQ (KBIT-2; Kaufman & Kaufman, 2004).

The current study

The hypothesised link observed between grammatical errors and processing constraints suggests that SLI has a complex nature that necessitates grammatical language interventions (Leonard et al., 2007). A secondary analysis of the Washington et al. (2011) data was completed for the DSS scored language samples to determine if expressive grammar intervention facilitated accelerated growth (i.e., to within normal limits), representing performance outside the pre-test range for the spontaneous use of grammar skills better than no intervention. Additionally, the authors tracked decreases in per cent error rates for targeted grammatical categories (e.g., *personal pronoun*, *main verb*, *sentence point*) for intervention and no intervention groups. The following research questions were addressed:

1. Do computer-assisted and table-top intervention result in accelerated growth in grammatical development compared to no intervention?
2. Do computer-assisted and table-top intervention result in significantly lower per cent error rates for targeted grammatical categories compared to no intervention?

Method

Participants

Following ethical approval, 34, 3- to 4-year-olds (*M* = 4;4 months, *SD* = 5 months) who were randomly selected from an intervention waitlist at a government-funded preschool speech-and-language initiative in Ontario, Canada met the Washington et al. (2011) study criteria (see below). Their parents identified them as Caucasian (n = 32), Asian (n = 1), or other (n = 1) and monolingual English speakers. The sample included 27 boys and 7 girls, residing in urban and rural regions.

All participants met the diagnostic criteria for SLI of an expressive nature as outlined in the Washington et al. (2011) study. These included normal hearing range, normal receptive language and nonverbal cognition, i.e., one standard deviation from the mean on the Peabody Picture Vocabulary Test-IIIB (PPVT-IIIB; Dunn & Dunn, 1997); the receptive portion of the Clinical Evaluation of Language Fundamentals-Preschool (CELF-P; Wiig, Secord, & Semel, 1992); and the Kaufman Brief Intelligence Test – 2: Matrices Subtest (KBIT-2; Kaufman & Kaufman, 2004). For expressive grammar, children demonstrated skills at or below the 10th percentile, on the Structured Photographic Expressive Language Test-Preschool (SPELT-P; Werner & Kresheck, 1983) and a spontaneous language sample scored for grammatical complexity (see Procedures).

Language assessment results revealed that all participants experienced grammatical deficits affecting the accurate production of 3rd person singular present progressive sentences containing a subject-verb-object (e.g., The boy + is eating + a hot-dog *or* He + is eating + a hot-dog). Following consent to participate, 22 of the 34 preschoolers were randomly selected to receive intervention, leaving 12 participants to remain on the waitlist for intervention. This selection allowed for equal numbers in each intervention group and in the control group (see Table 1). Half of the participants in intervention received computer-assisted intervention (n = 11) and the other half received table-top intervention (n = 11). Results of Univariate ANOVAs revealed non significant between-group differences for age (p = .126), gender (p = .902), nonverbal IQ (p = .443), receptive language word-level (p = .087), and receptive language sentence-level (p = .374), and expressive grammar on the SPELT-P (p = .080) and DSS (p = .127). There was no study attrition. Table 1 describes participants' demographic information.

Procedures

Assessment

Speech-language pathologists (SLPs) or graduate SLP students evaluated participants' language and cognitive skills during a 90-minute individual assessment in a clinical setting to determine participant suitability (pre-intervention). This session included the collection of a 45-minute spontaneous language sample during play (using a standard procedure and including a dollhouse, toy household objects and people and the *Spot Bakes a Cake* [Hill, 2003] and *Where's Spot* [Hill, 2000] books). At least 100 intelligible utterances were collected and digitally recorded from the participants at post-intervention and 3 months post-intervention, representing a break in intervention (cf. Washington et al., 2011), to establish spontaneous language outcomes associated with intervention. Language samples were transcribed and coded by assessors who were blind to group assignment and assessment time points.

DSS procedures were used to analyse the language samples (Lee, 1974). To obtain a DSS score, 50 consecutive utterances containing a subject and verb were selected. Each utterance was scored for grammatical accuracy (i.e., the DSS sentence point) and the eight DSS grammatical categories established by Lee (1974) that indicate grammar development and complexity in young children (i.e., indefinite pronouns/noun modifier, personal pronouns, main verbs, secondary verbs, negatives, conjunctions, interrogative reversals, wh-questions).

Growth beyond the 10th percentile (pre-test performance) to "within normal limits" represented clinically meaningful growth (i.e., acceleration) in spontaneous grammar skills. Since participants were 3- to 4-years of age (M = 4;4), grammatical performance was compared to the DSS point growth expected over a 6-month period for typical 4-year-olds (Lee & Canter, 1971). The 50th percentile was used as the expectation for normal developmental change, representing a 0.76 point-gain for this age group (Lee & Canter, 1971). Clinically meaningful DSS growth was established at or greater than the 0.76 DSS point-gain for change between pre-intervention to post-intervention (3-month gain1), post-intervention to 3 months post-intervention (3-month gain2), and pre-intervention to 3 months post-intervention (6-month gain). To establish DSS scoring reliability, 10% of language samples were randomly chosen for analysis by graduate SLP students. Inter-rater reliability for DSS, including point-to-point comparisons for word transcription, appropriate DSS sentences, category, and scoring was 91.3%, 97.2%, 90.8%, and 90.8%, respectively.

Preschoolers' mean length of utterance (MLU; Brown, 1973; Miller, 1981) was also calculated for the same language samples. MLU is another useful measure of grammatical morphology that offers information about use of morphemes and developmental change, but is limited in capturing changes in grammatical complexity (Goffman & Leonard, 2000). Due to this limitation, (a) MLU change scores were calculated to determine if gains in use of morphemes co-occurred with gains in grammatical complexity as measured by the DSS and (b) the 0.76 criterion applied to the DSS change scores was not applied to the MLU change scores. At pre-test, a univariate ANOVA revealed non significant between-group differences in MLU (p = .140).

An analysis of DSS per cent error rates for number of incorrect attempts for the *personal pronoun*, *main verb*, and number of utterances not awarded a *sentence point*, representing targeted grammatical categories, was also completed. There were no significant differences on per cent error rates between the three groups at pre-intervention for *personal pronoun* (p = .501), *main verb* (p = .072), and *sentence point* (p = .081). Errors in these categories decrease with time for typically developing preschoolers (Lee, 1974) and show improvement with intervention for children with language impairment (Fey, Cleave, Long, & Hughes, 1993; Lee, Koenigsknecht, & Mulgern, 1975).

Intervention

Preschoolers receiving intervention in the Washington et al. (2011) study participated in 20-minute sessions once weekly for 10 weeks with an SLP, typical of the intensity and frequency of intervention services under the government-funded initiative. The following procedure was used: (a) a 2-to-7-minute practice block introduced the routine; (b) *sentence-breakdown* was used to individually elicit sentence components (subject-noun phrase, verb, object-noun phrase) utilising the following questions, "Who do you want to play with?" (subject), "What is s/he doing?" (verb), and "What does s/he want to play with?" (object); (c) sessions followed the same procedure until 80% accuracy over two consecutive sessions was achieved; and (d) at the start of the subsequent session, preschoolers engaged only in *sentence build-up* ("Put it all together"), where the subject+verb+object was combined to produce a grammatically correct sentence (sentence point). Sentence-breakdown was not required once the 80% criterion was achieved. Random observations (20% of sessions) by observers using a checklist of critical intervention elements (e.g., the intervention procedure, identification of the interventionist, the session number, group type, length of the session, and the techniques used during the session) revealed that intervention fidelity was maintained 100% of the time. See Appendix for a sample intervention routine.

For computer-assisted intervention, expressive grammar training was completed using *My Sentence Builder*. This program is embedded within a syntactic slot-filler approach with visual representations for semantic and grammatical elements provided using picture support. Using a drill-play approach with modelling and repetition, preschooler–SLP dyads moved from screen-to-screen, selecting components during sentence-breakdown. The SLP took preschoolers to the sentence-creation screen first and told them they would be "making up" things about boys and girls. The dyad progressed through the subject, verb, object selection screens to choose the subject, verb, object for placement in the sentence-box at the bottom of the screen. Preschoolers were then asked to "put it all together". Following a correct production, preschoolers were taken to the sentence-selection and animation-production screens. The slow, deliberate, and sequential selection used with computer-based visual representations was the key intervention difference between computer-assisted and table-top intervention.

For table-top intervention, preschoolers engaged in clinician–client dyads for the same multi-step intervention procedures, this time using typical table-top materials (e.g., books, felt, or paper dollhouse objects) to demonstrate the semantic elements within the same drill-play activities. Emphatic stress was included to increase the salience of sentence components (grammatical and semantic) in contrast to the computer-based syntactic slot-filler approach. This technique involved the SLP verbally stressing sentence components during the multi-step procedure. In comparison to computer-assisted intervention, consistent visual support demonstrating grammatical elements was not provided. Instead, visual support was provided using table-top materials for semantic elements.

Preschoolers in the waitlist control group did not receive expressive grammar intervention from the SLP during the study. At the end of the study, intervention was offered.

Design and analysis

A pre-post-follow-up design was employed. The secondary analysis of the Washington et al. (2011) data was completed using two mixed model multivariate analyses of variance (MANOVAs) with pre-set alphas ($p < .05$). Effect sizes "an estimate of the effect of intervention" (Portney & Watkins, 2009, p. 373), represented by eta squared (η^2) and partial eta squared (η_p^2), were also reported. The first MANOVA compared the three groups (computer-assisted, table-top, no intervention: between-subjects factor) for DSS and MLU change scores (dependent variables) for the 3-month gain1, 3-month gain2 and 6-month gain (i.e., gain period, within-subjects factor). The second MANOVA compared the three groups for DSS per cent error rates (number of incorrect attempts for personal pronoun, main verb and number of utterances not awarded a sentence point, each divided by number of utterances selected) at pre-intervention, post-intervention, and 3 months post-intervention.

A significant time X group multivariate effect was predicted for each MANOVA, with the intervention groups outperforming the control group. Planned follow-up tests to the MANOVA were completed using mixed model Analyses of variance (ANOVAs) tests with adjusted alphas for each test (.05 divided by 2 = $p < .025$ for the DSS and MLU ANOVAs; .05 divided by 3 = $p < .017$ for each DSS grammatical category ANOVA). Post hoc analyses to the ANOVAs, also with adjusted alpha levels, were completed using univariate ANOVAs. These represented simple main effect tests for DSS and MLU scores for each of the three gain periods ($p = .025$ divided by 3, $p < .008$) and the DSS grammatical categories at each of the three assessment time-points ($p = .017$ divided by 3, $p < .006$). The adjusted alpha levels represented a Bonferroni correction, controlling for Type 1 error (Portney & Watkins, 2009).

Results

DSS and MLU gains

The MANOVA revealed significant differences among groups on DSS and MLU change scores (dependent variables), Wilks' $\Lambda = .40$, $F(4,60) = 8.62$, $p < .001$, $\eta^2 = .37$. A significant multivariate effect was found for time (3-month gain1, 3-month gain2, and 6-month gain), Wilks' $\Lambda = .32$, $F(4,28) = 15.07$, $p < .001$, $\eta^2 = .68$. A significant interaction for group X time was also found, Wilks' $\Lambda = .37$, $F(8,56) = 4.55$, $p < .001$, $\eta^2 = .50$. ANOVAs testing the dependent variables, using the pre-set adjusted alpha levels ($p < .025$), were conducted as follow-up tests. There was a significant interaction effect for group X time for DSS, $F(4,62) = 6.37$, $p < .001$, $\eta_p^2 = .29$, and MLU, $F(4,62) = 3.26$, p = .017, $\eta_p^2 = .17$, change scores.

Simple main effect tests were completed as a follow-up to the significant interaction for each ANOVA. Findings for DSS and MLU change met the set significance level ($p < .008$) for follow-up tests for each gain period. Pairwise comparisons of means revealed that computer-assisted and table-top intervention resulted in significantly higher DSS and MLU gains compared to controls. Only the two intervention groups achieved DSS point gains at or above 0.76 for each gain period, demonstrating accelerated growth. The two interventions did not differ statistically for DSS or MLU ($p > .05$). See figures 1 and 2.

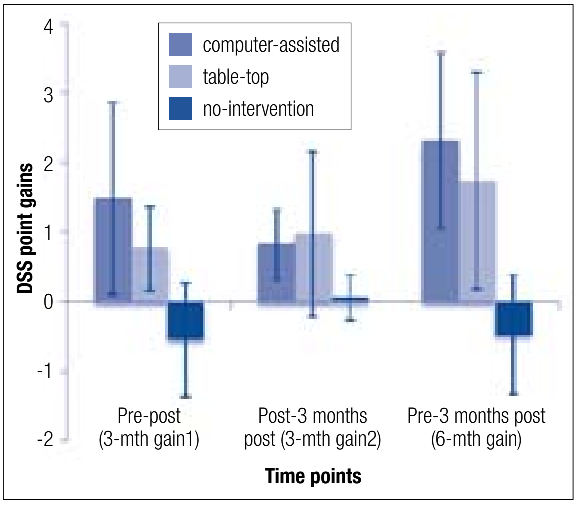

Figure 1. Mean DSS performance for each group
***Note.* DSS = Developmental Sentence Scoring (Lee, 1974).**

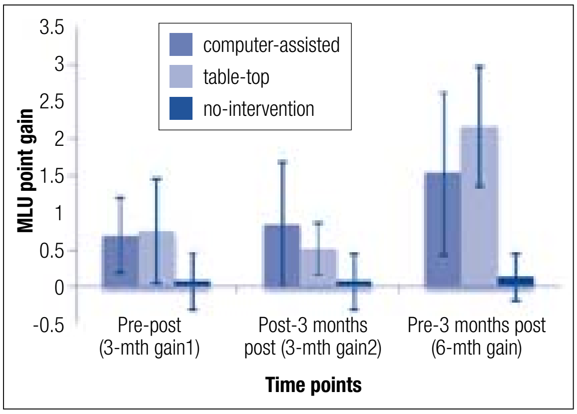

Figure 2. Mean MLU performance for each group
***Note.* MLU = Mean Length of Utterance (Brown, 1973; Miller, 1981).**

DSS per cent error rates

The MANOVA revealed significant differences among groups on *personal pronoun*, *main verb*, and *sentence point*, Wilks' $\Lambda = .39$, $F(6,58) = 5.85$, $p < .001$, $\eta^2 = .39$. A significant multivariate effect was found for time (pre-intervention, post-intervention, 3 months post-intervention), Wilks' $\Lambda = .57$, $F(6,26) = 3.34$, $p = .005$, $\eta^2 = .44$. A significant interaction for group X time was also found, Wilks' $\Lambda = .30$, $F(12,52) = 3.52$, $p < .001$, $\eta^2 = .45$. Follow-up tests using ANOVAs on the dependent variables

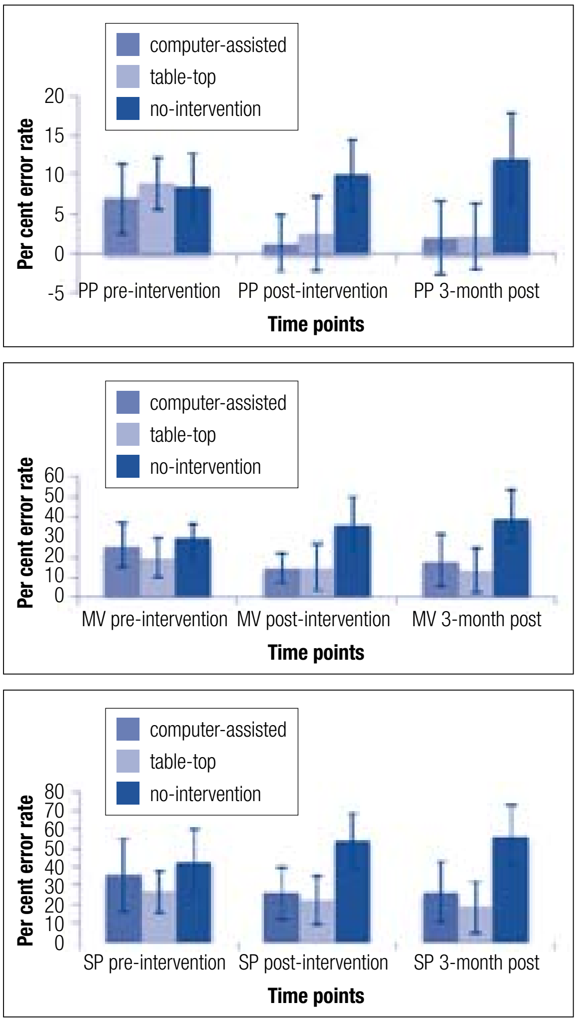

Figure 3. Mean per cent error rates for DSS grammatical categories per group at each assessment time point
***Note.* DSS = Developmental Sentence Scoring (Lee, 1974); PP = personal pronoun; MV = main verb; SP = sentence point**

at the pre-set adjusted alpha level ($p < .017$) were conducted. There was a significant interaction effect for group X time for DSS per cent error rates for, *personal pronoun*, $F(4,62) = 7.05$, $p < .001$, $\eta_p^2 = .31$, *main verb*, $F(4,62) = 7.44$, $p < .001$, $\eta_p^2 = .32$ and *sentence point*, $F(4,62) = 8.08$, $p < .001$, $\eta_p^2 = .34$.

Simple main effect tests were completed as a follow-up to the significant interaction for each ANOVA. Findings for DSS per cent error rates in each grammatical category met the set significance level ($p < .006$) for follow-up tests at post-intervention and 3 months post-intervention. Pairwise comparisons of means revealed that computer-assisted and table-top intervention facilitated significantly lower DSS per cent error rates in each category compared to no-intervention. The two intervention groups did not differ statistically ($p > .05$). See Figure 3.

Discussion

Preschoolers with SLI who received expressive grammar intervention experienced significantly greater improvement in their grammar skills that were maintained at post-intervention and at 3 months post-intervention compared to waitlist controls. Maintenance of gains beyond the intervention period is considered an important intervention outcome indicative of development (Yoder et al., 2011). The magnitude of gain in 6 months as a result of expressive grammar intervention was above that expected for typically developing 4-year-olds at the 50th percentile, demonstrating significant accelerated growth beyond the starting point in intervention. Thus, intervention offered a therapeutic advantage over no intervention for facilitating the outcomes observed for grammatical complexity, use of morphemes, and accuracy in targeted grammatical categories. However, computer-assisted and table-top intervention resulted in similar effects on the spontaneous use of expressive grammar skills. Consequently, it is important to consider the role of expressive grammar intervention, regardless of type, for facilitating growth in these skills.

The goals of language intervention for grammatical deficits are to improve children's production and comprehension of targeted language forms (Leonard et al., 2006). By directly targeting children's grammatical use of language forms, they become more aware of how to accurately sequence morphemes and phonemes into meaningful units. The explicit support and attention to grammatical features included in intervention may provide more time to process information and increase preschoolers' awareness and decrease language-learning efforts during expressive grammar intervention.

During computer-assisted and table-top intervention, the SLP made deliberate attempts to highlight sentence components needed to produce grammatically correct sentences. The syntactic slot-filler approach and emphatic stress were equally effective in highlighting these components for the sample of preschoolers. Implementing these techniques in a drill-play format with modelling and repetition resulted in multiple opportunities for focused practice (3000 production opportunities for the two interventions). Previous researchers highlight the necessity of explicit, repeated exposures to target forms that address grammatical productions for this population (Cleave & Rice, 1997). Computer-assisted intervention may provide motivation and increased tolerance for repetition in some preschoolers with SLI and should be considered a viable alternative to table-top intervention, where appropriate (cf. Washington et al., 2011).

The negative changes observed in DSS change scores for preschoolers in the waitlist control group on average were indicative of unsuccessful attempts at creating grammatically complex and correct productions and not a regression in these skills. An examination of the per cent error rates revealed that these children attempted to produce accurate and complex personal pronouns, main verbs and achieve the sentence points, but were unsuccessful in these attempts, resulting in the higher per cent error rates compared to cohorts in intervention. Lee (1974) and Lee and Canter (1971) suggested that as children's language skills develop, unsuccessful attempts at more complex productions in spontaneous language are expected. Thus, errors in syntactic productions are a normal part of grammatical development for young children with typically developing language skills. In fact for 5-year-olds, a 0.12-point decline in DSS scores at the 50th percentile is expected in 6 months. Since these errors are anticipated for typical preschoolers, errors for preschoolers who do not have typical language skills and are not receiving intervention would not be unexpected.

Clinical implications

The current findings expand on those reported in the Washington et al. (2011) study by providing evidence that grammatical language interventions were associated with accelerated growth to "within normal limits" for grammar development. The inclusion of computer-assisted and table-top intervention techniques, including specific step-by-step procedures, may be important in achieving this growth during SLP-led interventions for this population. Alternatively, preschoolers with SLI who do not receive intervention are at a significantly greater risk for not achieving good outcomes.

Limitations and future directions

Participants included in this study demonstrated specific expressive grammar deficits, thus application of these findings to other preschoolers with SLI with receptive difficulties is limited. The mixed evidence regarding the effectiveness of expressive grammar intervention for children with concomitant receptive and expressive grammatical deficits (cf. Law et al., 2012) suggests additional research is needed.

Another limitation is that DSS techniques are time consuming and scores are narrower in their representation of language skills (Lee & Canter, 1971). The inclusion of MLU in this study offered another measure of linguistic gains that might not have been captured in DSS scores. Future research with other children with SLI with receptive language deficits should expand the measures used to establish acceleration in expressive grammar and perhaps also consider sampling beyond a clinical conversation with an adult.

Conclusion

Expressive grammar intervention offers a therapeutic advantage over no intervention for the enhanced development of spontaneous language skills in preschoolers with expressive language impairment.

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Appendix. Sample intervention routine

SLP: "We are going to talk about boys or girls doing different things. You will have lots of time to practise telling me what different boys or girls are doing. I will be helping you a lot. Now let's start."

[A 2-to-7-minute practise block followed before the training period began (i.e., the scored portion). This practise was completed to help establish the expected routine.]

SLP: Who do you want to play? [Note: To elicit the target response he or she (subject-noun phrase), the SLP would probe further by saying, "What word do we use for the boy/girl when we start?" The additional probing was necessary to avoid the him/her response, considered the pragmatic or natural response to the initial who-question.]

Preschooler: Her.

SLP [using emphatic stress or pointing to grammatical image]: her?

Preschooler: She.

SLP: What is she doing? She…

Preschooler: catching.

SLP [using emphatic stress or pointing to grammatical image]: catching?

Preschooler: is catching.

SLP: What is she catching? She is catching…

Preschooler: a fish.

SLP: Now put it all together.

Preschooler: She+is catching+a fish.

References

Archibald. L., & Gathercole, S. (2007). The complexities of complex memory span: Storage and processing deficits in specific language impairment. *Journal of Memory and Language*, *57*, 177–194.

Brown, R. (1973). *A first language*. Cambridge, MA: Harvard University Press.

Cleave, P., & Rice, M. (1997). An examination of the morpheme BE in children with specific language impairment. *Journal of Speech and Hearing Research*, *40*, 480–492.

Dunn, L., & Dunn, L. (1997). *Peabody Picture Vocabulary Test* (3rd ed.). Circle Pines, MN: American Guidance Service.

Fey, M., Cleave, P., Long, S., & Huges, D. (1993). Two approaches to the facilitation of grammar in children with SLI: An experimental evaluation. *Journal of Speech and Hearing Research*, *36*, 141–157.

Goffman, L. & Leonard, J. (2000). Growth of language skills in preschool children with specific language impairment: Implications for assessment and intervention. *American Journal of Speech-Language Pathology*, *9*, 151–161.

Hill, E. (2000). *Spot bakes a cake*. New York, NY: Penguin Group.

Hill, E. (2003). *Where's Spot*. New York, NY: G. P. Putnam's Sons.

Kaufman, A., & Kaufman, N. (2004). *Kaufman Brief Intelligence Test – 2*. Circle Pines, MN: AGS Publishing.

Law, J., Garrett, Z., Nye, C., & Dennis, J. (2012). Speech and language therapy interventions for children with primary speech and language delay or disorder: Update. *Cochrane Database of Systematic Reviews*, *3*, Art. No: CD004110. doi: 10.1002/14651858.

Lee, L. (1974). *Developmental sentence analysis: A grammatical assessment procedure for speech and language clinicians*. Evanston, IL: Northwestern University Press.

Lee, L., & Canter, S. (1971). Developmental sentence scoring: A clinical procedure for estimating syntactic development in children's spontaneous speech. *Journal of Speech and Hearing Disorders*, *36*, 315–340.

Lee, L., Koenigsknecht, R., & Mulhern, S. (1975). *Interactive language development teaching*. Evanston, IL: Norwestern University Press.

Leonard, L. (1998). *Children with specific language impairment*. Cambridge, MA: MIT Press.

Leonard, L., Camarata, S., Pawlowska, M., Brown, B., & Camarata, M. (2006). Tense and agreement morphemes in the speech of children with specific language impairment during intervention: Phase 2. *Journal of Speech, Language, and Hearing Research*, *49*, 749–770.

Leonard, L., Camarata, S., Pawlowska, M., Brown, B., & Camarata, M. (2008). The acquisition of tense and agreement morphemes by children with specific language impairment during intervention: Phase 3. *Journal of Speech, Language, and Hearing Research*, *51*, 120–125.

Leonard, L., Ellis Weismer, S., Miller, C., Francis, D., Tomblin, J., & Kail, R. (2007). Speed of processing, working memory, and language impairment in children. *Journal of Speech, Language, and Hearing Research*, *50*, 408–428.

Miller, J. (1981). *Assessing language production in children: Experimental procedures*. Austin, TX: Pro-Ed.

Portney, L., & Watkins, M. (2009). *Foundations of clinical research: Applications to practice* (3rd ed.). Upper Saddle River, NJ: Prentice Hall Health.

Washington, K., & Warr-Leeper, G. (2006). A collaborative approach to computer-assisted treatment of preschool children with specific language impairment. *OSLA Connection Journal*, *2*, 10–11,16.

Washington, K., Warr-Leeper, G., & Thomas-Stonell, N. (2011). Exploring the outcomes of a novel computer-assisted treatment program targeting expressive-grammar deficits in preschoolers with SLI. *Journal of Communication Disorders*, *44*, 315–330.

Werner, O., & Kresheck, J. (1983). *The Structured Photographic Expressive Language Test – Preschool* (*SPELT-P*). Dekalb, IL: Janelle, Publications.

Wiig, E., Secord, W., & Semel, E. (1992). *Clinical Evaluation of Language Fundamentals – Preschool*. San Antonio, TX: Harcourt Brace & Company.

Yoder, P., Molfese, D., & Gardner, E. (2011). Initial mean length of utterance predicts relative efficacy of two grammatical treatments in preschoolers with specific language impairment. *Journal of Speech, Language, and Hearing Research*, *54*, 1170–1181.

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The effectiveness of a computer-supported intervention targeting orthographic processing and phonological recoding for children with impaired word identification

A preliminary study

Toni Seiler, Suze Leitão and Mara Blosfelds

This study investigated the effectiveness of a computer-supported intervention targeting orthographic processing and phonological recoding for word identification skills. Participants were three children (aged 7–8 years) with persistent word identification impairment. A single subject design with three phases was used, comprising a total of 31 sessions (8 baseline, 15 intervention, and a further 8 baseline) over 10 weeks. Results indicated a significant treatment effect based on measures of rate and accuracy of nonword reading measured at the start of every session. In addition, all participants made clinically significant gains in accuracy of nonword reading from pre- to post-intervention, and demonstrated mixed results with word and nonword reading efficiency.

About 8% of Australian children in year 2 do not meet the minimum National Benchmarks for Reading (Rowe, 2005). Given that this stage at school represents the beginning of the transition from learning to read to reading to learn, and that most children with early reading problems continue to have reading delays at the secondary school level (Kamhi, 2009), the development of effective interventions in the early years is a priority. Reading is a complex activity that involves a range of language skills (Bishop & Snowling, 2004). Coltheart (2006) suggests that in order to understand the reading process, the skills that underlie reading need to be understood first. Accurate word reading is considered to be a key skill in learning to read. Furthermore, poor performance on word identification has been found to predict later reading difficulties (Botting, Simkin, & Conti-Ramsden, 2006).

Theories underlying reading and word identification

The dual route model (Coltheart, 2006) proposes that there are two processes or routes involved in skilled reading aloud. The lexical route accesses a store of previously identified written words, referred to as mental orthographic representations (MORs), while the nonlexical route uses letter–sound relationships to decode unfamiliar words. Most children with significant reading problems demonstrate difficulty with the skills involved in the nonlexical route, that is, phonological recoding, the act of sounding out and blending to read the word or nonword (Herrmann, Matyas, & Pratt, 2006). There is strong evidence that phonological recoding plays a key role in the development of MORs (Cunningham, 2006; Cunningham, Perry, Stanovich, & Share, 2002; Share, 1999). Moreover, when phonological recoding is compromised, MOR development is also reduced (Kyte & Johnson, 2006), suggesting that the establishment of orthographic representations of written words is dependent on the degree and accuracy of phonological recoding. Other factors that influence MOR development include the provision of repetition (Nation, Angell, & Castles, 2007) and presentation of words of similar types (Goswami, Ziegler, Dalton, & Schneider, 2003). However, presentation of words in context has not been found to influence MOR development (Cunningham, 2006).

Recent research has shown that orthographic processing, the ability to acquire, store, and use MORs and orthographic pattern knowledge (Apel, 2011), also makes a unique and significant contribution to the development of word identification (Cunningham, Perry, & Stanovich, 2001) and predicts later word reading and comprehension skills (Badian, 2001). However, the relationship between orthographic processing skills and reading is a complex one. Apel (2009) found that preschool children without phonological recoding skills still developed MORs and were sensitive to the orthotactic probability of words (frequency with which a word's graphemes and bigraphs appear in English), thus supporting the independent contribution of orthographic processing skills. More recently, Deacon, Benere and Castles (2012) evaluated the direction of the relationship between orthographic processing and reading in a longitudinal study of children from grade 1 to 3. While their results indicated that reading skills predicted orthographic processing skills and supported the role played by phonological recoding, they concluded that the reverse could also be true: that orthographic processing plays a role in determining reading success.

Intervention for word identification disorders

Over the past 20 years, the focus of many reading intervention studies has been phonemic awareness because these skills have been identified as predictors of reading development (Bishop & Snowling, 2004), having significant positive effects on word identification skills (Torgerson, Brooks, & Hall, 2006). However, there is

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Toni Seiler (top), Suze Leitão (centre) and Mara Blosfelds increasing evidence of the need to also focus on orthographic processing. A meta-analysis conducted for the National Reading Panel in the United States (Ehri et al., 2001) indicated that although there was strong evidence for interventions focusing on phonemic awareness, there was a smaller effect size for students with reading impairment compared to at-risk or typically developing students. This suggests that interventions for students with reading difficulties need to focus on other areas in addition to phonemic awareness.

Earlier studies that examined orthographic processing in reading interventions found significant gains in nonword reading (McCandliss, Beck, Sandak, & Perfetti, 2003; Pullen, Lane, Lloyd, Nowak, & Ryals, 2005). These studies used a manipulative letters activity combined with other text-based tasks (repeated reading and sentence reading, respectively). Similar to other research focusing on phonemic awareness (Hatcher et al., 2006; Wheldall & Beaman, 1999), there was a range of improvement. While the researchers were unable to isolate which of the tasks produced the gains, a subsequent evaluation of Pullen et al. (2005) found that the orthographic processing task was the crucial element of the intervention (Lane, Pullen, Hudson, & Konold, 2009). This highlights the need to consider intervention programs that target the development of orthographic representations.

Computer-supported learning

Many aspects of the general curriculum, including the teaching of reading, are supported by computers. Though it has been found that the use of computers alone does not make a significant difference to learning outcomes (Torgerson & Zhu, 2003) or respond to learner needs (Moridis & Economidis, 2008), there are many advantages to computer-supported interventions (e.g., systematic delivery, integrated data collection and analysis, and increased motivation for children). These advantages can be used to address factors shown to influence the development of orthographic representations such as repetition and systematic presentation of words.

This research designed a computer-supported intervention based on the evidence demonstrating accurate phonological recoding to be an effective strategy for reading words using the nonlexical route (Coltheart, 2006). The intervention was designed to target both orthographic processing (by presenting items based on their orthotactic probability and encouraging attention to each letter in the stimulus) and phonological recoding (by providing corrective feedback about decoding accuracy). Computer delivery on an iPad also enables seamless presentation of more than 3000 items (words and nonwords) with automatic adjustment of difficulty level in response to errors, and allows collection of on-line data for later analysis.

Research aims

To assess the effectiveness of the computer-supported intervention designed for this research, the following research questions were posed:

1. Is a computer-supported intervention that targets orthographic processing and phonological recoding effective in increasing nonword reading skills in year 2 children with persistent word identification impairment?
2. Are the improvements in nonword reading as measured within the program, reflected in standardised tests of nonword reading accuracy and real and nonword reading efficiency?

Method

Study design

This study used a single subject research design with three phases. The first phase (A1), involved eight sessions where the child's nonword (NW) reading skills were assessed to establish a pre-intervention baseline. In the second phase (B) the child received 15 intervention sessions, followed by the third phase (A2) where the NW reading skills were assessed post-intervention. Standardised assessment of word and nonword reading was also administered during the pre- and post-intervention baseline sessions.

Participants

Three year 2 children (aged 7–8 years) participated in this study. Teachers from a Victorian government school were asked to identify children they considered to have typically developing oral language and intellectual skills, and who continued to have problems with word reading despite previously completing reading intervention programs (such as Reading Recovery). The participants were thus representative of those children reported in previous studies who make minimal response to current interventions. The inclusion criteria were therefore as follows:

- a score of more than 1 standard deviation (*SD*) below the mean on the Phonemic Decoding Efficiency subtest of the Test of Word Reading Efficiency 2: TOWRE 2 (Torgesen, Wagner, & Rashotte, 2012);
- a Core Language Score within 1.25 *SD* of the mean on the Clinical Evaluation of Language Fundamentals 4 (Semel, Wiig, & Secord, 2003);
- no developmental or sensory impairment, as screened using a parent questionnaire (Claessen, Leitão, & Barrett, 2010);
- hearing and vision in the normal range (school nurse screening);
- intellectual skills in the average range using the Wechsler Intelligence Scale for Children IV Full Scale Score (Wechsler, 2003);
- letter sound knowledge in the average range using the Grapheme subtest of the Phonological Awareness Test 2 (Robertson & Salter, 2007).

Approval for this research was granted by the Curtin University Human Research Ethics Committee and the Victorian Department of Education. Procedures complied with confidentiality guidelines and both caregivers and participants provided informed consent to participate. Participant details are presented in Table 1.

Table 1. Scores on standardised tests for selection (CELF 4, WISC IV)

Tests	Participant 1	Participant 2	Participant 3
CELF 4 (normal range 86–115)			
Core language score	100	96	82
Receptive language score	111	72	84
Expressive language score	102	102	86
WISC IV (normal range 86–115)			
Full scale	96	81	89
Verbal comprehension	102	96	93
Perceptual reasoning	92	90	100
Working memory	91	80	86
Processing speed	100	70	88

Design of the computer-supported intervention materials

Two computer-supported programs were developed for this research: the Assessment NW Lists, and the intervention activity targeting accurate phonological recoding of words and nonwords. Both were presented to all participants on an iPad, using graphics relating to the metaphor of learning to drive a car (Figure 1).

Figure 1. iPad screen graphic of intervention activity

The items were letter strings with 1:1 letter sound correspondence, thus presenting letter strings of similar type (Goswami et al., 2003). The Assessment NW Lists used nonwords and the intervention activity, both words and nonwords. The letter strings were presented with an increasing level of difficulty, starting with 2-letter strings and progressing through to 6-letter strings. Additionally, within each level the letter strings were ordered from those with high (easy) and progressing to those with low (harder) orthotactic probability. Each of the Assessment NW Lists required for the 31 sessions was constructed to be of equal difficulty by use of a systematic allocation of nonwords according to their orthotactic probability value. The MRC Psycholinguistic Database (Coltheart, 1981) was the source for the real words and the ARC Database (Rastle, Harrington, & Coltheart, 2002) for the nonwords. The orthotactic probability values of both words and nonwords were calculated using the N-Watch method (Davis, 2005), which enables users to obtain a broad range of statistics (e.g., word frequency, orthotactic and phonotactic probability).

An iPad was used to present the stimuli in a systematic manner and record the child's responses, but unlike many other programs, the interactive role of the researcher was central to provide reinforcement and feedback regarding reading accuracy.

Measures

The primary measures of intervention effectiveness were nonword reading rate (NW rate: the number of nonwords read out loud in 1 minute) and the total number of nonwords read correctly (NW total: the number correctly read to a ceiling of 6 out of 8 errors), from 31 experimenter-developed nonword lists each containing 70 letter strings – the Assessment NW Lists. These measures were taken at the beginning of every session (baseline and intervention). Nonword reading measures the child's ability to use orthographic processing and phonological recoding to decode unfamiliar words, and strongly predicts reading development (Badian, 2001).

Additional measures of intervention effectiveness were standardised measures of word and nonword reading administered by the researcher prior to the intervention, and by a speech pathologist unfamiliar with the children and blind to research aims during the post-intervention baseline sessions. These included the Test of Word Reading Efficiency 2 (TOWRE 2; Torgesen et al., 2012) and the Decoding subtests of the Phonological Awareness Test 2 (PhAT 2; Robertson & Salter, 2007).

Procedure

Each participant was involved in a total of 31 sessions of 15 to 20 minutes duration at their school. During the eight pre- and eight post-baseline sessions (A1 and A2), the Assessment NW List (referred to as *T Plate*) was administered. The child touched the *Go* button on the iPad and read out loud a nonword letter string. No feedback about accuracy was given and responses were recorded on a digital recorder for later analysis. This generated two scores, NW rate and NW total, and provided data for the starting level of each participant's intervention phase.

During the 15 intervention sessions, the child began the session with the T Plate and then completed the intervention task. After touching *Go* the child read out loud a randomly presented word or nonword, and was provided with verbal feedback from the researcher, who touched the *Correct* button for accurate phonological recoding and blending, or the *Help* button following inaccurate responses. The child then put real words in the *Book* and nonwords in the *Bin* by touching either graphic, and touched the *Go* button when they were ready to start the next trial.

Three levels of help were provided for inaccurate responses:

1. visual highlighting of each letter to prompt phonological recoding,
2. visual highlighting with auditory cues of how to sound out the word,
3. demonstration by the researcher of phonological recoding and blending to read the real or nonword.

To strengthen MOR development, the verbal feedback involved a scripted sentence for real words explaining the meaning of the word, and for nonwords a sentence explaining that it was not a word and thus had no meaning. At the completion of the intervention task, the program calculated percent correct responses.

The intervention involved three components: teaching (*L plate*), practising (*P plate*), and consolidating the skills of phonological recoding and blending to read letter strings (*D plate*). The L plate was the starting point at all levels (2-, 3-, 4-letter strings, etc.) where the researcher modelled and explained phonological recoding and blending. This was followed by the P plate (where the child practised phonological recoding and blending with a controlled set of words) and finally by the D plate (full driver's license). The D plate used a PEST algorithm, based upon that used by McArthur, Ellis, Atkinson, and Coltheart (2008) in which the computer program responds to the accuracy of the child's response. As errors are made the program presents increasingly easier letter strings (higher orthotactic probability). If the child's responses are accurate, the program presents letters strings of increasing difficulty (lower orthotactic probability). The child was required to reach 90% accuracy to move on to the next level.

Results

This intervention was tailored to match the skills of each participant. All participants began at 2-letter strings but each reached different levels: P1 progressed to 4-letter strings, P2 to 3-letter strings, and P3 to 5-letter strings.

Nonword reading accuracy and rate

Effectiveness was examined through analysis of the primary measures, NW rate and NW total, using the 2 *SD* band method (Portney & Watkins, 2009). First, the variability during the baseline phase was established using the mean and standard deviation of data points within that phase. The 2 *SD* band was drawn on the baseline phase and extended into the intervention and post-intervention phases (Figure 2). If at least 2 consecutive data points in the intervention phase fall outside the 2 *SD* band, changes from the baseline are considered significant.

All participants scored more than six consecutive points above the 2 *SD* band for NW rate and NW total, and remained above that level post-intervention, indicating that the intervention resulted in a significant and positive effect on nonword reading. Two participants (P1 and P2) took about eight intervention sessions to reach that point, while the third child (P3) began scoring above the 2 *SD* band by the second intervention session. Analyses of the responses revealed that during the first baseline, P1 and P2 were not using phonological recoding as a strategy at all (i.e., they made errors that were often not related to the target nonword), while P3 was already using phonological recoding but did not blend to read the letter string, or made errors on blending. All participants made greater gains in NW total compared to NW rate, indicating that they plateaued in speed of nonword reading, but continued to improve in accuracy.

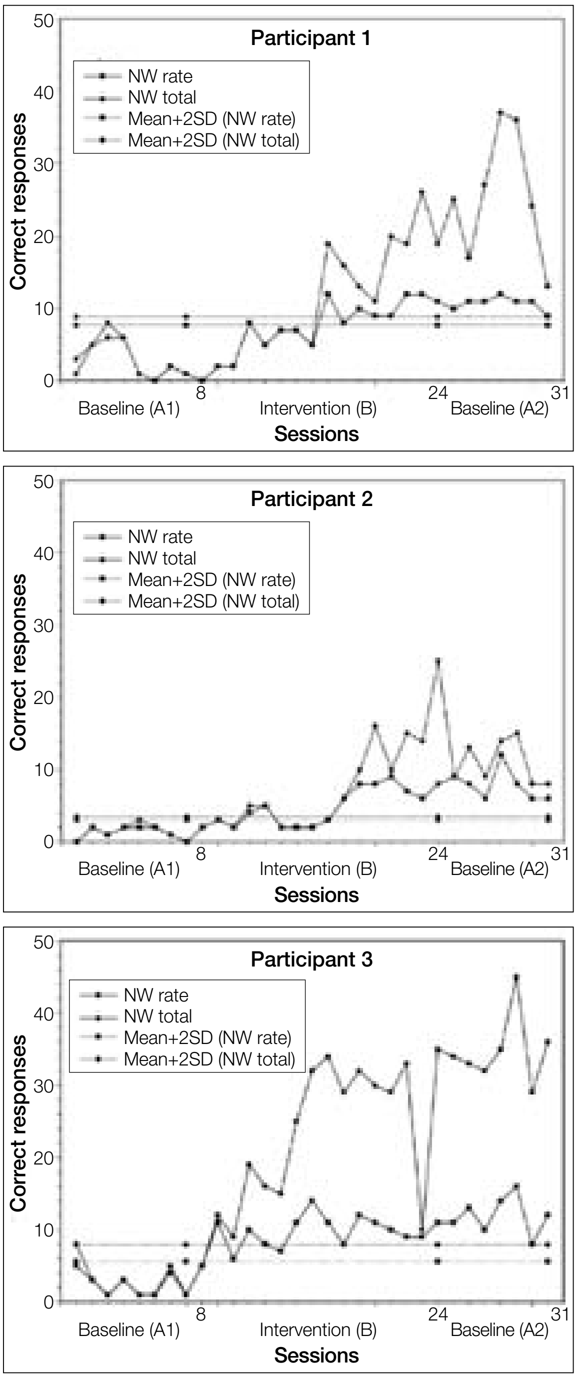

Figure 2. NW rate (correct responses in 1 min) and NW total (total number of correct responses) for participants 1, 2 and 3, showing the 2 SD band method of analysis

Standardised assessment results

The pre- and post-intervention scores on the standardised tests assessing accuracy of nonword reading (Decoding subtests of the PhAT 2) and efficiency of real word and nonword reading (TOWRE 2) were calculated and are reported in Table 2.

The PhAT 2 Decoding assesses accuracy of nonword reading using eight subtests. All participants made clinically significant gains in one or more of the three areas targeted by this intervention (i.e., VC, CVC, Consonant blends). P1 moved from below average to normal range in two areas (VC: 84 to 114, Consonant blends: 81 to 103). P2 improved from moderate impairment to normal range in one area (CVC: 75 to 108), and P3 from moderate impairment to normal range in two areas (CVC: 75 to 114, Consonant blends: < 77 to 90). Two participants generalised skills to a non-targeted area, and made clinically significant gains in the Total score (overall decoding): Consonant digraphs (P1 from 87 to 100, P3 from 73 to 100), Total score (P1 from 82 to 94, P3 from 77 to 88).

The TOWRE 2 assesses efficiency of real word (sight word efficiency) and nonword (phonemic decoding efficiency) reading. Two participants made clinically significant gains in nonword reading efficiency: P1 moved from moderate impairment to normal range (76 to 91) and P3 from severe to moderate impairment (69 to 76). P2 did not demonstrate gains (from 66 to 67). Word reading efficiency improved for P3 (from moderate impairment to normal range, 78 to 87), and remained the same for P1 (in the normal range, from 91 to 92), and P2 (in the moderately impaired range, from 79 to 76).

Discussion

The results of this preliminary study indicate that the computer-supported intervention designed to target orthographic processing and phonological recoding was effective in increasing nonword reading skills as measured during the baseline periods and start of each intervention session, and the effects remained significant during the follow-up baseline phase. In addition, these gains were reflected in clinically significant changes in a number of the standardised subtests, most particularly in the measures of nonword reading. These outcomes provide support for the effectiveness of this approach that combined computer-supported delivery (allowing items to be engagingly presented with automatic adjustment of difficulty level) with feedback and explicit teaching from a therapist.

Performance on the standardised assessments may have been influenced by differences in the stimuli and scoring. The PhAT 2 Decoding subtest assesses accuracy of nonword reading at different levels (e.g., CV, CVC,

Table 2. Scores on pre- and post-intervention standardized tests (TOWRE 2, PhAT 2 Decoding)

Tests	Participant 1		Participant 2		Participant 3	
	Pre	Post	Pre	Post	Pre	Post
TOWRE 2 (normal range 86–115)						
Sight word efficiency	91	92	79	76	78	87
Phonemic decoding efficiency	76	91	66	67	69	76
PhAT 2 Decoding (normal range 86–115)						
Vowel consonant	84	114	87	93	87	112
Consonant vowel consonant	97	112	75	108	75	114
Consonant digraphs	87	100	<73	73	73	100
Consonant blends	81	103	<77	77	<77	90
Vowel digraphs	<85	85	<78	<78	<78	<78
R controlled vowels	<85	<85	<81	<81	<81	<81
Consonant vowel consonant-e	<86	<86	<80	<80	<80	80
Diphthongs	<88	88	<82	<82	<82	82
PhAT 2 Total score	82	94	73	78	77	88

Consonant blends) and is not timed. In contrast, the TOWRE 2 is timed, presents mixed stimuli (e.g., CVC, digraphs), and encourages the child to read quickly and skip items they cannot read. All children made clinically significant gains in accuracy of nonword reading (PhAT 2), but the pattern was less clear on the TOWRE 2 which may be explained by the task being timed and the inclusion of items which were not targeted in the intervention (digraphs).

The language and cognitive profiles of the participants may also have influenced their performance. The child who improved from below average to normal range in both accuracy and efficiency of nonword reading, P1, scored in the normal range on all language and cognitive measures. In contrast, P3, whose cognitive scores were average but language scores were mildly impaired, improved from moderate impairment to normal range in nonword accuracy and word reading efficiency, but remained below average in nonword efficiency. P2, despite having average core language and cognitive skills, had severe impairments in receptive language and processing speed. He made clinically significant gains on the targeted areas only, did not generalise skills, and when faced with the pressure of the timed test (TOWRE 2), his decreased processing speed resulted in him reverting to pre-intervention patterns of guessing, with no change in word and nonword reading efficiency.

This preliminary study designed, developed and provided evidence on the effectiveness of a computer-supported intervention task targeting word decoding skills. However, the small number of participants limits generalisation of the findings to other children with word identification difficulties, and the short duration of the maintenance period prevents investigation of the sustained effects of the intervention. A follow-up study is currently in progress to address these limitations, involving a larger number of participants over a period of 20 weeks. Results from that study will enable further understanding of the value of this computer-based intervention task in improving word identification among children with reading difficulties.

Conclusion

This paper reports on a computer-supported intervention targeting orthographic processing (through encouraging attention to letter-sound mapping) and phonological recoding (through the provision of corrective feedback as the child attempted to sound out and blend). The use of computer-supported delivery allowed the intervention to provide a systematic focus on decoding skills starting at a level that matched the skills of each child. Prior to intervention, all children were unable to decode 2- and 3-letter strings; after intervention all had made gains in accurate phonological recoding (even those with severe impairments in some processing areas). The targets (letter strings of increasing length with 1:1 letter–sound correspondence) were appropriate to the needs of each participant and aimed to develop their MORs by increasing their ability to take note of each letter rather than guess based on the first letter. A strength of this intervention is that all children showed improvement even though they started with quite different language and cognitive ability profiles. These results provide additional evidence that orthographic processing is a key factor in improving word decoding skills, and highlight the value of using a computer to allow systematic delivery and integrated data collection.

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References

Apel, K. (2009). The acquisition of mental orthographic representations for reading and spelling development. *Communication Disorders Quarterly*, *31*(1), 42–52. doi: 10.1177152574010832555З

Apel, K. (2011). What is orthographic knowledge? *Language, Speech, and Hearing Services in Schools*, *42*(4), 592–603. doi: 10.1044/0161-1461(2011/10-0085)

Badian, N., A. (2001). Phonological and orthographic processing: Their roles in reading prediction. *Annals of Dyslexia*, *51*, 179–202. doi: 10.1007/s11881-001-0010-5

Bishop, D. V., & Snowling, M. (2004). Developmental dyslexia and specific language impairment: Same or different? *Psychological Bulletin*, *130*(6), 858–886. doi: 10.1037/0033-2909.130.6.858

Botting, N., Simkin, Z., & Conti-Ramsden, G. (2006). Associated reading skills in children with a history of specific language impairment (SLI). *Reading and Writing*, *19*, 77–98. doi: 10.1007/s11145-005-4322-4

Claessen, M., Leitão, S., & Barrett, N. (2010). Investigating children's ability to reflect on stored phonological representations: The silent deletion of phonemes task. *International Journal of Language and Communication Disorders*, *45*(4), 411–423. doi: 10.3109/13682820903111945

Coltheart, M. (1981). The MRC psycholinguistic database. *Quarterly Journal of Experimental Psychology*, *33A*(4), 497–505. doi: 10.1080/14640748108400805

Coltheart, M. (2006). Dual route and connectionist models of reading: An overview. *London Review of Education*, *4*(1), 5–17. doi: 10.1080/13603110600574322

Cunningham, A. E. (2006). Accounting for children's orthographic learning while reading text: Do children self-teach? *Journal of Experimental Child Psychology*, *95*(1), 56–77. doi: 10.1016/j.jecp.2006.03.008

Cunningham, A. E., Perry, K. E., & Stanovich, K. E. (2001). Converging evidence for the concept of orthographic processing. *Reading and Writing*, *14*, 549–568. doi: 10.1023/A:1011100226798

Cunningham, A. E., Perry, K. E., Stanovich, K. E., & Share, D. L. (2002). Orthographic learning during reading: Examining the role of self-teaching. *Journal of Experimental Child Psychology*, *82*(3), 185–199. doi: 10.1016/S0022-0965(02)00008-5

Davis, C. J. (2005). N-Watch: A program for deriving neighborhood size and other psycholinguistic statistics. *Behavior Research Methods*, *37*(1), 65–70. doi: 10.3758/BF03206399

Deacon, S. H., Benere, J., & Castles, A. (2012). Chicken or egg? Untangling the relationship between orthographic processing skill and reading accuracy. *Cognition*, *122*(1), 110–117.

Ehri, L. C., Nunes, S. R., Willows, D. M., Schuster, B. V., Yaghoub-Zadeh, Z., & Shanahan, T. (2001). Phonemic awareness instruction helps children learn to read: Evidence from the National Reading Panel's meta-analysis. *Reading Research Quarterly*, *36*(3), 250–287. doi: 10.1598/RRQ.36.3.2

Goswami, U., Ziegler, J. C., Dalton, L., & Schneider, W. (2003). Nonword reading across orthographies: How flexible is the choice of reading units? *Applied Psycholinguistics*, *24*(2), 235–247. doi: 10.1017/S0142716403000134

Hatcher, P. J., Goetz, K., Snowling, M. J., Hulme, C., Gibbs, S., & Smith, G. (2006). Evidence for the effectiveness of the early literacy support programme. *British Journal of Educational Psychology*, *76*(2), 351–367. doi: 10.1348/000709905X39170

Herrmann, J. A., Matyas, T., & Pratt, C. (2006). Meta-analysis of the nonword reading deficit in specific reading disorder. *Dyslexia*, *12*(3), 195–221.

Kamhi, A. G. (2009). The case for the narrow view of reading. *Language, Speech, and Hearing Services in Schools*, *40*(2), 174–177. doi: 10.1044/0161-1461(2009/08-0068)

Kyte, C. S., & Johnson, C. J. (2006). The role of phonological recoding in orthographic learning. *Journal of Experimental Child Psychology*, *93*(2), 166–185. doi: 10.1016/j.jecp.2005.09.003

Lane, H. B., Pullen, P. C., Hudson, R. F., & Konold, T. R. (2009). Identifying essential instructional components of literacy tutoring for struggling beginning readers. *Literacy Research and Instruction*, *48*(4), 277–297. doi: 10.1080/19388070902875173

McArthur, G. M., Ellis, D., Atkinson, C. M., & Coltheart, M. (2008). Auditory processing deficits in children with reading and language impairments: Can they (and should they) be treated? *Cognition*, *107*(3), 946–977. doi: 10.1016/j.cognition.2007.12.005

McCandliss, B., Beck, I. L., Sandak, R., & Perfetti, C. (2003). Focusing attention on decoding for children with poor reading skills: Design and preliminary tests of the word building intervention. *Scientific Studies of Reading*, *7*(1), 75–104. doi: 10.1207/S1532799XSSR0701_05

Moridis, C. N., & Economidis, A. A. (2008). Towards computer-aided effective learning systems: A literature review. *Journal Educational Computing Research*, *39*(4), 313–337

Nation, K., Angell, P., & Castles, A. (2007). Orthographic learning via self-teaching in children learning to read english: Effects of exposure, durability, and context. *Journal of Experimental Child Psychology*, *96*(1), 71–84. doi: 10.1016/j.jecp.2006.06.004

Portney, L. G., & Watkins, M. P. (2009). *Foundations of clinical research* (3rd ed.). Upper Saddle River, NJ: Pearson Prentice Hall.

Pullen, P. C., Lane, H. B., Lloyd, J. W., Nowak, R., & Ryals, J. (2005). Effects of explicit instruction on decoding of struggling first grade students: A data based case study. *Education and Treatment of Children*, *28*(1), 63–75.

Rastle, K., Harrington, J., & Coltheart, M. (2002). 358,534 nonwords: The ARC nonword database. *Quarterly Journal of Experimental Psychology*, *55*(4), 1339–1362. doi: 10.1080/02724980244000099

Robertson, C., & Salter, W. (2007). *The Phonological Awareness Test 2*. East Moline, IL: LinguiSystems.

Rowe, K. (2005). *Teaching reading: Report and recommendations*. Canberra, ACT: Department of Education, Science and Training.

Semel, E., Wiig, E. H., & Secord, W. A. (2003). *Clinical Evaluation of Language Fundamentals 4 Australian*. Sydney, NSW: Harcourt Assessment.

Share, D. L. (1999). Phonological recoding and orthographic learning: A direct test of the self-teaching hypothesis. *Journal of Experimental Child Psychology*, *72*(2), 95–129. doi: 10.1006/jecp.1998.2481

Torgerson, C., & Zhu, D. (2003). *A systematic review and meta-analysis of the effectiveness of ICT on literacy learning in English, 5–16*. In Research Evidence in Education Library. London: Social Sciences Research Unit, Institute of Education.

Torgerson, C. J., Brooks, G., & Hall, J. (2006). *A systematic review of the research literature on the use of phonics in the teaching of reading and spelling*. Report no. 711. Annesley, England: Department for Education and Skills.

Torgesen, J. K., Wagner, R. K., & Rashotte, C. A. (2012). *Test of Word Reading Efficiency (2nd ed.)*. Austin, TX: Pro-Ed.

Wechsler, D. (2003). *Wechsler Intelligence Scale for Children IV (Australian)*. Marrickville, NSW: Harcourt Assessment.

Wheldall, K., & Beaman, R. (1999). *An evaluation of MULTILIT – Making up lost time in literacy*. Executive summary. Sydney, NSW: Macquarie University Special Education Centre.

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Children's naming as a function of neighbourhood density

Skott E. Freedman

The majority of previous studies examining the role of neighbourhood density (ND) during children's naming have limited analyses to the semantic level (i.e., whether or not a word was correctly retrieved). In order to investigate potential effects on articulation, the present investigation explored the influence of ND on preschool children's naming accuracy using both semantic and phonological analyses. Thirty-seven typically developing children participated in a picture naming task consisting of 30 stimuli differing in ND (low, high). Results indicated that words with more semantic neighbours facilitated naming, such that lexical-semantic representations were more accurately retrieved than those with fewer neighbours. A similar facilitative effect was found at the phonological level; words with high phonological ND were articulated with greater levels of accuracy than those with low phonological ND. Findings are interpreted in the context of lexical facilitation.

The notion that the lexicon significantly affects phonological development was proposed over 35 years ago by Ferguson and Farwell (1975, p. 437), who argued that "a phonic core of remembered lexical items and the articulations that produced them is the foundation of an individual's phonology." Phonological neighbourhood density (ND) is a variable representing such an interaction. ND indexes the number of meaningful words in a given language (deemed *neighbours*) that can be created by adding, deleting, or substituting a phoneme in any word position (Luce & Pisoni, 1998; Vitevitch & Luce, 1998). Consider the English word "back". By substituting the first sound, the word "pack" would be considered a neighbour, as would the word "bat" by substituting the final sound. Words with many neighbours such as "back" have high phonological ND and presumably reside in dense neighbourhoods, while words with few neighbours such as "budge" have low ND and are said to reside in sparse neighbourhoods.

Studies investigating the relationship between ND and speech production have reported that words with high ND are better articulated and acquired than those with low ND. Munson and Solomon (2004) conducted an acoustic analysis of adults' word productions varying in ND. Results indicated that adults articulated words with high ND to a greater degree (e.g., expanded vowel spaces) than words with low ND, suggesting a greater need for intelligibility when words have many similarly sounding items. Additionally, Storkel and colleagues have repeatedly found that both children and adults learn words with high ND more accurately than words with low ND (Storkel, Armbruster, & Hogan, 2006; Storkel & Rogers; 2000). Lexical acquisition has also been explored with respect to ND. In order to determine how ND might influence children's first words, Storkel (2004) conducted an analysis of the earliest acquired words based on parental report. Findings revealed that early acquired words are overall higher in ND, suggesting a production advantage (at least at the semantic level) for words with many phonological neighbours.

Although effects of ND on speech production have been investigated previously using picture-naming tasks, relevant to the present study, the extent to which production has been measured remains largely restricted to a semantic analysis. That is, productions have been scored as correct if the target lexical-semantic representation was retrieved irrespective of phonological accuracy (e.g., [tuf] for "tooth"). This is perhaps the appropriate analysis for use with adult participants, who demonstrate few production errors during naming. Children, in contrast, produce speech sound errors during language acquisition. Notably the influence of ND on children's naming accuracy using a semantic analysis has been studied only in a small number of experiments; even fewer have examined productions at the phonological level.

In order to understand how ND and other factors might influence children's naming accuracy at the semantic level, Newman and German (2002) administered a naming task to typical school-aged children. Phonological ND was calculated for two word lists. Results showed that words with low ND were named more accurately (i.e., correct lexical-semantic representations were retrieved) than words with high ND, with the authors interpreting the results as stemming from lexical competition. On words with high ND, children may have not retrieved the appropriate target due to inhibiting competitors. However, in a follow-up study with children with word-finding impairment (German & Newman, 2004), the opposite result was found: words with high ND

KEYWORDS
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PHONOLOGICAL DEVELOPMENT

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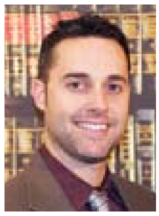

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were named more accurately (i.e., correct lexical-semantic representations were retrieved) than words with low ND. In response, the authors acknowledged that a lack of stimuli control may have been a factor.

In another picture-naming study researching effects of ND in clinical populations, Arnold, Conture, and Ohde (2005) presented 20 words varying in ND to 18 preschool children who did/did not stutter. Although some of the children's responses contained phonological/articulatory errors, importantly these productions were discarded and only correctly articulated responses were analysed. Findings showed that all children were slower and less accurate naming words with high ND. Thus, words with more neighbours delayed naming and decreased accuracy. No difference in reaction time or accuracy was found between the two groups. Finally, while four out of nine children in each group produced more errors on words with high ND, the remaining five children did not show any difference. Perhaps then the influence of ND is more influential for some children than others.

Although a semantic analysis was used to examine effects of ND in the above studies, little consideration was given to the phonological level. It is possible that more phonological measures might not have revealed effects of ND for the older children though, given that school-aged children produce target phonemes with over 90% accuracy (Waring, Fisher, & Atkin, 2001). Hence, it seems that in order to evaluate how ND affects production accuracy at the phonological level, there must be a sufficient number of (developmental) phonological production errors. Because children of younger ages such as preschoolers demonstrate numerous phonological errors (Waring et al., 2001), analysing effects of ND on production for this population would be beneficial for the current experimental question. Moreover, using measures that evaluate production at the phonological level might offer additional information about the effects of ND versus using semantic analyses alone.

Models of speech production (e.g., Goldrick & Rapp, 2007) have previously attempted to understand the level of processing in which ND operates, with possibilities ranging from lexical to post-lexical and articulatory levels. Given that many studies have reported a productive advantage for words with high versus low ND (e.g., Storkel, 2004), there appears to be some support for ND operating at the lexical level. And yet, without examining actual articulatory differences between words with low and high ND, particularly at an age where developmental errors still occur, it is difficult to explore additional effects of ND at post-lexical and articulatory levels. Analyses that examine responses at the phonological level may offer such insight.

The present experiment

It is currently uncertain how a child's articulation of a word during naming may be influenced by its phonological similarity to other words. The goal of this study is therefore to determine how lexical entries interact with one another during development with respect to their phonological composition. Thus, in addition to analysing productions at the semantic level, phonological measures of accuracy will also be used. This can expand our understanding of the developing lexicon, in addition to offering clinical implications.

Based on previous work reporting facilitative effects of ND on production for both adults and children (Storkel et al., 2006; Storkel & Rogers, 2000), coupled with greater attention to detail when articulating words with high ND (Munson & Solomon, 2004), it is predicted that children in the present study will best articulate words with high ND. Similarly, it is predicted that neighbours of a word will facilitate naming at the semantic level, thereby affording words with high ND an advantage over words with low ND during retrieval. One possibility is that lexical phonological processing involves a "cascading" effect, in which nontarget words sharing a target's phonological structure are also activated (Goldrick & Rapp, 2007). Assuming that words with high ND have more forms activated during naming, such words might be retrieved more accurately. Words may act as lexical facilitators with one another, thus resulting in more accurate naming and articulation for words with more phonologically similar forms relative to words with few neighbours. If a facility influence of ND is discovered, clinical implications seem possible. For example, a goal of increasing expressive vocabulary for a child with language deficits might include words with high ND.

Method

Participants

Thirty-seven monolingual English-speaking children (20 females, 17 males) participated in the study. The average age of children participating in the study was 4;6 (years; months) (*SD* = 0;8; range = 3;0–5;11). Children were recruited to participate in the study through public announcements and distribution of flyers to daycare centers and preschools. Children who were monolingual and typically developing according to parent report, using an in-depth questionnaire, were eligible to participate in the study. Additionally, each child scored within typical limits (SS 85–124) on two standardised tests of speech and language: the *Goldman Fristoe Test of Articulation*, 2nd edition (GFTA-2; Goldman & Fristoe, 2000), and the *Peabody Picture Vocabulary Test – III* (PPVT-III; Dunn & Dunn, 1997), respectively.

Stimuli

Thirty illustrations, half of which depicted words with low ND, and the other half of which depicted words with high ND, were used as stimuli (see Appendix A). The illustrations were selected from the *Assessment of English Phonology* (Barlow, 2003), a colourful picture-naming probe designed for children.

Consistent with other investigations (e.g., Luce & Pisoni, 1998), ND was determined by the number of words that could be created by adding, deleting, or substituting, a single phoneme to a target item. ND was calculated with the *Irvine Phonotactic Online Database* (IPhOD; Vaden & Halpin, 2005), which offers information about a word's sublexical and lexical properties. Although the database is based on an adult lexicon, previous research has demonstrated that the use of adult lexicons provides comparable measures of ND with children (Hoover, Storkel, & Kieweg, 2008); for example, words that are considered to be low in ND for adults are also low in ND for children.

Stimuli in the experiment were divided at the median value for ND; all words below the median were characterised as having low ND, while those above the median value were classified as containing high ND. In the low ND condition, the mean ND was 5.5 (*SD* = 2.9; range = 1–9). In the high ND condition, the mean ND was 19.7 (*SD* = 10.8; range = 11–42). An independent-samples t-test confirmed that the high ND condition had significantly more neighbours than the low ND condition, $t(28) = 4.91$, $p < .01$, $d = 1.79$.

It was also necessary to control for a multitude of other factors to minimise confounding effects obtained in prior research. In order to control for neighbourhood frequency (word frequencies of a word's neighbours), frequency-weighted ND was calculated for words with low ND and high ND. In the low ND condition, the mean frequency-weighted ND was 5.17 (*SD* = 4.4). In the high ND condition, the mean frequency-weighted ND was 19.0 (*SD* = 11.8). An independent-samples t-test confirmed that the high frequency-weighted ND condition had significantly more neighbours than the low ND condition, $t(28) = 4.26$, $p < .01$, d = 1.55. Note that the means of each condition were nearly identical to the original means using a traditional definition of ND. Therefore, it would be less likely to observe confounding effects related to neighbourhood frequency.

Additionally, stimuli were carefully selected and statistical analyses confirmed that the two sets of stimuli (low ND, high ND) did not differ (all *ps* > .05; see Appendix B) in any of the following variables, as calculated with the IPhOD (Vaden & Halpin, 2005) and the Bristol Norms for Age of Acquisition, Imageability, and Familiarity (when such information was available, Stadthagen-Gonzales & Davis, 2006):

1. word frequency,
2. phonotactic probability (probability of a sound's co-occurrence with other sounds in a language),
3. word length (number of phonemes and syllables),
4. imageability (capacity of a word's referent to evoke mental images of objects or events; Paivio,Yuille, & Madigan, 1968),
5. familiarity (how relatively familiar a word is in a language),
6. visual complexity (size of the graphics file),
7. grammatical class,
8. stress placement,
9. phonological composition (e.g., consonant clusters, syllable-final consonants), and
10. age-of-acquisition.

Design and procedure

The study employed a within-subjects design with ND (low, high) serving as the independent variable, and accuracy (semantic, articulatory) the dependent variables. Children were seated at a computer and told they would be looking at pictures. A practice item was provided to ensure task comprehension; test stimuli were then presented using Microsoft PowerPoint®. Stimuli presentation was randomised for each participant using a random number generator. Words were elicited spontaneously for each picture with a general question (e.g., "What's this?") or a specific prompt (e.g., "What is she drinking?"). If a child did not know a word, a delayed imitation was obtained (e.g., "They're teeth. What are they?"). The type of response (spontaneous, imitative) was noted and considered when evaluating accuracy. Speech samples were digitally recorded at a sampling rate of 44.1 kHz directly to a Roland Edirol R-09 recorder.

Analyses

The children's responses were phonetically transcribed by the investigator, a native English speaker and speech-language pathologist trained in English phonetics. Inter-rater transcription reliability was calculated for approximately 17% of speech samples by a research assistant trained in phonetic transcription. Mean point-to-point transcription agreement reached 96% between listeners (*SD* = 4%; range = 89%–100%).

In order to discern the influence of ND on children's speech productions, three dependent variables were measured for all items: 1) semantic accuracy, 2) binary articulatory accuracy, and 3) segmental articulatory accuracy.

A traditional semantic analysis was conducted in order to analyse word retrieval regardless of phonological errors. Children's productions were scored as correct if a target item was spontaneously named regardless of its articulatory accuracy. For example, [tif] for "teeth" was scored as correct in the analysis because the child had successfully provided the lexical-semantic representation. Semantic errors and no responses were scored as incorrect. Finally, delayed imitations were also scored as incorrect in this analysis since the child did not independently name the target.

A second analysis evaluated overall articulatory accuracy. This type of analysis explored whether some articulation errors could be related to a word's ND. Using a binary criterion (yes, no), children's responses were scored as correct if they phonetically matched the adult target form, and incorrect if there were omissions, distortions, additions, or substitutions. For example, [tif] for "teeth" would be marked as incorrect because of an articulatory error.

A third analysis considered the accuracy of production with respect to featural properties of the sounds in target words. Following Edwards, Beckman, and Munson (2004), each consonant in a child's production was coded for accuracy on a 3-point scale: place of articulation, manner of articulation, and voicing. Each vowel was also coded for accuracy on a 3-point scale: dimension (front, middle, back), height (high, mid, low), and length (lax, tense). One point was awarded for each correct feature; thus, each phoneme could receive a maximum of 3 points.

Inter-rater reliability was calculated for the scoring measures on approximately 17% of speech samples by a research assistant trained in phonetic transcription. Mean scoring reliability was 98% (*SD* = 2%; range = 92%–100%).

Results

Given there were three dependent variables (semantic, binary, segmental) and two levels of the independent variable, ND (low, high), six accuracy scores were calculated for each child: semantic accuracy for words with low ND, semantic accuracy for words with high ND, and so forth. Semantic accuracy was calculated by determining how many words were correctly retrieved out of the 15 possible targets in each condition (low ND, high ND); raw scores were then converted to proportions (e.g., 12/15 = 0.8). The same method was used to calculate accuracy in the binary articulatory analysis. For the segmental articulatory analysis, each word was assigned a total possible number of points, with 3 points assigned per phoneme. Average scores for segmental accuracy were then calculated by dividing the total number of points the child received in each condition (low ND, high ND) by the total number of possible points in each condition. A separate analysis of individual means revealed that 97% of participants performed similarly to the overall group (i.e., within two standard deviations of the mean). Proportions were arcsine-transformed to approximate a normal distribution; each variable was normally distributed. A paired samples *t*-test was conducted on the transformed data for each dependent variable to compare average production accuracy of words with low ND with that of words with high ND. A conservative alpha level of 0.01 was used for statistical tests to allow for multiple comparisons. When applicable, spontaneous productions and imitations were analysed together given that the majority of children's responses (> 75%) were spontaneous. Furthermore, past studies have found no significant difference in articulatory accuracy between imitations and spontaneous productions of words (Andrews & Fey, 1986; Goldstein & Fabiano, 2004). Average accuracy rates for each dependent variable are presented in Table 1 by condition.

Effect sizes were calculated for all analyses. Using Cohen's *d* (1988), effect sizes were considered to be small (0.2–0.3), medium (0.5), or large (0.8).

Table 1. Mean percentage accuracy rates and standard deviations for children's naming by analysis and condition

	Semantic	Binary	Segmental
Low neighbourhood density	75.50 (10.31)	70.81 (21.16)	95.78 (4.37)
High neighbourhood density	81.80 (10.38)	77.66 (19.19)	96.88 (3.11)

Semantic accuracy

The first analysis was used to determine how ND might influence children's naming according to semantic accuracy. A main effect of ND was found, $t(36) = 4.55$, $p < .01$, $d = 0.61$, noting a moderate-large effect size. Consistent with predictions, words with high ND were named more accurately than words with low ND.

Binary articulatory accuracy

The next analysis considered effects of ND on production at the phonological level using a binary measure of phonetic accuracy. There was a significant effect of ND, $t(36) = 3.82$, $p < .01$, $d = 0.34$. As predicted, children more accurately articulated words with high ND versus low ND.

Segmental articulatory accuracy

The third analysis investigated how effects of ND might impact production accuracy at a segmental level. Again, a main effect of ND was discovered, $t(36) = 3.58$, $p < .01$, $d = 0.29$. Segmental accuracy on words with high ND was greater than those with low ND.

Summary of results

In summary, children more accurately named (retrieved) and articulated words with high ND versus low ND. This was true at the phonological level using both a binary and segmental measure of phonetic accuracy.

Discussion

The current experiment was designed to shed light on how items in the developing lexicon may interact with one another as a function of their phonological similarity: competitively, facilitatively, or neither. Results will first be discussed for the semantic analysis, followed by interpretations of the articulatory findings.

Regarding an influence of ND on semantic accuracy, children most successfully retrieved words with high ND. This finding revealed a facilitative nature of the lexicon during naming, such that words appeared to aid one another. Consistent with original predictions and previous findings (e.g., Storkel et al., 2006), words with many phonologically similar forms were easier to retrieve than those with few forms. Considering the possibility that lexical forms must be activated in some manner prior to retrieval, greater activation might be provided to words with high ND versus low ND. While such activation could potentially inhibit naming of a lexical representation (i.e., via lexical competition), it appears this relationship actually *facilitates* production during children's naming. These results also support an influence of ND at the lexical level in models of speech production (e.g., Goldrick & Rapp, 2007).

In addition to finding facilitative effects of ND at the semantic level, a similar pattern emerged at the phonological level. Words with high ND were articulated more accurately than those with low ND. Such productive advantages have been demonstrated previously. Recall that Munson and Solomon (2004) found that adults articulated words with high ND to a greater degree than words with low ND, related perhaps to a need for greater intelligibility when words have multiple similarly sounding forms. Based on the current results, it appears that a word's ND can also influence young children's articulation of a word.

Note that participants in the present study *did* exhibit developmental production errors on this task; such errors were more likely to occur on words with low ND than on words with high ND. This is a novel finding. ND may then not only play a role in lexical processing, but also in post-lexical processing at the articulatory level. Otherwise, articulatory differences might not have been observed between words with low and high ND. Revisiting Goldrick and Rapp's (2007) proposed "cascading" effect during phonological processing, nontarget words sharing a target's phonological structure may also become activated during productive acquisition of a word. As mentioned above, this relationship seems to facilitate production. Words with high ND presumably have more forms activated relative to words with low ND, thereby resulting in more accurate articulation for words with more phonologically similar forms relative to words with few neighbours.

Clinical implications

Apart from theoretical contributions, there are also clinical implications of the results. Since words with high versus low ND were more accurately named at the semantic level, these words may be ideal targets for children with word-finding deficits. One might argue that having children succeed early (with high ND words) in treatment may increase motivation before presenting more challenging activities. Speech-language pathologists could match word naming strategies to target words based on their ND, with phonemic cues provided when necessary to improve naming of these forms. Future research is warranted to determine how incorporating ND into treatment may assist children with word-finding impairment.

Limitations

Although there was an attempt to control for many confounding stimuli factors such as imageability, information was not available for all items. It is possible that results may have been impacted by variables for which data were unavailable. Additionally, given that imitated and spontaneous productions were analysed together for the articulatory analyses, it cannot be ruled out that response accuracy may have been inflated for some children after hearing a model. Future studies of this nature can control for this possibility.

Future directions

Work in the future should include older participants to rule out the possibility that ND may be a developmental factor affecting articulation only at an earlier age. It is uncertain whether ND may simply cease to influence production at the phonological level at a certain age due to more influential factors (e.g., phonotactic probability). Experimental studies should also be conducted with different clinical populations such as children with word-finding impairment in order to examine any performance differences.

Conclusion

In conclusion, this study found that preschool children retrieved the lexical-semantic representations of words with high ND more accurately than those with low ND. This revealed a facilitative nature of the lexicon in terms of *semantic* accuracy. A similar result was found regarding *phonological* accuracy; words with high ND were articulated with a greater degree of accuracy than those with low ND. As such, the degree of phonological similarity in the lexicon appears to impact preschoolers' production accuracy both at the lexical and phonological level.

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References

Andrews, N., & Fey, M. (1986). Analysis of the speech of phonologically impaired children in two sampling conditions. *Language, Speech, and Hearing Services in Schools*, *17*, 187–198.

Arnold, H. S., Conture, E.G., & Ohde, R. N. (2005). Phonological neighborhood density in the picture naming

Appendix A. Experimental stimuli

Low neighbourhood density words	Neighbourhood density	High neighbourhood density words	Neighbourhood density
wagon	1	drum	11
guitar	1	water	11
brother	3	feather	12
chicken	3	ladder	13
finger	3	shower	13
flower	4	cloud	14
judge	4	lemon	14
twins	5	teeth	14
queen	7	green	16
brush	8	plate	17
space	8	jeep	20
father	8	vase	21
knife	9	zoo	36
three	9	toes	41
snail	9	nail	42

Appendix B. Experimental stimuli control

Variable	Means (SD): low neighbourhood density stimuli	Means (SD): high neighbourhood density stimuli	Statistic
Word frequency[1]	106.67 (174.26)	58.40 (117.41)	$t(28) = 0.89$, $p = 0.38$, $d = 0.32$
Positional segment frequency	0.22 (0.07)	0.22 (0.06)	$t(28) = 0.16$, $p = 0.87$, $d = 0$
Biphone frequency	0.004 (0.004)	0.003 (0.003)	$t(28) = 0.96$, $p = 0.35$, $d = 0.28$
Number of phonemes	4.07 (0.65)	3.60 (0.74)	$t(28) = 1.77$, $p = 0.08$, d = 0.67
Number of syllables	1.47 (0.52)	1.33 (0.49)	$t(28) = 0.73$, $p = 0.47$, $d = 0.27$
Imageability	612.40 (43.35)	608.33 (79.06)	$t(17) = 0.14$, $p = 0.89$, $d = 0.06$
Familiarity	365.50 (101.02)	377.44 (148.45)	$t(17) = 0.21$, $p = 0.84$, $d = 0.09$
Visual complexity	51.35 (26.85)	41.61 (25.35)	$t(28) = 1.02$, $p = 0.32$, $d = 0.37$
Age-of-acquisition	3.94 (2.18)	4.04 (1.46)	$t(15) = 0.11$, $p = 0.90$, $d = 0.05$

[1] *Note.* While the means for word frequency appear different, upon further inspection it was determined that one word with low ND had a very high word frequency value; when this word was omitted, the average word frequency for words with low ND was 59.73, and the average word frequency for words with high ND was 58.40, helping to explain the lack of significant difference reported here.

of young children who stutter: Preliminary study. *Journal of Fluency Disorders*, *30*, 125–148.

Barlow, J. A. (2003). *Assessment of English phonology*. Unpublished instrument. Retrieved from http://slpath.com/barlow.html

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

Dunn, L. M., & Dunn, L. M. (1997). *Peabody Picture Vocabulary Test* (3rd ed.). Bloomington, MN: Pearson.

Edwards, J., Beckman, M. E., & Munson, B. R. (2004). The interaction between vocabulary size and phonotactic probability effects on children's production accuracy and fluency in nonword repetition. *Journal of Speech, Language, and Hearing Research*, *47*, 421–436.

Ferguson, C. A., & Farwell, C. B. (1975). Words and sounds in early language acquisition. *Language*, *51*, 419–439.

German, D. J., & Newman, R. S. (2004). The impact of lexical factors on children's word finding errors. *Journal of Speech, Language, and Hearing Research*, *47*, 624–636.

Goldman, R., & Fristoe, M. (2000). *Goldman-Fristoe Test of Articulation* (2nd ed.). Circles Pines, MN: American Guidance Service.

Goldrick, M., & Rapp, B. (2007). Lexical and post-lexical phonological representations in spoken production. *Cognition*, *102*, 219–260.

Goldstein, B., & Fabiano, L. (2004). Spontaneous and imitated productions in Spanish-speaking children with phonological disorders. *Language, Speech, and Hearing Services in Schools*, *35*, 5–15.

Hoover, J. R., Storkel, H. L., & Kieweg, D. (2008, November). *A child database for calculating phonotactic probability and neighbourhood density*. Presented at American Speech-Language-Hearing Association Convention, Chicago, IL.

Luce, P. A., & Pisoni, D. B. (1998). Recognizing spoken words: The neighbourhood activation model. *Ear and Hearing*, *19*, 1–36.

Munson, B., & Solomon, N. P. (2004). The effect of phonological neighbourhood density on vowel articulation. *Journal of Speech, Language, and Hearing Research*, *47*, 1048–1058.

Newman, R. S., & German, D. J. (2002). Effects of lexical factors on lexical access among typical language-learning children and children with word-finding difficulties. *Language and Speech*, *45*, 285–317.

Paivio, A., Yuille, J., & Madigan, S. (1968). Concreteness, imagery, and meaningfulness values for 925 nouns. *Journal of Experimental Psychology Monograph*, *76*(1, Pt. 2), 1–25.

Stadthagen-Gonzalez, H., & Davis, C. (2006). The Bristol norms for age of acquisition, imageability and familiarity. *Behavior Research Methods*, *38*, 598–605.

Storkel, H. L. (2004). Do children acquire dense neighborhoods? An investigation of similarity neighborhoods in lexical acquisition. *Applied Psycholinguistics*, *25*, 201–221.

Storkel, H. L., Armbruster, J., & Hogan, T. P. (2006). Differentiating phonotactic probability and neighborhood density in adult word learning. *Journal of Speech, Language, and Hearing Research*, *49*, 1175–1192.

Storkel, H. L., & Rogers, M. A. (2000). The effect of probabilistic phonotactics on lexical acquisition. *Clinical Linguistics and Phonetics*, *14*, 407–425.

Vaden, K., & Halpin, H. (2005). *Irvine phonotactic online dictionary*, Version 1.3. [Data file]. Retrieved from http://www.iphod.com

Vitevitch, M. S., & Luce, P. A. (1998). When words compete: Levels of processing in spoken word perception. *Psychological Science*, *9*, 325–329.

Waring, R., Fisher, J., & Atkin, N. (2001). The articulation survey: Putting numbers to it. In L. Wilson & S. Hewat. (Eds.), *Proceedings of the 2001 Speech Pathology Australia national conference: Evidence and innovation* (pp. 145–151). Melbourne: Speech Pathology Australia.

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Reliability of the Focus on the Outcomes of Communication Under Six (FOCUS©)

Karla N. Washington, Bruce Oddson, Bernadette Robertson, Peter Rosenbaum and Nancy Thomas-Stonell

The purpose of this study was to determine the test-retest and inter-rater reliability of the Focus on the Outcomes of Communication Under Six (FOCUS©). The FOCUS© is a clinical outcome measure, based on the International Classification of Functioning Disability and Health – Children and Youth (ICF-CY), designed to capture communicative participation in children receiving speech-language intervention. Of the 70 children (aged 6 and younger) with speech and/or language impairments and their 13 speech-language pathologists (SLPs) who participated in the study, 22 children and 7 SLPs took part in the test-retest reliability procedures and 48 children and 6 SLPs took part in the inter-rater reliability procedures. The results revealed high correlations for both test-retest and inter-rater reliability, demonstrating the reliability of the FOCUS© across time and observers, and supporting its use by SLPs for clinical and research purposes.

Speech and/or language impairment represents a high prevalence condition in young children, experienced by 4.56% to 19% of those aged 16 years and younger (Law, Boyle, Harris, Harkness, & Nye, 2000; McLeod & Harrison, 2009). For these children, there may be negative consequences on their ability to engage with others in social interactions (McCabe, 2005). The ability to participate with others is considered to be an important intervention outcome for children with speech and/or language difficulties who are receiving speech-language services (Threats, 2003; Washington, 2012).

In Australia, speech-language pathologists (SLPs) are required to complete a thorough evaluation of an individual's body functions and structures as well as activities and participation prior to commencing intervention (Speech Pathology Australia [SPA], 2011). When activities and participation are considered alongside body functions and structures, a more holistic approach to the evaluation of an individual's communication skills can be achieved. This approach to practice has its foundation in the World Health Organization's (WHO) International Classification of Functioning, Disability, and Health – Children and Youth (ICF-CY) (WHO, 2007), which SPA uses as a framework to guide assessment and intervention.

The ICF-CY was derived from the International Classification of Functioning, Disability and Health (ICF) (WHO, 2001) and focuses on the birth to 18-year population. When the ICF-CY is used as a framework for assessing children's speech and language skills, children's body functions and structures (e.g., articulation functions, expression/reception of language), activities and participation (e.g., conversations with others) and contextual factors (e.g., languages spoken) are evaluated. Consequently, this framework promotes the consideration of outcomes at multiple levels, including at the level of *communicative participation*, defined as communication in life situations where knowledge, information, ideas, or feelings are exchanged (Eadie et al., 2006; Yorkston et al., 2008).

For children, communicative participation involves using speech and/or language skills to send and receive messages to facilitate their inclusion with others (Washington, Thomas-Stonell, McLeod, & Warr-Leeper, 2012). Many measures are available to assess changes in the body functions and structures related to speech and language for children. Across clinical services, however, there is a growing need for the development of measures designed to capture clients' communicative participation (Wade & De Jong, 2000; McLeod & Threats, 2008; Washington, 2007; 2010; Westby, 2007).

These measures could increase our understanding of the breadth of the impact of communication impairments and speech-language intervention on children's activities and participation. Consequently, decisions to include intervention goals that focus on communicative participation, as well as impairment, can be supported and evidence-based service provision can be facilitated.

Measuring communicative participation outcomes

There are a limited number of tools available for assessing communicative participation outcomes. Tools such as the American Speech-Language and Hearing Association (ASHA) Pre-K National Outcome Measure (Pre-K NOMS; ASHA, 2000), the Therapy Outcome Measures (TOMs; Enderby & John, 1997), and the Australian adaptation of the TOMS, the AusTOMs (Perry et al., 2004) are available, but are not aligned with the ICF-CY framework and so do

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OUTCOME MEASURES
PRESCHOOL CHILDREN
RELIABILITY
SPEECH PATHOLOGY

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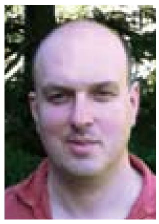
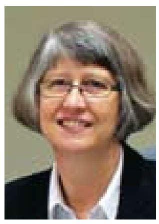

Karla N. Washington (top), Bruce Oddson (centre) and Bernadette Robertson not have a specific focus on activity and participation in children and youth. In the Pre-K NOMS, changes are measured at ICF levels of body functions and activity, but not participation. The TOMS, aligned with the International Classification of Impairment, Disability and Handicap (ICIDH; WHO, 1980), reflect a broad view of outcome measurement (e.g., clinical, functional, social issues). In the AusTOMs, global outcomes are measured using the ICF's domains of impairment, activity-limitation, and participation-restriction. The TOMS, AusTOMS, and Pre-K NOMS were designed to measure outcomes; however, only the TOMs and AusTOMs have published information on reliability and validity (John & Enderby, 2000; Perry et al., 2004; Roulstone, John, Hughes, & Enderby, 2004; Unsworth et al., 2004).

Measures designed to capture performance for pretest and post-test functioning in skills must be sensitive to change (Wade & De Jong, 2000). Sensitive measures are useful for providing information on changes in level of functioning following intervention. A critical component in establishing the outcomes of intervention is the use of valid and reliable measures (Yorkston, Klasner, & Swanson, 2001), those that reflect the most current theoretical framework for the population of interest (Jette & Haley, 2005) and evidence-based practice. The reliability of a measure refers to its reproducibility or dependability (Portney & Watkins, 2009). The validity of a measure reflects the assurance that a test is measuring what it is intended to measure (Streiner & Norman, 2008). For measurement development, information on internal consistency (i.e., items measuring same construct), test-retest reliability (i.e., measurement consistency), inter-rater reliability (i.e., measurement stability across observers/raters), and validity (e.g., content, construct) must be included. These factors provide evidence of a measure's soundness (i.e., psychometric properties) and demonstrate its usefulness in clinical research and decision-making (Portney & Watkins, 2009).

Peter Rosenbaum (top) and Nancy Thomas-Stonell

Developing the FOCUS©

In response to the need for outcome measures of communicative participation in children, a team of Canadian researchers developed the Focus on the Outcomes of Communication Under Six (FOCUS©; Thomas-Stonell, Oddson, Robertson, and Rosenbaum, 2010). The FOCUS© was developed to capture real-world changes in children's communication that are associated with speech-language intervention. It can be completed by SLPs and parents using parallel FOCUS© forms during an initial assessment and following intervention. As reported by Thomas-Stonell et al. (2010), the changes captured by the FOCUS© include communicative participation, confidence, and quality of life.

The FOCUS© was developed based on descriptive comments from parents and SLPs of 210 children regarding observed outcomes following speech-and-language intervention (Thomas-Stonell et al., 2010). These comments were elicited using open-ended questions on a questionnaire that parents and SLPs completed, asking them to describe changes they observed and why they were important to them and their child/client. A content analysis of the responses was completed to describe changes that were associated with speech-and-language intervention. These responses were grouped according to the ICF-CY domains, with 90% falling within the domain of communicative participation (activities and participation domain).

FOCUS© items were developed primarily using the parents' own comments about observed changes following speech-language pathology intervention with some consideration of SLPs' comments and observations (cf. Thomas-Stonell, Oddson, Robertson & Rosenbaum, 2009; Thomas-Stonell et al., 2010). The final FOCUS© form contained 50 items (see Appendix). In initial reliability testing, test-retest reliability (1-week apart) for parental administration of the FOCUS© was very high ($r > .95$). However, for SLPs, test-retest (1-week apart) reliability was acceptable ($r > .70$) and inter-rater reliability ranged from poor ($r = .51$) to acceptable ($r > .70$). This testing was based on a sample of children with speech-language impairments who received speech-and-language intervention during the 1-week period (Thomas-Stonell et al., 2010).

To evaluate construct validity (i.e., ensuring that a measure does that it is intended to do), parents ($n = 22$) completed the FOCUS© as well as the Pediatric Quality of Life Inventory (PedsQL; Varni, 1998). Pearson correlations revealed positive associations between the FOCUS© and the PedsQL for total scores, change scores, and scores on the psychosocial domain (a domain that includes social, school, and emotional functioning). These findings suggested that the FOCUS© was sensitive to changes in communication and related participation skills (Thomas-Stonell et al., 2010).

The current study

There is evidence of construct validity of the FOCUS©, and reliability has been confidently established for parental administration. However, test-retest and inter-rater reliabilty for SLPs' administration of the FOCUS© had not been confidently established (Thomas-Stonell et al., 2010). The authors acknowledged that the results of the initial reliability study might have been impacted by the intervention the children received. The purpose of this paper is to report the test-retest and inter-rater reliability of the FOCUS© within and between SLPs. The reliability procedures in the current study were completed for children with speech-language impairments who were not receiving intervention, to address the limitation of the initial reliability study.

Methods

Ethical approval was obtained from each participating site prior to the commencement of this study. SLPs and parents of children with speech-language impairments provided consent.

Participants

Seventy children and their SLPs ($n = 13$) who volunteered to participate were included. The following inclusion criteria were used: (a) child identified with a speech and/or language impairment by a participating SLP, (b) child and SLP enrolled at a participating site, and (c) child 6-years-old and younger.

Participants were recruited from four publicly funded children's speech-and-language initiatives in two Canadian provinces. These initiatives were located in urban settings and provided government-funded access to speech-language pathology assessment and intervention services.

As parents of children with speech-language impairments accessed services, SLPs from these initiatives invited them to participate (see Table 1). There were 49 boys and 21 girls, ranging from 10 months to 6 years 0 months ($M = 3$ years 10 months, $SD = 14.45$). Twenty-two children and six

SLPs completed the test-retest reliability phase. The mean age of the 22 children (15 boys) was 3 years 5 months (*SD* = 12.03; range = 0;10 to 5;3). Forty-eight children and seven SLPs completed the inter-rater reliability phase. The mean age of the 48 children (34 boys) was 4 years 1 month (*SD* = 14.89; range = 2;0 to 6;0). All 70 children resided in urban or rural settings with their parents. Thirteen of the 70 children (19%) came from home environments where English was a second language; however, SLPs reported that all children were proficient in English.

To provide a consistent classification of children's communication level across the four participating sites one measure was used, the Communication Function Classification System (CFCS; Hidecker et al., 2011). The CFCS (http://faculty.uca.edu/mjchidecker/CFCS/index.html) is a valid and reliable measure that focuses on Activity and Participation levels as described in the WHO's ICF (Hidecker et al., 2011). It classifies the everyday communication performance of an individual based on five descriptive levels where "1" represents *strongest* and "5" represents *weakest* communication. A parent, caregiver, and/or a professional who is familiar with the individual rates the person's communication level. For this study, participating SLPs used parent report along with an informal observation of the child during the assessment to classify children's communication skills.

The classification of children's communication skills was as follows: 1) "inconsistent sender and/or receiver with familiar partners" (47%, n = 33); 2) "effective sender and receiver with familiar partners" (20%, n = 14); 3) effective sender and receiver with unfamiliar and familiar partners (18.5%, n = 13); 4) seldom effective sender and receiver even with familiar partners (8.5%, n = 6); and (5) "effective but slower paced sender and/or receiver with unfamiliar and/or familiar partners" (6%, n = 4).

Thirty (43%) children had specific medical diagnoses including cerebral palsy, hypotonia, and global developmental delay. The most to least frequently addressed intervention goals across children were: expressive language (30%), receptive language (25%), phonology (rule-based production errors) (23%), intelligibility (clarity in productions) (13%), and social language (9%). SLPs identified these goals based on children's areas of need following their initial assessment.

Tools

The FOCUS© is a measure of communicative participation following SLP intervention for children aged 6 years and younger. The FOCUS© contains 50 items about children's abilities to be involved with others in meaningful ways (e.g., "makes friends easily") (WHO, 2007). The response options for the SLP version of the measure are on a 7-point scale ranging from "not at all like my client" to "exactly like my client", or "can always do without help" to "cannot do at all" (see Appendix). Higher FOCUS© scores are indicative of better communicative participation. It evaluates changes in both capacity (i.e., what the child is capable of doing in an ideal environment such as a structured therapy session) and performance (i.e., what the child is able to do in various environments such as home, school, daycare).

Procedures

All SLPs received the same training seminar on completing the FOCUS©, including practice opportunities and background regarding its development and purpose. The administration instructions and definitions of FOCUS© terms were specifically reviewed (see Appendix).

The reliability testing procedures were completed based on SLPs' availability at each site. Two sites completed test-retest procedures and two sites completed inter-rater procedures. This resulted in the natural creation of two phases of children and SLPs, the test-retest phase and the inter-rater phase.

Test-retest reliability

To establish test-retest reliability, one SLP administered the FOCUS© for the same child on two occasions. The FOCUS© was first administered during an initial assessment and then again within 1-month of the initial assessment during which time no speech-language intervention was provided (Format-1). SLPs were instructed to use their "best clinical judgment", which was to be based on two factors: (a) their clinical assessment findings/observations, and (b) parental report about their child's communication skills in the community (e.g., at home, school or on the playground).

Table 1. Demographics of participants

		Entire sample (n = 70)	Test-retest (n = 22)	Inter-rater (n = 48)
Age in months	Mean	46	41	49
	Range	10–72	10–63	24–72
Gender	Females	21	7	14
	Males	49	15	34
English as a second language	n	13	5	8
	%	19%	38%	62%
CFCS level*	Mode	4	4	4
	Range	1–5	1–5	1–5
Medical diagnoses**	n	30	14	16
	%	43%	64%	33%

CFCS = Communication Function Classification System (Hidecker et al., 2011)
*Level 1 = "effective sender and receiver with unfamiliar and familiar partners"
*Level 2 = "effective but slower paced sender and/or receiver with unfamiliar and/or familiar partners"
*Level 3 = "effective sender and receiver with familiar partners"
*Level 4 = "inconsistent sender and/or receiver with familiar partners"
*Level 5 = "seldom effective sender and receiver even with familiar partners"
**Medical diagnoses included: cerebral palsy, hypotonia, and global developmental delay.

Inter-rater reliability

To establish inter-rater reliability, two SLPs independently administered the FOCUS© for the same child. The FOCUS© was completed using Format-1 (i.e., one month apart) or Format-2 (i.e., during an initial assessment lasting for one or two sessions), based on the availability of SLPs at that site. In both formats, one primary/lead SLP conducted the initial assessments. Ninety-six inter-rater comparisons were completed for inter-rater reliability procedures. For 84 of these comparisons, two SLPs completed the FOCUS© within an 8-day period (using Format-2) and for the remaining eight comparisons, two SLPs completed the FOCUS© within a 1-month interval using Format-1.

For each of the 96 comparisons, the two SLPs interacted with and observed the child separately. They also had an opportunity to ask parents how the child was communicating in everyday settings (e.g., "please describe your child's ability to participate at home/school/other"). This was facilitated face-to-face for all 96 comparisons. Both SLPs also had the opportunity to review the clinical data collected during the assessment and contact the parents via telephone for any additional questions that followed from the parent interview.

Data analysis

FOCUS© test-retest and inter-rater reliability were determined using bivariate Pearson correlations with one-tailed significance tests. This analysis examines the linear relationship between variables (e.g., scores) that are normally distributed (Portney & Watkins, 2009). In this study, the purpose of the Pearson correlations was to evaluate the linear associations between SLP FOCUS© scores. These scores were normally distributed, with no outliers. FOCUS© raw scores were calculated and entered in the correlational analysis using the Statistical Program for the Social Sciences (SPSS; PASW, 2009). For test-retest reliability, scores were coded "SLP Time 1" and "SLP Time 2". For inter-rater reliability, scores were coded "SLP 1" and "SLP 2". To classify the size of observed correlational relationships, guidelines from Hinkle, Wiersma, and Jurs (2003) were used where .00–.30 = little if any correlation, .30–.50 = low correlation, .50–.70 = moderate correlation, .70–.90 = high correlation, and .90–1.00 = very high correlation. There was no study attrition or missing data.

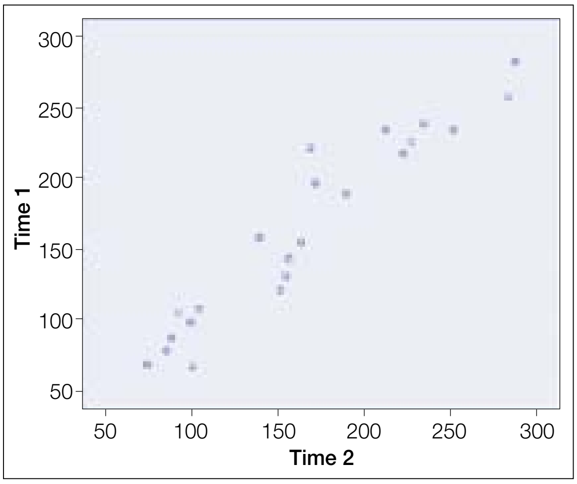

Figure 1. Scatterplot illustrated for test-retest reliability (same SLP at two different time points), r = .96, p<.001, r² = .92. Seven SLPs and 22 children were included in the test-retest reliability procedures.

Results

Test-retest reliability

SLP Time 1 FOCUS© scores ranged from 68 to 283 (*M* = 165.09, *SD* = 67.53). SLP Time 2 FOCUS© scores ranged from 74 to 287 (*M* = 165.86, *SD* = 65.54). There was a significant, positive and very high correlation between scores for SLP Time 1 and SLP Time 2 FOCUS© scores, $r = .96$, $p < .001$; 95% CI .90–.98, N = 22. See Figure 1 for SLP Time 1 and SLP Time 2 scatterplot. This analysis demonstrated that there was consistency and similarity of FOCUS© scoring for the two time-points.

Inter-rater reliability

SLP 1 FOCUS© scores ranged from 65 to 336 (*M* = 240.83, *SD* = 58.51). SLP 2 FOCUS© scores ranged from 84 to 328 (*M* = 238.48, *SD* = 65.10). There was a significant, positive, and high correlation between SLP 1 and SLP 2 FOCUS© scores, $r = .90$, $p < .001$; 95% CI .83–.94, N = 48. See Figure 2 for SLP 1 and SLP 2 scatterplot. This analysis demonstrated consistency and similarity of FOCUS© scoring for the two SLPs.

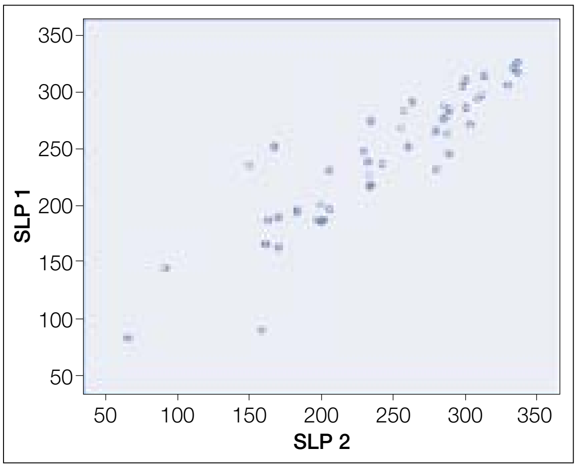

Figure 2. Scatterplot illustrated for inter-rater reliability (two different SLPs for the same child), r = .90, p<.001, r² = .81. Six SLPs and 48 children were included in the inter-rater reliability procedures.

Discussion

Clinical evaluation of communicative participation is not usually completed during SLP assessments of children. The dearth of measures available to capture these skills is a primary reason for this gap in our understanding of the real-world effectiveness of SLP interventions for children. Measuring communicative participation is, however, very much needed to evaluate the holistic impact of speech-language therapy on children's lives (McLeod & Threats, 2008; Washington et al., 2012).

To address the need for clinical measures of communicative participation, the FOCUS© was developed by a team of Canadian researchers. The FOCUS© was designed to be used by SLPs and parents. Consequently, the reliability for its use by SLPs and parents needed to be established. There is prior evidence of the validity of the FOCUS© as well as reliability for parental administration (Thomas-Stonell et al., 2010). However, further evidence supporting the reliability of the FOCUS© for SLP administration was needed. This study provides data that describe the reliability of SLPs' ratings of young children's communicative participation using the FOCUS©.

Results of the study indicated that SLPs' administration of the FOCUS© was reliable. Comparisons of the FOCUS© for test-retest reliability were very high (r = .96), revealing the same SLPs could reliably administer the FOCUS© within a 1-month time interval. The very high test-retest reliability estimates of the FOCUS© are in-line with impairment-based measures of speech and language for young children, such as the Clinical Evaluation of Language Fundamentals-Preschool (CELF-P; Wiig, Secord, & Semel, 2004), MacArthur-Bates Communicative Developmental Inventories – Second Edition (CDI-II; Fenson et al., 2007), and the Preschool Language Scales – Fourth Edition (PLS-4; Zimmerman, Steiner, & Pond, 2004). They are also in line with other participation-based measures (e.g., the TOMS and AusTOMs). The size of the correlation coefficients is indicative of the strength of the relationship between two variables (Hinkle et al., 2003). The very high values observed in this study indicate there is consistency in the administration of the FOCUS© by the same SLP, which suggests that it is psychometrically sound.

This study also showed that the FOCUS© had high inter-rater reliability. Thus, two SLPs could reliably administer the FOCUS© for the same child with speech-language impairments. The developers of the TOMs also found that SLPs had high (>.80) inter-rater reliability for different test domains (Enderby & John, 1997). In addition, the high inter-rater reliability of the FOCUS© was consistent with values found for impairment-based measures (e.g., CELF-P and PLS-4). The difference between reliability scores obtained in the previous study of FOCUS© reliability (Thomas-Stonell et al., 2010) and the results from this study could be attributed to the reliability procedures not being completed for children receiving speech-language intervention, thus addressing a possible confound in the initial study.

Measures that are valid, reliable, and reflective of the most current theoretical framework are needed within the rehabilitation sciences to quantify functional changes in skills (Jette & Haley, 2005; Wade & de Jong, 2000; Yorkston et al., 2001). The current findings support the consistency and accuracy in FOCUS© ratings when administered by SLPs. This new evidence for test-retest and inter-rater reliability expands on the already established evidence for parental administration and evidence of construct validity for this measure.

Limitations and future directions

Larger samples are typically used in describing the reliability of outcome measures. The sample used in this study was relatively small and there may have been a selection bias due to the convenience sample included. Thus, these findings should be interpreted with caution. Further, the sample of children may not be representative of all children with speech and/or language impairment as a large proportion was diagnosed with additional medical diagnoses. That said, the FOCUS© was developed using young children with medical diagnoses as well as those with a variety of speech-language characteristics. Consequently, the sample of children included in this study is reflective of those with whom the FOCUS© can be used. While there is evidence supporting the reliability of the FOCUS© additional research should be undertaken with a larger sample comprising a broader range of children with speech-language impairments.

Clinical implications

To further the evidence-based delivery of speech-language pathology services, clinical measures that have good psychometric properties such as reliability and validity are needed. The Focus© is a new measure available for use by SLPs (www.focusoutcomemeasurment.ca). This measure is specific to evaluating communicative participation in young children. To date, there have been a limited number of measures available to evaluate this area of functioning. The support provided for the FOCUS© by this study is timely because it shows the reliability of a new measures designed to evaluate real-world functioning for young children with speech-language impairments.

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References

Eadie, T., Yorkston, K., Klasner, E., Dudgeon, B., Deitz, J., Baylor, C., Miller, R., & Amtmann, D. (2006). Measuring communicative participation: A review of self-report instruments in speech-language pathology. *American Journal of Speech-Language Pathology*, *15*, 307–320.

Enderby, P., & John, A. (1997). *Therapy outcome measures: Speech-language pathology technical manual*. London, UK: Singular Press.

Hidecker, M., Paneth, N., Rosenbaum, P., Kent, R., Lillie, J., Eulenberg J.,...Taylor, K. (2011). Developing and validating the communication function classification system (CFCS) for Individuals with cerebral palsy. *Developmental Medicine and Child Neurology*, *53*(8), 704–710.

Hinkle, D., Wiersma, W., & Jurs, S. (2003). *Applied statistics for the behavioral sciences*. (5th ed.). Independence, KY: Wadsworth Publishing.

Jette, A., & Haley, S. (2005). Contemporary measurement techniques for rehabilitation outcomes assessment. *Journal of Rehabilitation Medicine*, *37*, 339–345.

John, A., & Enderby, P. (2000). Reliability of speech and language therapists using therapy outcome measures. *International Journal of Language and Communication Disorders*; *35*(2), 287–302.

Law, J., Boyle, J., Harris, F., Harkness, A., & Nye, C. (2000). Prevalence and natural history of primary speech and language delay: Findings from a systematic review of the literature. *International Journal of Language and Communication Disorders*, *35*(2), 165–188.

McCabe, P. (2005). Social and behavioral correlates of preschoolers with specific language impairment. *Psychology in Schools*, *42*(4), 373–387.

McLeod, S., & Harrison, L. (2009). Epidemiology of speech and language impairment in a nationally representative sample of 4- to 5-year-old children. *Journal of Speech, Language, and Hearing Research*, *52*, 1213–1229.

McLeod, S., & Threats, T. (2008). The ICF-CY and children with communication disabilities. *International*

Journal of Speech-Language Pathology, *10*(1), 92–109.
National Outcomes Measurement System. (2000). *Pre-kindergarten speech-language pathology users guide*. Rockville, MD: American Speech-Language-Hearing Association.
PASW Statistics. (2009). *Statistical program for the social sciences* (Version 18.0.0). Chicago, IL: SPSS Inc.
Perry, A., Morris, M., Unsworth, C., Duckett, S., Skeat, J., Dodd, K., Taylor, N., & Riley, K. (2004). Therapy outcome measures for allied health practitioners in Australia: The AusTOMs. *International Journal of Quality Health Care*, *16*(4), 285–91.
Portney, L., & Watkins, M. (2009). *Foundations of clinical research: Applications to practice* (3rd ed.). Upper Saddle River, NJ: Prentice Hall.
Roulstone, S., John, A., Hughes, A., & Enderby, P. (2004). Assessing the construct validity of the therapy outcome measure for preschool children with delayed speech and language. *International Journal of Speech-Language Pathology*, *6*(4), 230–36.
Speech Pathology Australia. (2011). *Competency-based occupational standards for speech pathologists – Entry level*. Retrieved from http://www.speechpathologyaustralia.org.au/all-latest-news/1037-cbos-2011
Streiner, D., & Norman, G. (2008). *Health measurement scales: A practical guide to their development and use* (4th ed.). Oxford, UK: Oxford University Press.
Thomas-Stonell, N., Oddson, B., Robertson, B., & Rosenbaum, P. (2009). Predicted and observed outcomes in preschool children following speech and language treatment: Parent and clinician perspectives. *Journal of Communication Disorders*, *42*, 29–42.
Thomas-Stonell, N., Oddson, B., Robertson, B., & Rosenbaum, P. (2010). Development of the FOCUS© (Focus on the Outcomes of Communication Under Six). *Developmental Medicine and Child Neurology*, *52*, 47–53.
Threats, T. (2003). The conceptual framework of ASHA's new scope of practice for speech-language pathology. *Journal of Medical Speech-Language Pathology*, *10*(3), xvii–xxiv.
Unsworth, C., Duckett, S., Duncombe, D., Perry, A., Skeat, J., & Taylor, N. (2004). Validity of the AusTOM scales: A comparison of the AusTOMs and EuroQOL-5D. *Health and Quality of Life Outcomes*, *2*, 64–75.
Varni, J. (1998). *The PedsQL measurement model for the pediatric quality of life inventory*. Retrieved from http://www.pedsql.org/about_pedsql.html
Wade, D., & De Jong, A. (2000). Recent advances in rehabilitation. *British Medical Journal*, *320*, 1385–1388.
Washington, K. (2007). Using the ICF within speech-language pathology: Application to developmental language impairment. *International Journal of Speech-Language Pathology*, *9*(3), 242–255.
Washington, K. (2010). Focus on practical application of the International Classification of Functioning, Disability and Health (ICF): Using the ICF-CY in pediatric speech-language pathology in day-to-day clinical practice. *Communiqué*, *24*(2), 4, 8.
Washington, K. (2012). The association between expressive grammar intervention and social and emergent literacy outcomes. *American Journal of Speech-Language Pathology*. doi: 10.1044/1058-0360(2012/11-0026
Washington, K., Thomas-Stonell, N., McLeod, S., & Warr-Leeper, G. (2012). Parents' perspectives on the professional–child relationship and children's functional communication following speech-language intervention. *Canadian Journal of Speech-Language Pathology and Audiology*, *36*(3), 220-233.
Westby, C. (2007). Application of the ICF in children with language impairments. *Seminars in Speech-Language Pathology*, *28*(4), 265–272.
Wiig, E., Secord, W., Semel, E. (2004). *Clinical evaluation of language fundamentals – Second edition*. San Antonio, TX: The Psychological Corporation.
World Health Organization (1980). *ICIDH: International classification of impairments, disabilities, and handicaps*. Geneva: Author.
World Health Organization (2001). *International classification of functioning, disability and health (ICF)*. Geneva: Author.
World Health Organization. (2007). *International classification of functioning, disability and health – Version for children and youth: ICF-CY*. Geneva: Author.
Yorkston, K., Klasner, E., & Swanson, K. (2001). Communication in context: A qualitative study of the experiences of individuals with multiple sclerosis. *American Journal of Speech-Language Pathology*, *10*, 126–137.
Zimmerman, I., Steiner, V., & Pond, R. (2002). *Preschool language scale – Fourth edition*. San Antonio, TX: The Psychological Corporation.

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Appendix. Focus on the Outcomes of Communication Under Six (FOCUS©) Items

Administration Instructions: The FOCUS© is an outcome measure that takes a 'snapshot' of your client's skills as they are today. Some items may bot apply to your clients right now. If so, please select "Not at all like my client". Your client may begin to learn some of these skills during therapy and choosing this option will let us measure all of the changes that your client is making. Please be sure to answer every question. Thank you.

The FOCUS definitions, "When reading FOUCS items, the words 'talking', 'tell', 'speech' and 'words' refer to verbal speech. FOCUS items that refer to 'communicating', 'conversation', 'participates' and 'asking' apply to any form of communication (pecs, AAC, sign)".

Part 1	FOCUS© Item
1.	My child makes friends easily.
2.	My child is included in play activities by other children.
3.	My child is comfortable when communicating.
4.	My child is confident communicating with adults who know my child well.
5.	My child takes turns.
6.	My child talks while playing.
7.	My child is willing to talk to others.
8.	My child is confident communicating with adults who do not know my child well.
9.	My child can communicate independently.
10.	My child talks a lot.
11.	My child can string words together.
12.	My child gets along with other children.
13.	My child can communicate independently with other children.
14.	My child's speech is clear.
15.	My child understood the first time when s/he is talking with other children.
16.	My child speaks slowly when not understood.
17.	My child speaks in complete sentences.
18.	My child uses communication to solve problems.
19.	My child waits for her/his turn to talk.
20.	My child conveys his/her ideas with words.
21.	My child uses correct grammar when speaking.
22.	My child uses new words.
23.	My child uses words to ask for things.
24.	My child's communication skills get in the way of learning.
25.	My child's communication skills limit her/his independence.
26.	My child is understood the first time when talking with adults who do not know my child well.
27.	My child can tell adults who do not know my child well about past events.
28.	My child uses language to communicate new ideas.
29.	My child needs help to be understood by other children.
30.	My child becomes frustrated when trying to communicate with other children.
31.	My child can communicate independently with adults who do not know my child well.
32.	My child is reluctant to talk.
33.	My child can talk to other children about what s/he is doing.
34.	My child has difficulties changing activities.

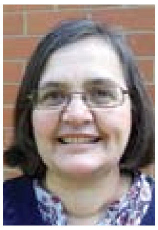
Part 2	FOCUS© Item
1.	My child plays well with other children.
2.	My child will sit and listen to stories.
3.	My child can communicate effectively with adults who know my child well.
4.	My child is included in games by other children.
5.	My child will try to carry on a conversation with adults who do not know my child well.
6.	My child will ask for things from adults s/he knows well.
7.	My child participates in group activities.
8.	My child can tell stories that make sense.
9.	My child can respond to questions.
10.	My child will ask for things from other children.
11.	My child can carry on a conversation with other children.
12.	My child can communicate effectively with other children.
13.	My child can communicate effectively with adults who do not know my child well.
14.	My child can be understood by other children.
15.	My child can talk about what s/he is doing with adults who do not know my child well.
16.	My child joins in conversations with her/his peers.

Assessment of complex sentences in children with language impairment: Six key suggestions from the literature

Gillian Steel, Miranda Rose and Patricia Eadie

KEYWORDS
ASSESSMENT
CHILD LANGUAGE
COMPLEX SENTENCES
LANGUAGE IMPAIRMENT
SYNTAX

THIS ARTICLE HAS BEEN PEER-REVIEWED



Gillian Steel (top), Miranda Rose (centre) and Patricia Eadie

Complex sentences express the interaction of two or more propositions and are formed by embedding a subordinate clause within a main sentence. Knowledge about complex sentences is important for speech-language pathologists assessing children with language impairment as these linguistic structures are important for oral language and literacy development. A review of the literature suggests that a range of issues must be considered when assessing these more sophisticated language forms. This paper provides speech-language pathologists with six key suggestions to consider when assessing complex sentences in children with language impairment.

The consequences of childhood language impairment (LI) are far-reaching. There is evidence that children with a history of LI have poorer outcomes as adolescents and young adults in terms of academic attainment and employment (Clegg, Hollis, Mawhood, & Rutter, 2005) and social relationships (Durkin & Conti-Ramsden, 2007). Furthermore, children who experience both oral language problems and literacy problems are at greater risk for developing behavioural disorders (Tomblin, Zhang, Buckwalter, & Catts, 2000).

The emergence, and subsequent mastery, of complex sentences are noteworthy milestones in children's language development. Complex sentences allow relationships between ideas and thoughts to be described that cannot adequately be expressed through simple sentences (Scott, 1988a). Complex sentences provide children's language with the flexibility and sophistication that is absent when only simple sentences are available. Efficiency is achieved by combining a number of ideas into one sentence rather than juxtaposing a series of simple sentences (Bloom, Lahey, Hood, Lifter, & Fiess, 1980). As complex sentences are commonly used for interaction in a range of social and vocational activities and for literacy development, appropriate assessment of and intervention for complex sentences is warranted. This review provides practical suggestions for approaching the assessment of complex sentences.

Overview of complex sentence types

Complex sentences contain a main clause and at least one subordinate clause (Quirk, Greenbaum, Leech, & Svartvik, 1985). They are one example of multi-clause sentences, the other type being coordinated sentences (see Figure 1). Coordinated sentences link two main clauses that are syntactically equal using a small set of coordinating conjunctions such as *and* or *or* (Bloom et al., 1980). Subordinate clauses, which are one of the constituents of complex sentences, are not syntactically equal to the main clause. They are dependent on the main clause and are thus embedded within the main clause (Quirk et al., 1985).

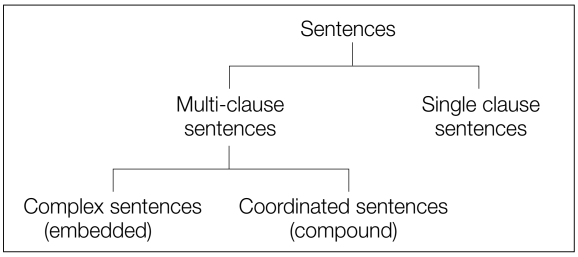


Figure 1. Types of sentences

Subordinate clauses operate within complex sentences in two ways. They can fill one of the sentence elements or they can modify one of the elements of the sentence. The embedded clause may be a nominal clause, also referred to as a complement clause, which can fill the subject (e.g., *That you want a drink is very obvious to me*), object (e.g., *I know that you want a drink*) or complement (e.g., *A drink is what I really want*) slot of the main clause. Alternatively, it may be an adverbial clause which fills the adverbial slot in the main clause (e.g., *I want a drink because it is so hot today*) (Quirk et al., 1985). The subordinate clause may modify the noun, adverb or adjective in the main clause. The noun is often modified through the use of relative clauses (e.g., *The boy, who I saw running, will need a big drink*) (Quirk et al., 1985). For a comprehensive guide to identifying and categorizing complex sentences, the reader is referred to Steffani (2007) with the caution that some terminology differs from that used by other literature sources that have informed this review.

Complex sentence use in children with LI

Children with LI have significant difficulty acquiring language and their difficulties with early grammatical development are well documented (Leonard, 1998). However, there has been less focus on the acquisition of later developing structures, such as complex sentences, among children and adolescents with LI (Blake, Myszczyxzyn, & Jokel, 2004).

While there is evidence that children with LI experience difficulty with complex sentences throughout their school years there is some debate about many aspects of complex sentence production (Blake et al., 2004; Nippold, Mansfield, Billow, & Tomblin, 2008; Scott & Windsor, 2000). It is not clear whether children with LI show slower development or deviant production. Difficulties they experience include the omission of relative clause markers (Novogrodsky & Friedmann, 2006), the decreased production of complex sentences (Liles, Duffy, Merritt, & Purcell, 1995; Marinellie, 2004; Nippold et al., 2008), increased errors in complex sentences (Blake et al., 2004; Marinellie, 2004; Scott & Windsor, 2000) and decreased use of cognitive state verbs (Owen van Horne & Lin, 2011). Understanding the patterns of strengths and weaknesses in children's production of complex sentences is necessary for meaningful and comprehensive assessment of language skills and planning intervention goals.

Key suggestions

As the research into the use of complex sentences in children with LI is relatively limited, the main themes from 22 studies relating to complex sentences in both children with and without LI have been identified and are presented here as six key suggestions for assessment practice. The bulk of the literature in this area focuses on school-aged children at the primary level and adolescents at secondary level. Therefore, these suggestions are most relevant for speech pathologists working with these populations. The suggestions relate to the context in which complex sentences are assessed, the content of the assessment and the tasks used in the assessment of complex sentence use.

1 Assess the use of complex sentences in reading and writing activities

Given the close link between oral language and literacy development (Bishop & Snowling, 2004), it is important to consider the effect of children's complex sentence use on the related areas of writing and reading comprehension. Upper primary school and secondary school students tend to produce more complex language in the written condition compared to the spoken condition (Scott & Windsor, 2000). As children advance through primary school they need to be able to comprehend the more complicated types of written complex sentences, such as centre-embedded relative clauses (e.g., *The horse* <u>*that the reluctant child is going to ride*</u> *has a very gentle nature*) (Kuder, 2008) and multiple embeddings (e.g., *Those fleeing* <u>*thought that the enemy would have forgotten*</u> <u>*that the bridge had to be crossed*</u> <u>*when the tide was at low ebb*</u>) (Scott, 2009).

The written texts utilised in educational settings are often more complex than oral narratives in a range of ways, including the number of clauses contained in each sentence and the extent to which the noun phrases and verb phrases are elaborated (Scott, 2009). The written material read by children in the upper primary school years is more complex than the language they produce and it is through exposure to complex syntax in written material that children further extend and develop their oral skills (Westby, 1998).

2 Gather information about a range of complex sentences in different genres

It is important to assess the production of all types of complex sentences, including complement clauses, adverbial clauses and relative clauses. In addition, it is necessary to sample different discourse genres as the use of complex sentences is closely related to language task.

During the school years children learn to use different types of complex sentences for different genres (Scott, 1988b). The development of narratives (fictional stories), both oral and written, is a major focus of these years. The use of conjunctions, elaborated noun phrases and mental and linguistic verbs, all of which are components of complex sentences, contribute to the production of a more literate style (Westby, 1998). At school, children increase their use of finite subordinate clauses (e.g., *The children pretended* <u>*that pirates lived on the lake*</u>) (Berman, 2004) and the use of relative clauses to elaborate noun phrases (e.g., *We were scared of the noise* <u>*that the old door made*</u>) (Eisenberg et al., 2008).

Complex sentences are also important for the production of expository discourse (provision and explanation of information, usually factual), which is frequently utilised in the upper primary and secondary school years. Expository tasks elicit more complex speech than conversational tasks (Nippold, Hesketh, Duthie, & Mansfield, 2005), evidenced by a greater use of adverbial, relative and complement clauses. Thus, children harness a level and range of complex language forms requisite for a particular task. Further, Verhoeven et al. (2002) found that genre dictates the use of certain types of complex sentences. Coordination was used frequently in narratives but subordination was the preferred method of linking clauses in expository discourse.

While there is limited data available about the performance of children with LI on all types of complex sentences in all genres, there is evidence that these children are making less use of complex sentences than both their age equivalent peers (Nippold et al., 2008) and younger children (Marinellie, 2004; Scott & Windsor, 2000). More specifically, children with LI use fewer adverbial, relative and coordinating clauses in conversation (Marinellie, 2004) and fewer subordinate clauses in storytelling tasks (Liles et al., 1995). Assessment tasks must be utilised that provide opportunities to sample all these types of structures.

3 Collect additional measures to frequency counts

Measures of frequency of complex sentence use may not be sensitive enough on their own to identify differences between children with LI and children with typically language development (TLD). Eisenberg (2003) reported that both children with LI (aged 5 years) and TLD (aged between 3 and 5 years) produced infinitives with the same frequency in conversation. However, the children with TLD produced infinitives with a wider variety of verbs than the children with LI. In a follow-up elicitation study, the children with LI used fewer different verbs within constructions and produced fewer infinitives with ditransitive verbs (which take three arguments such as <u>*I*</u> *told* <u>*the teacher*</u> <u>*that I would be late*</u>) than the younger children with TLD (Eisenberg, 2004). Superficial measures of language complexity, such as presence or absence of a particular sentence type, are therefore insufficient on their own for either diagnosing language difficulties or planning appropriate intervention.

4 Gather information about children's knowledge of cognitive state verbs

Information about a child's use of cognitive state verbs is critical as these verbs are frequently used to encode the more complex concepts expressed in complex sentences. Cognitive state verbs describe communication (e.g., *tell*, *ask*), desire (e.g., *want*, *hope*) and mental states (e.g., *remember*, *think*). These verbs are important for the formation of complement clauses, a device often used in storytelling to describe psychological causality (e.g., *The children wanted to get away so they decided to swim to the island*) (Bishop & Donlan, 2005). Bishop and Donlan (2005) reported that children with LI (aged between 7 and 9 years) used fewer cognitive verbs than aged-matched children and produced few examples of complementation in a range of storytelling tasks. Reasons for this are unclear but two possibilities present themselves. Children may not have the verbs in their vocabulary to formulate complements (Owen van Horne & Lin, 2011). Alternatively, they may not have mastered the syntactical skill of forming complements and therefore could not utilise mental state verbs in this manner. It is thus important to determine if children have access to the lexical items needed for the production of this type of complex sentence.

5 Consider the method of language sample elicitation

If language samples are used to assess children's use of complex sentences, it is important to choose tasks that sufficiently challenge the language system so that any problems are observed. Conversational tasks are less useful than oral narratives in revealing the difficulties that primary school-aged children with LI experience with complex sentences. For example, Marinellie (2004) reported that complex sentences produced by children with LI in conversations were correctly structured. In contrast, studies involving narratives (Liles et al., 1995; Scott & Windsor, 2000) demonstrated that one of the most powerful factors that differentiated the children with LI from the children with TLD was the proportion of ungrammatical T-units, which consist of a main clause and any dependent clauses embedded in the main sentence (Hunt, 1970). It may be that children with LI reduce the complexity of their language as a simplification strategy, only producing in conversation those structures with which they are confident. The narrative condition may force the children to attempt less familiar structures in order to fulfil the demands of the task, resulting in the production of more errors.

6 Use specifically designed elicitation tasks

Tasks that are specifically designed to elicit complex sentences should also be part of an assessment battery. Complex constructions occur less frequently than simple structures in spontaneous language and thus there are fewer opportunities to observe these linguistic forms (Crain & Thornton, 1991). Various factors such as the person interacting with the child, the setting and materials can affect the type and complexity of language elicited in language samples and this is problematic when making judgements about what children do and do not know about language (Eisenberg, 1997). Failure to use a particular structure in a language sample does not necessarily mean lack of competence (Crain & Thornton, 1991; Eisenberg, 1997). It may merely reflect absence of opportunity. Additionally, a few examples of a particular structure do not necessarily equate to competence (Eisenberg, 2005). For example, mastery of complement clauses involves use of this structure with a range of verbs and this skill develops gradually over time. Productions with a few early developing verbs such as *want* and *need* do not necessarily mean a child can use this complex form with later developing verbs such as *remember* and *decide*.

Elicitation procedures increase opportunities for production of a particular structure. For example, in one procedure designed to elicit complement clauses, short scenarios are acted out with miniature toys and then children are given a trigger phrase that prompts completion of the sentence (Eisenberg, 2005). The sentences are constructed so that the production of a complement clause is the only correct response (e.g., "*Mickey is swimming in the pool. Mickey says to Bugs 'C'mon Bugs! You should swim! Mickey wants ..... You finish the story. Mickey...?"* ***Mickey wants Bugs to swim***.) (Eisenberg, 2005). A variety of different sentence structures and verbs can be incorporated into the design of the task.

In elicited tasks, children demonstrate competence at an earlier age with certain linguistic structures such as infinitival complements and passives than had previously been thought (see Crain & Thornton, 1991; Eisenberg, 1997). Steel, Rose, Eadie, and Thornton (in press) demonstrated that children with TLD produced significantly more complement clauses and significantly more different verbs in elicitation tasks than in language samples.

Thus, for children with LI, elicitation tasks may reveal problems that are not evident in spontaneous language because certain structures may not be used spontaneously. For example, Novogrodsky and Friedmann (2006), in an elicitation task, found that children and adolescents with LI (aged 9 to 14 years) had trouble formulating relative clauses in which the elaborated noun was the object of the embedded clause (e.g., *The zebra, that the monkey tickled, chased the rabbit*). These children had difficulty assigning the correct thematic role to the constituents of the sentence. Others investigating relative clauses in spontaneous language samples from preschool and primary school-aged children with LI have not reported such difficulties (e.g., Blake et al., 2004). This suggests that conversational discourse is a genre in which children simply may not produce many object relatives. However, well-constructed elicitation tasks may stress the language system resulting in the errors reported.

Conclusion

This literature review has highlighted a range of issues that should be considered when assessing complex sentence production in children with LI. It is clear that this is not a simple area of language to assess as many factors must be considered and a range of approaches are required. It is important to develop a comprehensive description of complex sentence production in order to plan efficacious intervention for language impairment in school-aged children and adolescents to minimise potential negative long-term effects of LI.

Acknowledgements

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References

Berman, R. (2004). Between emergence and mastery: The long developmental route of language acquisition. In R. Berman (Ed.), *Language development across childhood* *and adolescence*. Amsterdam: John Benjamins Publishing Company.

Bishop, D., & Donlan, C. (2005). The role of syntax in encoding and recall of pictorial narrative: Evidence for specific language impairment. *British Journal of Developmental Psychology*, *23*, 25–48.

Bishop, D., & Snowling, M. (2004). Developmental dyslexia and specific language impairment: Same or different. *Psychological Bulletin*, *130*(6), 858–886.

Blake, J., Myszczyxzyn, D., & Jokel, A. (2004). Spontaneous measures of morphosyntax in children with specific language impairment. *Applied Psycholinguistics*, *25*, 29–41.

Bloom, L., Lahey, M., Hood, L., Lifter, K., & Fiess, K. (1980). Complex sentences: Acquisition of syntactic connectives and the semantic relations they encode. *Journal of Child Language*, *7*, 235–261.

Clegg, J., Hollis, C., Mawhood, L., & Rutter, M. (2005). Developmental language disorders – a follow-up in later adult life: Cognitive, language and psychosocial outcomes. *Journal of Child Psychology and Psychiatry*, *46*, 128–149.

Crain, S., & Thornton, R. (1991). Recharting the course of language acquistion: Studies in elicited production. In N. A. Krasnegor, D. M. Rumbaugh, R. L. Schiefelbusch & M. Studdert-Kennedy (Eds.), *Biological and behavioral determinants of language development* (pp. 321–338). Hillsdale, NJ: Lawrence Erlbaum Associates.

Durkin, K., & Conti-Ramsden, G. (2007). Language, social, behaviour, and the quality of friendships in adolescents with and without a history of specific language impairment. *Child Development*, *78*(5), 1441–1457.

Eisenberg, S. (1997). Investigating children's language: A comparison of conversational sampling and elicited production. *Journal of Psycholinguistic Research*, *26*(5), 519–538.

Eisenberg, S. (2003). Production of infinitival object complements in the conversational speech of 5-year-old children with language-impairment. *First Language*, *23*, 327–341.

Eisenberg, S. (2004). Production of infinitives by 5-year-old children with language-impairment on an elicitation task. *First Language*, *24*, 305–321.

Eisenberg, S. (2005). When conversation is not enough: Assessing infinitival complements through elicitation. *American Journal of Speech-Language Pathology*, *14*, 92–106.

Eisenberg, S., Ukrainetz, T. A., Hsu, J. R., Kaderavek, J. N., Justice, L. M., & Gillam, R. B. (2008). Noun phrase elaboration in children's spoken stories. *Language, Speech, and Hearing Services in Schools*, *39*, 145–157.

Owen van Horne, A. O. V., & Lin, S. (2011). Cognitive state verbs and complement clauses in children with SLI and their typically developing peers. *Clinical Linguistics and Phonetics*, *25*(10), 881–898.

Hunt, K. (1970). Syntactic maturity in schoolchildren and adults. *Monograph of the Society for Research in Child Development 35*(1, Serial No. 134), 1–67.

Kuder, S. (2008). *Teaching students with language and communication disabilities*. Boston: Pearson.

Leonard, L. (1998). *Children with specific language impairment*. Cambridge, MA: The MIT Press.

Liles, B. Z., Duffy, R. J., Merritt, D. D., & Purcell, S. L. (1995). Measurement of narrative discourse ability in children with language disorders. *Journal of Speech and Hearing Research*, *38*, 415–425.

Marinellie, S. (2004). Complex syntax used by school-age children with specific language impairment (SLI) in child-adult conversation. *Journal of Communication Disorders*, *37*(6), 517–533.

Nippold, M., Hesketh, L., Duthie, J., & Mansfield, T. (2005). Conversational versus expository discourse: A study of syntactic development in children, adolescents and adults. *Journal of Speech, Language, and Hearing Research*, *48*, 1048–1064.

Nippold, M., Mansfield, T., Billow, J., & Tomblin, J. B. (2008). Expository discourse in adolescents with language impairments: Examining syntactic development. *American Journal of Speech-Language Pathology*, *17*(4), 356–367.

Novogrodsky, R., & Friedmann, N. (2006). The production of relative clauses in syntactic SLI: A window to the nature of the impairment. *Advances in Speech-Language Pathology*, *8*(4), 364–375.

Quirk, R., Greenbaum, S., Leech, G., & Svartvik, J. (1985). *A comprehensive grammar of the English language*. London: Longman.

Scott, C. (1988a). Producing complex sentences. *Topics in Language Disorders*, *8*(2), 44–62.

Scott, C. (1988b). Spoken and written discourse. In M. Nippold (Ed.), *Later language development: Ages nine through to nineteen* (pp. 49–95). Boston: College-Hill Press.

Scott, C. (2009). A case for the sentence in reading comprehension. *Language, Speech, and Hearing Services in Schools*, *40*(2), 184–192.

Scott, C., & Windsor, J. (2000). General language performance measures in spoken and written narrative and expository discourse of school-age children with language learning disabilities. *Journal of Speech Language and Hearing Research*, *43*, 324–339.

Steel, G., Rose, M., Eadie, P., & Thornton, R. (in press). *Assessment of complement clauses: A comparison between elicitation tasks and language sample data*. *International Journal of Speech-Language Pathology*.

Steffani, S. A. (2007). Identifying embedded and conjoined complex sentences: Making it simple. *Contemporary Issues in Communication Sciences and Disorders*, *34*, 44–54.

Tomblin, B. J., Zhang, X., Buckwalter, P., & Catts, H. W. (2000). The association of reading disability, behaviour disorders and language impairment among second grade children. *Journal of Psychology and Psychiatry*, *41*, 473–482.

Verhoeven, L., Aparici, M., Cahana-Amitay, D., van Hell, J., Kriz, S., & Viguie-Simon, A. (2002). Clause packaging in writing and speech: A cross-linguistic developmental analysis. *Written Language and Literacy*, *5*(2), 135–162.

Westby, C. (1998). Communication refinement in school age and adolescence. In W. Hayes & B. Shulman (Eds.), *Communication development: Foundations, processes, and clinical applicatons* (pp. 311–360). Baltimore, MD: Williams and Wilkins.

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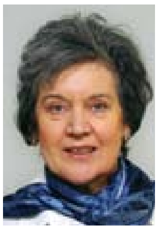
Webwords 45

Apps for speech-language pathology intervention

Caroline Bowen



Caroline Bowen

Personal computers (PCs) are devices that have at least one processing element – typically a central processing unit (CPU) and some form of memory. They are programmable to perform a predetermined set of mathematical or logical operations of input, processing, output and storage. The results of these operations can be saved, stored and retrieved by users. PCs come in many forms including the desktop, the laptop or notebook, its smaller relation the netbook or lunchbox PC, mobile devices, wearable computers the size of a wrist watch or even smaller, personal digital assistants (PDAs), tablet PCs such as iPads and Androids, and tablet e-book readers like e-Reader and Kindle. As with so many other professions, all of these devices and their input, output and storage peripherals have found a place among our work tools.

Of the mobile devices (iOS, iPOd, iPad, Android and Blackberry), tablet computers and their application software (applications or apps) in particular have caught on. An app, such as iTunes, Microsoft Office or the calculator on a computer, is computer software designed so that the user can perform specific tasks. An app can run on the Internet, on the user's computer, or on a phone or other electronic device.

Lists

The word "app" is on (nearly) everyone's lips and many authors have attempted the impossible task of creating the definitive list of the best ones for speech-language pathologists to use in assessment and intervention, and lists of "top apps" in general. But as Holland, Weinberg and Dittelman (2012, p. 223) found, "Recommending apps today meant modifying the list soon thereafter. This is because there are so many of them, and the number is only growing." Such lists include Sean Sweeney's continually updated collaborative SLP Apps List, Bradd Spirrison's 20 Best iOS and Android Apps of 2012 (so far) on TechCrunch, Aubrey Taylor Klingensmith's What is the Best AAC App out there? on speechie apps, Katherine Kelley's Best List of Speech Language Apps on peachy speech, and Judith Kuster's (2012) "In search of the perfect Speech-Language App?" in her Internet column.

Blogs, boards, professional publications and social media

Blogs and message boards

In November 2012, Webwords 44: Life online touched on blogs, message boards and social media pages developed by colleagues as resource sites. These included a speech therapy app review blog by Mirla Raz and Pat Mervine's collection of app recommendations on the Speaking of Speech message board. Others are Speech-Language Apps by Dina Derrick, Speech Language Pathology Sharing by Eric Sailers, Apps for Older Students to Enhance Language and Learning Skills by Marg Griffin, and The Speech Guy by Jeremy Legaspi. Therapy App 411 edited by Renata Joy, Jeremy Legaspi, Sean Sweeney and Deborah Tomarakos is a collaborative blog with contributions by SLPs, OTs, other therapists and special educators.

Professional publications

Increasingly, the *ASHA Leader* features articles about apps. For example, Apps: An Emerging Tool for SLPs (Gosnell, Costello & Shane, 2011), Apps to Aid Aphasia (Sutton, 2012a), Apps for Brain Injury Rehab (Sutton, 2012b), App-Enabled Telepractice (Curtis & Sweeney, 2012), and Apps That Crack Curriculum Content (Sweeney, 2012). Todd Wingard's excellent overview Apps for Speech-Language Pathology Practice on the ASHA website sets out twelve advantages and two disadvantages of using mobile devices and apps in education settings and an assortment of useful links to other articles. The disadvantages he nominates are the initial setting up costs and the need to have a WiFi or 3G network available because mobile devices cannot be "plugged in" to the Internet.

Social media

Since June 2012 the Speech Pathology Australia's social media activity has incorporated a Facebook group called APPropriate Apps. It provides both a forum and a learning opportunity where SPA members can discuss and share information and advice about apps, mobile devices and related technology. Fun-loving Sharon Crane who expertly moderates the group and active contributors to the site regularly come up with quirky offerings such as the Sesame Street song "There's an App for That", time- and effort-saving resources like Sound Literacy (no more phonics tiles or weighty magnetic letters!), and excellent finds like 10 Alternative Communication Apps for iPad.

Evaluating and rating apps

Every now and then there is a reminder to SLPs in the informative sources described above that speech-language pathology is a scientific, evidence based discipline (Dollaghan, 2004) and that very few apps are associated with peer-reviewed evidence that has been published in the juried literature. Recognising this, ASHA addresses the question of what to ask when evaluating any treatment procedure, product or program in an article that concludes with a helpful list of eight additional questions specifically related to mobile devices and apps.

In a related piece, Wakefield and Schaber (2012) suggest a method of using evidence to choose a treatment app. The authors elaborate a 5-step process: 1) Frame your clinical question using PICO (population, intervention, comparison, and outcome); 2) find the evidence; 3) assess the evidence; 4) search the app store and consult the evidence; 5) Make a clinical decision and integrate the different types of evidence to determine your choices.

Deborah Tomarakos of Speech Gadget presents her App review checklist cum star rating system for reviewing speech/language/educational apps in her ASHAsphere article "Rate that App". She rates under four headings: *1) General information and operation* for a possible six clearly specified points, *2) Features* also for up to six, *3) App design* for up to four, and *4) (suitability for) Speech/language use* for up to 4. Potentially, an app can achieve 20 points. The points are used to award a star rating to the app: 17–20 points attract a 5-star rating, 13–16 points is four stars, 9–12 points is three stars, 5–8 points is two stars, and 0–4 points is one star. Webwords has two suggestions. First to modify the scale so that 1–4 points would attract one star, and zero points would be starless, and second to add a further heading, *Evidence and theory*.

EBP, ethics and apps

SPA's (2010a, p. 3) Position Statement on Evidence-Based Practice in Speech Pathology states that:

> *It is the position of Speech Pathology Australia (The Association) that speech pathology is a scientific and evidence-based profession and speech pathologists have a responsibility to incorporate best available evidence from research and other sources into clinical practice. Speech Pathology Australia has a strong commitment to promoting and supporting evidence-based practice. The development of a coordinated, national evidence-based practice strategy is a key strategic goal of the Association.*

Under the heading of "Fairness (Justice)" in the SPA (2010b) Code of Ethics it says, "We provide accurate information. We strive to provide clients with access to services consistent with their need."

The proliferation of apps and the enthusiastic and sometimes undiscriminating use of them by both speech-language pathologists and consumers raises ethical issues, and as Leitão et al. (2012) point out, when ethical issues arise we need to be proactive in our (evidence based) professional lives. But how do we accurately and constructively inform consumers about the apps that they introduce to us and that we introduce to them?

The answer may lie in an article by Clark (2003) who discussed the strategy an SLP can adopt when selecting an intervention. She suggested that the clinician can start with the question "*Does* this therapy work; is it evidence-based?" and seek answers via a literature search. If the literature search fails to reveal evidence for the therapy, the clinician can ask a different question: "*Should* this therapy work; is it theoretically sound?" and seek an understanding of how the non-evidence based intervention is *supposed* to work, developing an account of the mechanism underpinning the intervention. After all, we do not knowingly embark on an intervention path unless we believe that it is going to work in the client's favour.

Applying Clark's strategy to apps, we could change the first question to: "Does this app work; is it evidence based?" and if the answer is "no", rephrase the second question as "Should this app work; is it theoretically sound?" and develop an easily understood rationale, and no hard sell, for including the app in the client's intervention regimen.

Consumers of our services, or their carers, should know that in simple terms there are four overlapping types of speech-language pathology app: those that are purpose designed to treat communication or swallowing disorders, repurposed apps that were not originally intended for SLP intervention, apps whose aim is to provide an incentive or motivation in the process of SLP intervention, and apps designed to track intervention data. When any app-based activities are introduced they need to know *why*, and they need to know what *outcomes* the clinician hopes to achieve for the client, and the clinician needs a transparent means of measuring and demonstrating the outcomes. It is a simple idea; it fits with the way we do business; and it is a good place to start.

The Code of Ethics and the Position Statement on EBP were researched and written before the release of the first iPad three years ago in April 2010. The EBP Position Statement is due for review in a little over three years time in August 2016. Webwords shied away from making a list of top apps for the profession, and is even more wary of predicting the sort of development we might see in mobile devices and apps in the next three or so years. A Google search for "what is the future of apps" will give the reader an inkling of the massive technological changes that may be in store.

References

Clark, H. M. (2003). Neuromuscular treatments for speech and swallowing: A tutorial. *American Journal of Speech-Language Pathology*, *12*, 400–415.

Curtis, N. & Sweeney, S. (2012, 9 October). APP-titude: App-enabled telepractice. *The ASHA Leader*.

Dollaghan, C. (2004, 13 April). Evidence-based practice: Myths and realities. *The ASHA Leader*.

Gosnell, J. (2011, 11 October). Apps: An emerging tool for SLPs: A plethora of apps can be used to develop expressive, receptive, and other language skills. *The ASHA Leader*.

Gosnell, J., Costello. J., & Shane, H. (2011). Using a clinical approach to answer, "What communication apps should we use?" *Augmentative and Alternative Communication*, *20*, 87–96.

Holland, A. L., Weinberg, P., & Dittelman, J. (2012). How to use apps clinically in the treatment of aphasia. *Seminars in Spreech and Language*, *33*(3), 223–233.

Kuster, J. M. (2012, April 3). Internet: In search of the perfect speech-language app? *The ASHA Leader*.

Leitão, S., Bradd, T., McAllister, L., Russell, A., Kenny, B., Scarinci, N. … Wilson, C. (2012). Emerging ethical and professional issues. *Journal of Clinical Practice in Speech Language Pathology*, *14*(1), 33–36.

Speech Pathology Australia. (2010a). *Code of ethics*. Melbourne: Author.

Speech Pathology Australia. (2010b). *Position statement: Evidence based practice in speech pathology*. Melbourne: Author.

Sutton, M. (2012a, 5 June). App-titude: Apps to Aid Aphasia. *The ASHA Leader*.

Sutton, M. (2012b, 3 July). APP-titude: Apps for brain injury rehab. *The ASHA Leader*.

Sweeney, S. (2012, 28 August). APP-titude: Apps that crack curriculum content. *The ASHA Leader*.

Wakefield, L. & Schaber, T. (2012, 31 July). APP-titude: Use the evidence to choose a treatment app. *The ASHA Leader*.

Links

Like all Webwords columns, this one is available online at www.speech-language-therapy.com. Readers are invited to visit Webwords 45 on the Internet to view the websites featured here, taking advantage of the resources many of them hold.

Top 10 resources

iPad and iPhone apps for voice

Alison Winkworth

Alison Winkworth

This Top 10 is a set of resources selected by Dr Alison Winkworth. Alison specialises in voice in her private practice and lectures at Charles Sturt University in Albury-Wodonga. A member of the Australian Voice Association, she's a keen singer and percussionist, and lives in north-east Victoria. Below is a list of apps that Alison has trialled with clients with voice disorders.

1 Piano keyboard, e.g., Virtuoso Piano, Pianist Pro

Piano keyboard is useful for providing a musical model for testing phonational range and pitch matching.

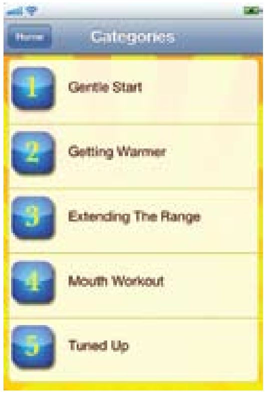
This app enables you to play a keyboard note, or chord, to provide a pitch model for a client. I use this during voice assessment to help the client reach higher or lower notes during evaluation of maximum pitch range. Although there are apps that would measure a client's fundamental frequency, I prefer to use my auditory judgement and pitch matching with a piano keyboard on most occasions. And it's been years since I lugged a full size electronic keyboard around with me now, thanks to apps like these.

2 Sound level meter, e.g., Decibel Meter Pro, Decibel 10th

Sound level meter apps can be used in LSVT for people with Parkinson's disease, as well as with other clients, especially children, to give them a greater awareness of loudness. However, as the reliability of sound level meter apps are yet to be established, these apps should be used with caution.

The sound level meter apps can replace the expensive SPL meter in the clinic, and there are again lots to choose from. A readout on the sound level meter will help teach a client greater awareness of their own and others' vocal loudness. It's also useful for teaching clients that articulatory precision can be more effective than simply raising one's vocal loudness, in getting a message across. When I work with teachers with voice problems, apps like these help in achieving subtle changes in loudness while improving speech clarity.

3 Voice care info and voice warm up exercises



Examples of voice care information and voice warm-up exercises include:

- **Your Voice** (free), information and exercises for preventing voice problems by Dr Edwin Yiu (professor in speech pathology at Hong Kong University), and
- **Warm Me Up** ($7.49), with over 50 vocal exercises that singers love.

4 Voice analyser

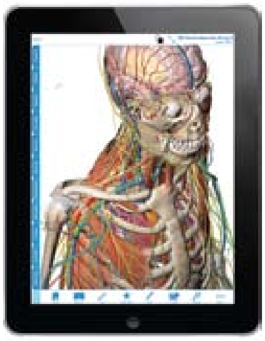
Voice analysers like this app show a real-time spectrogram and spectrum to provide biofeedback to clients. For example, in the voice quality "twang" (a piercing, nasal sound in its purest form, that is highly vocally efficient), we look for high amplitude formants clustered around 3–5kHz. Once the sound is produced, the spectrum screen in this app provides instant feedback to clients.

There are now many acoustic analysis apps, but they're mainly designed for music professionals and sound engineers. It takes some lateral thinking to apply them to voice work, but if you have some basic knowledge of acoustics, apps like these can augment voice work with clients. In fact, there are even apps clinicians can use to learn more about the physics of sound, such as **iPlay Fourier** ($8.49).

5 Tuner, e.g., ClearTune, Pitch2Note or n-Track Tuner

Tuner apps can be used instead of using your own pitch judgement. These apps are mainly designed for musicians, such as guitarists, to help them tune their strings. But if you're not confident using your own pitch-matching abilities, then a tuner app will help in identifying the client's vocal frequency on a sustained vowel.

6 Anatomy teaching, e.g., Visible Body, Gray's Anatomy, 3D Brain, Laryngeal Anatomy, LUMA ENT



Anatomy apps can be used with clients or students, or for checking on a muscle name for your own learning. I also like using **Upper Respiratory Virtual Lab**. Using your fingers to swipe and zoom, you "dive in" virtually, through the nose and past the soft palate to view the vocal folds, clicking on key anatomical structures along the way. With **Draw MD – ENT**, there are pre-set anatomical diagrams that you can then highlight and draw or stamp over, educating clients about the voice and vocal pathology.

7 Acoustic analysis of voice quality, e.g., Voice Test

For a sustained "ah" this app provides measures of perturbation in the voice signal – percent jitter and shimmer – that more or less equate to vocal roughness as a perceptual judgement. No claims are made about its accuracy however, and you need to take into account all the caveats that go with acoustic analysis of voice quality. I haven't yet found a single app that measures harmonic-to-noise ratio either.

8 Other audio programs

Other audio-type programs include those such as delayed auditory feedback (**DAF**), babble noise for masking (**BabelBabble**), and various hearing screening apps (e.g., **Hearing Test**, **Siemens Hearing Test**), plus voice recorder apps such as **iTalk** or **Recorder Pad Pro**.

9 Calm training

The calm training app is not necessarily specific to voice patients, but is useful for clients for stress and anxiety management. I use **MyCalmBeat** and **Free Your Mind**. I also use the binaural beat technology in **Pzizz Energiser** myself to take a quick 15–20 minute nap during the day. Friends have also recommended **Musician's Hypnosis**, as a configurable program to help with things like exam anxiety and stagefright. But there are many hypnosis-type apps for both iPhone and iPad.

10 New apps not yet trialled

And lastly, all the other apps I haven't used much yet, but plan to: including **AudioTools**, for the serious audiophile, **Passaggio** for visual feedback about pitch and loudness, metronome apps such as **iBeat** and **Tap Metronome**, **Voice Changer** (for exploring some wildly different voices), and fun altered-voice playback apps like **Talking Tom Cat** and **Singing Fingers**.

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What's the evidence?

The use of iPods® or iPads® to support communication intervention for children with ASD

Dean Sutherland

Dean Sutherland

A scenario

"You are contacted by parents of a 5-year-old who has autism spectrum disorder (ASD). The parents have recently seen a TV documentary that included footage of several children and young adults with ASD using iPods® and iPads® during communication exchanges with adults. The family have already purchased an iPad® and now want you to provide support to teach their child how to communicate using the device."

A clinical question

Up to half of all children diagnosed with ASD may be candidates for some form of augmentative and alternative communication (AAC) system due to the considerable difficulty they experience developing spoken language (Mirenda & Iacono, 2009). An appropriate clinical question to ask is "Which AAC system will result in positive communication outcomes for this particular the child?" The answer to this question requires careful assessment and consideration of the available evidence. This issue is becoming more challenging as parents or family members are exposed to information that includes bold statements about the therapeutic powers of new mainstream technology such as the iPad®. More specifically, the scenario described above leads to the question: "Are iPads® or iPods® effective in supporting the development of communication skills in children with ASD?"

Searching for the evidence

In order to answer this question, a systematic search was conducted of 4 electronic databases: Education Resources Information Center (ERIC), Medline, ProQuest and PsycINFO. The search terms used were: *autism; ASD; developmental disabilities; communication; augmentative and alternative communication; SGD; speech-generating device; Proloquo2go; iPad; iPod*. The inclusion of both iPods® and iPads® was considered appropriate as the functionality of these devices is identical when used as a speech generating device (SGD). Only English-language publications were considered and no date restrictions were applied during the search. Additional manual searches of identified publications' reference lists were also conducted. Only articles that reported outcomes from research studies involving children or young people with ASD using iPads® or iPods® for communication purposes in an intervention setting were included.

Forty-seven potential articles were identified, of which 9 met the criteria for inclusion. These included 8 individual studies and one systematic review. The systematic review covered the 8 individual studies (Kagohara et al., 2013). The 8 studies identified reported findings involving between 1 (Kagohara et al., 2010) and 5 (Flores et al., 2012) participants aged 4 (van der Meer, Sutherland, O'Reilly, Lancioni, & Sigafoos, 2012) to 23 (van der Meer et al., 2011) years. The studies reported the use of iPods® only (e.g., van der Meer, Didden et al., 2012), iPads® only (Flores et al., 2012) or a combination of iPods® and iPads® (e.g., Kagohara, van der Meer et al., 2012). The studies also involved either the *Pick a Word* (Flores et al., 2012) or *Proloquo2go*™ (all other studies) applications loaded to the iPad® or iPod® in order to provide the visual symbols and voice output functionality.

The evidence

The 8 articles reviewed provided level III-2 evidence (NHMRC, 1998) in support of the use of iPods® or iPads® for children with ASD to support new, or increase existing communication skills. Level III-2 evidence is in the mid-range of the NHMRC's hierarchy for determining the certainty that studies are designed to answer the research questions and reduce the effect of bias. Table 1 contains summary information of the identified articles. The studies identified were limited in scope to naming pictures and requesting preferred items (e.g., toys or snacks). Seven of these articles were based on studies using well-constructed single-case experimental designs (Schlosser, 2003). For example, independent and dependent variables were clearly identified, the studies included clear information on how experimental control within and between participants was achieved, and high levels of inter-observer reliability were reported (Koul & Corwin, 2011).

Critical appraisal of an example of the evidence

Van der Meer, Kagohara, et al. (2012) was selected for critical appraisal as this article reported findings from a study that investigated children's preferences for AAC options (manual signs vs iPod®) and the influence of any preference on increasing vocabulary skills (i.e., requesting "more").

Aim of the study

The aims of the study were to determine:

- children's preference for communication using an iPod® compared to manual signs;
- if the use of a preferred mode of AAC leads to increased production of manual signs or use of an iPod® to request 'more' access to a toy or snack item.

Study methodology

Four children aged 5 to 10 years with diagnosed ASD (n = 2) or developmental disability with ASD-like behaviours (n = 2) participated in the study. The Vineland-II (Sparrow, Cicchetti, & Balla, 2005) was used to determine participants' level of expressive language. Age equivalences of between 8 months and 2 years: 1 month were recorded. Sessions took place in a small room immediately adjacent

Table 1. Articles reporting the use of iPads® or iPods® for supporting communication intervention for children with ASD

Authors/ Year	No. participants (age range)	Intervention focus/ device	Summary of findings
1. Kagohara et al. (2010)	1 (17)	Requesting preferred items: iPod®	Participant learned to select icon to select snack items with support of delayed prompting and differential reinforcement.
2. van der Meer et al. (2011)	3 (13–23)	Requesting preferred items: iPod	One participant with ASD (age 13) and two participants with severe intellectual disability (ID) without ASD. Participant with ASD and one participant with ID learned to use the iPod to request toys and snacks. One participant with ID did not learn to use iPod.
3. Achmadi et al. (2012)	2 (13 & 17)	Requesting preferred items: iPod	Both participants were successfully taught to turn on iPods and to request preferred items.
4. Flores et al. (2012)	5 (8–11)	Requesting preferred items: iPad	Three participants showed increased use of iPads to request items compared to picture-based system.
5. Kagohara, et al. (2012)	2 (13, 17)	Picture naming: iPod or iPad	Both participants learned to use both iPods and iPads to name pictures.
6. van der Meer, Kagohara et al. (2012)*	4 (5–10)	Requesting preferred items: iPod	All participants learned to use iPod to request preferred items. Three participants indicated a preference for the iPod and one participant preferred manual signs.
7. van der Meer, Didden et al. (2012)*	4 (6–13)	Requesting preferred items: iPod	All participants learned to use iPod to request preferred items. Three participants indicated preference for the iPod and one participant preferred a picture exchange system.
8. van der Meer, Sutherland et al. (2012)*	4 (4–11)	Requesting preferred items: iPod and iPad	All participants learned to use iPod to request preferred items. Three participants indicated initial preference for the iPod. One participant did not indicate a clear preference. Preferences changed as proficiency with AAC systems increased.

* These studies also investigated participants' preferences for using iPods® compared to picture exchange and manual signs.

to the participants' classroom in a special education unit of a regular primary school.

A multiple-probe across participants and alternating-treatments study design was utilised. This involved these phases: baseline; intervention; preference assessments; post-intervention and follow-up. The alternating-treatments design was put in place to compare participants' skills on the two AAC options.

Baseline

During the baseline phase, the participants were provided access to the iPod® and a visual prompt for the manual sign for either a snack or toy. If participants pressed the appropriate iPod® symbol, a synthesised spoken message was produced i.e., "*I want a snack please"* (food), or "*I want to play*" (toy) (p. 1662). Correct selection of the iPod® symbol or production of the manual sign resulted in participants being offered a selection of snack items or toys. During the baseline phase, 1 of the 4 children requested items using the iPod® (with up to 30% accuracy) but no children produced manual signs.

Intervention

During intervention, the researcher created opportunities for the children to request by saying "*Here's a tray of snacks. Let me know if you want something*" accompanied by visual and verbal prompting (e.g., pointing to the snack items). S/he also provided graduated assistance (e.g., for some children this initially involved full "hand-over-hand") and verbal prompting (e.g., "*Press 'play' to ask to play with a toy*"). The criterion level for each AAC option was set at 80% correct unassisted requests over 3 consecutive sessions. Data were collected on the number of requests and level of prompting in each session. A second observer obtained reliability data by recording requests and level of prompting. The mean inter-observer reliability figure reported was 99.6% across 43% of all sessions.

Preference measures involved presenting participants with both the iPod® and manual sign visual prompt and asking "*Which communication option would you like to use? Sign language on this side (while pointing), or the iPod® on this side (while pointing)*" (p. 1663).

Results

All four participants learned to make requests using the iPod®. Three participants learned to request items using manual signs. Three participants demonstrated preference for the iPod® while one child preferred the use of the manual sign. Preferences remained consistent across the study. The three participants who preferred the iPod® also learned to use it more quickly and maintained their learned skills at a higher level than they did with manual signs.

Strengths

This study had several strengths in both its design and execution. These included:

- The single-case experimental study design and control measures (e.g., multiple baseline);
- inter-observer data reliability figure of 99.6%;
- clear and positive results in both the learned skills and preference assessments.

Weaknesses

The authors identified several weaknesses of the study. These included:

- small number of participants (n = 4);
- only the communication skill of "requesting" was investigated;
- only two communication options were considered;

- the potential influence of verbal prompts creates questions about the ability of participants to spontaneously request items;
- the need for consideration of generalisation data (e.g., could participants demonstrate these skills with other adults or peers?).

Clinical bottom line

This study along with the other 7 identified studies (see Table 1) provide preliminary empirical evidence for the use of iPods® or iPads® to support the development of requesting and naming communication skills for children with ASD or developmental disabilities with ASD-like characteristics. Three studies compared the use of iPods®/iPads® with other AAC systems and reported that some children indicate a preference for using iPods® compared to manual signs or picture exchange-based systems (e.g., van der Meer, Kagohara et al., 2012).

It is important to remember that new mainstream electronic devices such as iPods® or iPads® provide a new and more affordable form of AAC. Thus, the research base and best practices in the use of AAC are still applicable to these devices. The use of AAC including SGDs with children with ASD has been investigated in many studies and summarised in journal articles (e.g., Mirenda, 2003) and books (e.g., Mirenda & Iacono, 2009), and clinicians should also consider findings from the broader AAC-autism literature when using iPods®/iPads® in practice.

Issues for consideration

A number of issues should form the basis for further research into the use of computer-based intervention for children with ASD. These issues are also relevant when considering whether to use iPods®/ iPads® in a particular practice situation. For example:

- What are the differences between the iPod® and the iPad®? Is one device better suited to achieving the therapeutic goals sought?
- What is/are the AAC system/s that provide the best fit for the developmental and communication needs of each child?
- What new and evolving features are available with a range of personal electronic products developed by both Apple® and other manufacturers (e.g., Samsung®, HP® and Dell®)?
- Does the use of SGDs such as iPods® or iPads® support the development of natural speech?
- What applications will be used on the device? Seven of the identified studies used Proloquo2go™. A recent search of the Apps store™ revealed more than 100 apps aimed at supporting communication development were available.
- Does consideration of child preferences during intervention result in improved communication outcomes?
- What is the role of communication partners in supporting the emergence of more advanced forms of communication using AAC options (e.g., greetings and commenting)?

Conclusion

The accessibility and price of phone and tablet-based devices such as iPods® and iPads®, combined with mainstream media reports of positive case stories, have increased client demand for speech-language pathologists to support the use of these devices. However, research investigating specific devices – as opposed to research examining the effectiveness of SGDs more broadly – has focused on only two communicative functions, two devices and two software applications. The evidence suggests that although some children with ASD indicate a preference for and are able to learn to use these devices to request highly motivating items or name pictures, some children will not demonstrate increased communication skills as a result of iPod® or iPad®-based interventions.

Further research must continue to be undertaken to determine the effectiveness of new devices and software with AAC capabilities in supporting the development and generalisation of a range of communication skills. Notwithstanding the current limitations, there is preliminary empirical evidence that the use of mainstream technology such as the iPad® and iPod® may help some children with ASD to develop requesting and picture-naming skills.

References

Achmadi, D., Kagohara, D. M., van der Meer, L., O'Reilly, M. F., Lancioni, G. E., Sutherland, D., … Sigafoos, J. (2012). Teaching advanced operation of an iPod-based speech-generating device to two students with autism spectrum disorders. *Research in Autism Spectrum Disorders*, *6*, 1258–1264.

Flores, M., Musgrove, K., Renner, S., Hinton, V., Strozier, S., Franklin, S., & Hill, D. (2012). A comparison of communication using the Apple iPad and a picture-based communication system. *Augmentative and Alternative Communication*, *28*, 74–84.

Kagohara, D., van der Meer, L., Ramdoss, S., O'Reilly, M. F., Lancioni, G. E., Davis, T. N., … Sigafoos, J. (2013). Using iPods® and iPads® in teaching programs for individuals with developmental disabilities: A systematic review. *Research in Developmental Disabilities*, *34*(1) 147–156. j.ridd.2012.07.027

Kagohara, D. M., van der Meer, L., Achmadi, D., Green, V. A., O'Reilly, M., Lancioni, G, E. … Sigafoos, J. (2012). Teaching picture naming to two adolescents with autism spectrum disorders using systematic instruction and speech-generating devices. *Research in Autism Spectrum Disorders*, *6*, 1224–1233.

Kagohara, D., van der Meer, L., Achmadi, D., Green, V., Mulloy, A., Lancioni, G., … Sigafoos, J. (2010). Behavioural intervention promotes successful use of iPod-based communication device by adolescent with autism. *Clinical Case Studies*, *9*, 328–338.

Koul, R. & Corwin, M. (2011). Augmentative and alternative communication intervention for persons with chronic severe aphasia: Bringing research to practice. *EBP Briefs*, *6*, 1–8. Retrieved from http://www.speechandlanguage.com/ebp/pdfs/EBPV6A2.pdf

Mirenda, P., & Iacono, T. (Eds.) (2009). *Autism spectrum disorders and AAC*. Baltimore: Paul H. Brookes.

Mirenda, P. (2003). Toward functional augmentative and alternative communication for students with autism: Manual signs, graphic symbols, and voice output communication aids. *Language, Speech, and Hearing Services in Schools*, *34*, 203–216.

National Health and Medical Research Council (NHMRC). (1998). *A guide to the development, implementation and evaluation of clinical practice guidelines*. Retrieved from http://www.nhmrc.gov.au/_files_nhmrc/publications/attachments/cp30.pdf

Schlosser, R. (2003). Single-subject designs. In Schlosser, R. (Ed.). *The efficacy of augmentative and alternative communication: Toward evidence-based practice* (pp. 85–143). Bingley, UK: Emerald.

Sparrow, S., Cicchetti, D., & Balla, D. (2005). *Vineland-II adaptive behavior scales (2nd ed.)*. Minneapolis: Pearson.

van der Meer, L., Kagohara, D. M., Achmadi, D., Green, V. A., O'Reilly, M. F., Lancioni, G. E., …Herrington, C. (2011). Teaching functional use of an iPod-based speech-generating device to individuals with developmental disabilities. *Journal of Special Education Technology*, *26*, 1–11.

van der Meer, L., Didden, R., Sutherland, D., O'Reilly, M. F., Lancioni, G. E., & Sigafoos, J. (2012). Comparing three augmentative and alternative communication modes for children with developmental disabilities. *Journal of Developmental and Physical Disabilities*, *24*, 1–18. doi 10.1007/s10882-012-9283-3

van der Meer, L., Kagohara, D. M., Achmadi, D., O'Reilly, M. F., Lancioni, G. E., Sutherland, D., & Sigafoos, J. (2012). Speech-generating devices versus manual signing for children with developmental disabilities. *Research in Developmental Disabilities*, *33*, 1658–1669.

van der Meer, L., Sutherland, D., O'Reilly, M. F., Lancioni, G. E., & Sigafoos, J. (2012). A further comparison of manual signing, picture exchange, and speech-generating devices as communication modes for children with autism spectrum disorders. *Research in Autism Spectrum Disorders*, *6*, 1247–1257.

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Peer review

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Digital possibilities and ethical considerations: Speech-language pathologists and the web

Grant Meredith, Sally Firmin and Lindy McAllister

KEYWORDS
ACCESS
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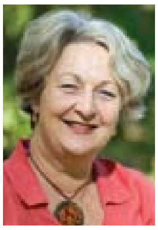

Grant Meredith (top), Sally Firmin (centre) and Lindy McAllister

The world wide web offers the promise and means of continual development and improved access to speech-language pathology services for people with communication disorders. In this paper we describe practices and possibilities for service provision for this population, using telehealth and emergent virtual worlds. We illustrate these technologies with a particular focus on research and developments for people with communication disorders. We then highlight some of the ethical risks associated with the web in terms of the promotion of non-evidence based practices, client–patient relationships and the storage and access of client data. These concerns are discussed with reference to Speech Pathology Australia's Code of Ethics, and provide guidance to speech-language pathologists regarding the potential dangers associated with service provision over digital platforms.

Last year the world wide web (the web) turned 21, and now over 72% of Australian households are connected to it (Australian Bureau of Statistics, 2011). The web is a collection of web pages which function as a resource of the Internet (the world's largest network consisting of millions of linked computers) (Morley, 2011). Today, the Internet and the web enable people around the world to communicate, interact, and share information on a large scale for activities such as commerce, health care, education, socialising, and gaming. However, global inequality of access and knowledge of information and communication technologies (ICT), known as the *digital divide* (Wei, Teo, Chan, & Tan, 2011) does exist. Consequently, the Australian federal government has recently begun rolling out its highly publicised National Broadband Network (NBN) which aims to connect all Australians to a high-speed web by 2020, enabling a digitally supported economy (Department of Broadband, Communications & the Digital Economy, 2011).

As an ICT infrastructure develops, it is the role of all public sectors, including health, to utilise and plan for its inclusion into a digital future. The first purpose of this paper is to outline developments within telehealth, and work associated with the emergent virtual world platforms, with regard to the provision of speech-language pathology (SLP) services. The second aim of this paper is to outline for SLPs some major ethical concerns associated with embracing these emergent and evolving technologies; that is, serving a digital community while abiding by the profession's Code of Ethics. We commence our discussion of these applications of the web in regards to people with communication disorders (PWCD) through a short review of the more established area of telehealth.

Telehealth

Telehealth is not a new digital phenomenon. Modern telehealth started in the 1960s largely driven by the needs of the military and of space exploration. Early technologies included the use of television and the telephone (World Health Organisation [WHO], 2010). Contemporary telehealth includes:

> *The delivery of health care services, where distance is a critical factor, by all health care professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment and prevention of disease and injuries, research and evaluation, and for the continuing education of health care providers, all in the interests of advancing the health of individuals and their communities. (WHO, 2010, p. 38)*

The provision of health services to remote sites is supported by a wide range of technologies (see Table 1 for a list of resources commonly used by SLPs to support their service delivery). Technologies such as videoconferencing suites, email, tele-imaging, and more recently, rich multimedia approaches such as video-streaming are commonly used (WHO, 2010). The use of fixed, high-tech videoconferencing suites to provide telehealth services through public health departments is well established. One example of the use of this technology occurs within the Southern Inland Health Initiative which delivers telehealth services including videoconferencing and remote diagnosis to outpatients in rural and remote areas in Western Australian (Department of Health, 2011). A second tool is the portable *e-hab* system, developed by Theodoros and colleagues, for telehealth service delivery to people with a range of communication and swallowing impairments (see for example, Sharma, Ward, Burns, Theodoros & Russell, 2011). Another technology being investigated for service provision is desktop videoconferencing applications such as Skype, which are envisaged to play an important role in future delivery of low-risk clinical functions (Armfield, Gray & Smith, 2012; Carey et al., 2010).

Table 1. Websites of interest to SLPs

Name	Description	URL
Dropbox	A storage website that allows file storage and sharing	https://www.dropbox.com/
Facebook	A social networking website that allows account holders to create profiles, upload images, video and text chat over the Internet	http://www.facebook.com
Second life	A 3D virtual world where users can communicate using free voice and text chat	http://www.secondlife.com
Skype	A platform that allows text, voice and video calls over the Internet	http://www.skype.com
Twitter	A social networking website that allows account holders to post short text messages	http://www.twitter.com/
YouTube	High-quality video streaming technology that offers support for nearly every video format	http://www.youtube.com

Virtual worlds

An emergent web-based platform that may be new in concept and practice to SLPs are virtual worlds. Virtual worlds are on-line three-dimensional (3D) environments which attract large numbers of registered and concurrent users for a range of purposes including commerce, education, and socialisation. An example of a popular virtual world is *Second Life* (http://secondlife.com/). In 2011 the number of registered users across virtual worlds was approximately 1.185 billion (Wasko, Teigland, Leidner, & Jarvenpaa, 2011), indicating these virtual environments have become well accepted in modern society. Users within virtual worlds represent themselves as an *avatar*. An avatar is a user controlled virtual character through which the user can portray and play out their identity (Novak, 2012). Through avatars users can personalise their appearance and their movements to a high degree, enabling complex interaction with other avatars in the form of virtual gestures, instant text messaging, and speech. These virtual environments are currently being used and trialled across many sectors for simulated scenarios, for learning, and for provision of support services (see Wasko et al., 2011).

Virtual worlds are currently not well utilised or researched by SLPs (Brundage, 2007; Brundage, Graap, Gibbons, Ferrer, & Brooks, 2006; Packman & Meredith, 2011; Meredith, Miller, & Simmons, 2012), but they do offer new possibilities for client services and education. For instance, Brundage and colleagues developed and evaluated simulated job-interview scenarios using people who stutter which were presented to the user through the use of elaborate virtual reality (VR) headgear. Participants were led through a simulated process which situated them within a 3D virtual setting of an office environment and job interview. The virtual interviewer was controlled externally by the researchers to give it a sense of autonomous in-world life. The ability to control the interviewer avatar and responses enabled the researchers to inject variability, mood, manner and stress into the environment. Results indicated that the general fluency levels of the participants were the same within the virtual environment as they were in real life, and that they experienced similar feelings and apprehensions associated with the real-world alternative. The participants indicated that they generally found the VR experience to be realistic. These findings suggest that virtual environments, if designed and implemented well, could be alternative environments within which clients can test and practice intervention strategies.

Virtual worlds also hold great promise for education of SLP students, and self-advocacy for consumers. There have been significant advancements in the use of virtual worlds for simulation and service delivery across many health sectors. For instance, the Northern Michigan University's Speech-Language and Hearing Science Island (Bickley, 2009) within *Second Life* was designed as a SLP and hearing science experience for students, patients, and other interested individuals. The island also offers a conceptual virtual SLP clinical environment, an interactive larynx model, and an educational area concerning stuttering.

Similarly, the Virtual Stuttering Support Centre (VSSC) (Meredith, 2011), located on the University of Ballarat's virtual island within *Second Life*, houses a virtual campus and a range of interactive virtual experiences. The VSSC contains a series of interactive scenarios which a person who stutters can work through in order to practise their fluency (Packman & Meredith, 2011). The scenarios are hosted by *Bots* (software-controlled avatars which look similar in appearance to a human-controlled avatar, giving the scenario a sense of autonomy and validity). The VSSC also has the capabilities to hold virtual meetings, conferences, and social functions for people who stutter all over the world to interact with, share ideas, and build on-line support structures.

Ethical challenges for SLPs using web-based services

So far in this paper we have drawn on developments in telehealth and virtual worlds, with particular reference to applications of these technologies to people who stutter, to illustrate the potential of the web to improve access to SLP services for PWCD. In this section, we consider ethical issues that may arise with telehealth and virtual worlds, and some implications for practice with regards to Speech Pathology Australia's (SPA) Code of Ethics.

There are numerous ethical issues arising from the use of the web for the delivery of SLP services including ease of client access to information and treatments that are not evidence-based, the impact of technology on the clinician–client relationship, and privacy and data storage.

Unregulated and non-evidence based information and practices

One of the dangers involved with the web is the freedom that it offers. It is now easy for a private individual anywhere in the world to create their own website and advertise an unsubstantiated, non-researched claim of assistance, cure and treatment. Such claims of instant or rapid cures may be accessed by vulnerable individuals seeking a solution to chronic or debilitating conditions. Concerns have been raised within a variety of health fields ranging from alternative medicine to autism spectrum disorder and stuttering about such sites (British Stammering Association, 2011; Cienki & Zaret, 2010; Harmse, Pottas, & Takeda, 2010). Websites offering such interventions are difficult to police and shut down due to being internationally hosted and to the legislative complexity surrounding the global governance of websites. These websites are problematic for SLPs in at least two major ways. First, because members of the public are often not in a position to judge the quality of information on websites, they may not be able to distinguish between evidence based SLP practices and those promoted on websites that are not evidence based. Evidence based treatments have been ethically researched, scrutinised by peers and have proof of their general effectiveness. The opposite can be said for some web-based treatments and therapies already in existence. Second, non-research based information on a website may be used by PWCD to self-diagnose and perhaps self-treat their communication disorder. The risk for these people can be significant in terms of financial commitments and wasted effort techniques taught by unqualified people. Another risk for PWCD could be loss of faith in the associated SLP profession due to the technique not providing them with a promised "cure" or "elimination" of their communication disorders. SLPs have ethical duties to educate clients, their families and carers, and the community at large, about evidence based approaches that are known to be effective and provide accurate and timely information about those practices which are not evidence based (SPA, 2010, Practice 3.1). Professional associations may play a role in monitoring these sites. The SLP profession itself has a responsibility to actively educate members and clients about trusted websites and supported techniques. At the very least, individual SLPs need to be able to make informed and ethical comments about web-based information if asked by clients (SPA, 2010, Practice 3.1).

Clinician–patient relationships

The interpersonal aspects of therapeutic interventions delivered via the web need careful consideration and management by SLPs to fulfil their ethical duties to their clients (SPA, 2010, Practice 3.1).

A growing area of ethical concern in the use and expansion of virtual worlds, telehealth and other web-based services is the impact that they may have on the "traditional clinician–patient relationships" (Stanberry, 2000, p. 615). Cornford and Klecun-Dabrowska (2001) caution against the "substitution of care with treatment" (p. 161). Very little research has been conducted to examine patient satisfaction with the quality of interactions in telehealth relationships (Ellis, 2004), although recent work and understanding has suggested that client satisfaction and acceptance of telehealth is on the rise (Theodoros, 2012).

It is possible that the impersonal nature of some telehealth practices and virtual worlds hosted by automated avatars, or even completely unmoderated, may increase a sense of alienation commonly experienced by some clients (Bauer, 2010).

Developers of on-line practices must be careful to supply information to clients and potential clients in easily understood language. Checking the comprehension of information provided to clients is easier to do in face-to-face clinical settings. In on-line and largely unmoderated environments information needs to be provided with attention to the complexity and language used (Worrall, Rose, Howe, McKenna & Hickson, 2007).

Privacy and data storage

The Code of Ethics requires SLPs to protect client confidentially and ensure the safety and welfare of their clients (SPA, 2010, Standards 3.1.4 and 3.1.7). The use of web based speech-language pathology services and digital records create additional complexities and ethical concerns for both clients and SLPs to manage. Telehealth and virtual worlds, as well as older technologies like email, require the storage, retrieval and transmission of various forms and levels of personal data concerning users at both client and practitioner levels.

Privacy of data

Informational privacy (control over the flow of our personal information) is threatened through the use of the web (Tavani, 2011). In a telehealth context, personal information can be transmitted using a variety of technologies including the traditional approaches such as email, videoconferencing and the web or in new and emerging technologies such as cloud computing (applications and services which are offered over the Internet, collectively termed the *cloud* [Creeger, 2009]), and virtual worlds.

SLPs need to adopt standards, data policies and procedures in order to minimise the impact of the above technologies (Darkins, 2012). This could include a range of privacy protection approaches such as phish detection filters, the use of strong passwords and sign-out, the use of anti-virus and anti-spyware protection, maximising browser privacy enhancing capabilities, and the adoption of authentication and encryption protocols particularly when cloud computing and mobile technologies are utilised (Tavani, 2011; Zhang & Zhang, 2011). In addition, Darkins (2012) suggests organisations adopt a systems approach (a holistic and analytical approach) as an overall model for thinking about data privacy issues in the implementation of telehealth programs. This suggests organisations think about their telehealth as part of their overall health delivery and not in isolation.

SLPs need to be aware of the *Privacy Act 1988* (Cth) which regulates the way personal information is collected, stored, used and disclosed (McDermid, 2008), and the *Privacy Amendment (Private Sector) Act 2000* (Cth). This legislation extended the protection of information privacy to include many private sector organisations, and organisations that provide health services or store health-related information (McDermid, 2008). The legislation includes a list of ten national privacy principles which set the minimum standard for information privacy. The intent of this legislation is governance for organisations in the information economy, and is of particular relevance to SLPs ensuring protection of client confidentiality, safety and welfare.

Storage of data

Another issue of concern is the enormous volume of data (e.g., practitioner notes, lab test results, scans) digitally generated and the storage of that data. Telehealth practitioners need to consider what type of data should be stored, how much should be stored, for how long, and in what format. Currently, legislation requires health practitioners to store files for seven years after a client finishes treatment, or until the child reaches 25 years of age. This requires enormous data storage capacity. Telehealth providers are considering the use of cloud computing as an option to overcome their data storage dilemmas; however, storage in the cloud provides its own set of privacy and security concerns. Some suggest the use of *private clouds*, where data is restricted to servers in specific locations, and the development of standards and metrics to measure performance and regulations compliance by cloud computing vendors (Herold, 2012) will be important. This emerging landscape may provide SLPs adopting telehealth services or using other digital services with an alternative solution, but will require preservation of ethical standards required by SPA.

In conclusion

The web offers new frontiers like media rich telehealth and virtual worlds for SLPs to venture into, explore and appraise. These digital platforms offer new avenues for treatment and education provision to clients. They also aid SLPs to deliver services across large geographical areas in cost-efficient and ethically considered ways, through implementation of processes and organisational philosophies which protect the privacy and storage of data. Both telehealth and virtual worlds require further rigorous trialling, evaluation, management and development in order to be seen as viable and ethical alternatives for conventional SLP, client interactions. Clients themselves need to be educated about the possible dangers of the largely unregulated Internet. More importantly SLPs need to understand how to use the web wisely to deliver services without breaching professional standards and ethical codes of conduct.

References

Armfield, N., Gray, L., & Smith, A. (2012). Clinical use of Skype: A review of the evidence base. *Journal of Telemedicine and Telecare*, *18*(3), 125–127.

Australian Bureau of Statistics. (2011). *ONLINE @ HOME*. Retrieved 20 January 2012, from http://www.abs.gov.au/AUSSTATS/abs@.nsf/Lookup/4102.0Main+Features50Jun+2011

Bauer, K. (2009). Healthcare ethics in the information age. In R. Luppicini, & R. Adell (Eds.), *Handbook of research on technoethics* (pp. 170–185). Hershey, PA: Information Science Reference.

Bickley, D. (2009). *Northern Michigan University's Speech-Language & Hearing Virtual Clinic*. Retrieved 12 April 2012, from http://www.donbickley.com/nmuspeechpath.html

British Stammering Association. (2011). *Misleading treatment claims*. Retrieved 21 September 2012, from http://www.stammering.org/claims.html

Brundage, S. B. (2007). Virtual reality augmentation for functional assessment and treatment of stuttering. *Topics in Language Disorders*, *27*(3), 254–271.

Brundage, S. B., Graap, K., Gibbons, F., Ferrer, M., & Brooks, J. (2006). Frequency of stuttering during challenging and supportive virtual reality job interviews. *Journal of Fluency Disorders*, *31*, 325–339.

Carey, B., O'Brian, S., Onslow, M., Block, S., Jones, M. & Packman, A. (2010). Randomized controlled non-inferiority trial of a telehealth treatment for chronic stuttering: The Camperdown Program. *International Journal of Language and Communication Disorders*, *45*, 108–120.

Cienki, J. J., & Zaret, L. (2010). An Internet misadventure: Bloodroot salve toxicity. *Journal of Alternative and Complementary Medicine*, *16*(10), 1125–1127.

Cornford, T., & Klecun-Dabrowska, E. (2001). Ethical perspectives in evaluation of telehealth. *Cambridge Quarterly of Healthcare Ethics*, *10*, 161–169.

Creeger, M. (2009). Cloud computing: An overview. *Queue*, *7*(5), 1–5.

Darkins, A. (2012). Patient safety considerations in developing large telehealth networks. *Clinical Risk*, *18*(3), 90–94.

Department of Broadband Communications & the Digital Economy. (2011). *National Digital Economy Strategy*. Retrieved 10 February 2012, from http://www.nbn.gov.au/the-vision/digitaleconomystrategy/

Department of Health. (2011). *Southern Inland Health Initiative*. Retrieved 19 September 2012, from http://www.wacountry.health.wa.gov.au/index.php?id=645

Ellis, I. (2004). Is telehealth the right tool for remote communities? Improving health status in rural Australia. *Contemporary Nurse*, *16*, 163–168.

Harmse, R., Pottas, D., & Takeda, H. (2010). Help me to understand your world: A reflection on the potential impact of e-health systems on the prognosis for Asperger syndrome. *IFIP Advances in Information and Communication Technology*, *335*, 210–221.

Herold, R. (2012). *Cloud computing in healthcare: Key security issues*. Retrieved 25 September 2012, from http://www.bankinfosecurity.com/webinars/cloud-computing-in-healthcare-key-security-issues-w-200

McDermid, D. (Ed.). (2008). *Ethics in ICT: An Australian perspective*. Frenchs Forest, NSW: Pearson Education

Meredith, G., Miller, C., & Simmons, G. (2012). Stuttering support & nursing education: Two case studies in Second Life. In C. Wankel & R. Hindrich (Eds.), *3D virtual world learning handbook* (pp. 217–254). Charlotte, NC: IGI Global Publications.

Meredith, G. (2011). Virtual Stuttering Support Centre (VSSC). Retrieved 12 April, 2012 from http://guerin.ballarat.edu.au/ard/itms/research/researchProjects/nonFunded/VRSL/VSSC.shtml

Morley, D. (2011). *Understanding computers: In a changing society* (3rd ed.). Boston, MA: Course Technology.

Novak, J. (2012). *Game development essentials* (3rd ed.). Clifton Park, NY: Delmar.

Packman, A., & Meredith, G. (2011). Technology and the evolution of clinical methods for stuttering. *Journal of Fluency Disorders*, *36*(2), 75–85.

Sharma, S., Ward, E., Burns, C., Theodoros, D., & Russell. T. (2011). Assessing swallowing disorders online: A pilot telerehabilitation study. *Telemedicine and e-Health*, *17*(9), 688–695.

Speech Pathology Australia. (2010). *Speech Pathology Australia: Code of ethics*. Retrieved 19 September 2012, from http://www.speechpathologyaustralia.org.au/about-spa/code-of-ethics

Stanberry, B. (2000). Telemedicine barriers and opportunities for the 21st century. *Journal of Internal Medicine*, *247*, 615–628.

Tavani, H. T. (2011). *Ethics and technology: Controversies, questions, and strategies for ethical computing* (3rd ed.). Hoboken, NJ: John Wiley.

Theodoros, D. (2012). A new era in speech-language pathology practice: Innovation and diversification. *International Journal of Speech-Language Pathology*, *14*(3), 189–199.

Wasko, M., Teigland, R., Leidner, D., & Jarvenpaa, S. (2011). Stepping into the internet: New ventures in virtual worlds. *MIS Quarterly*, *35*(3), 645–652.

Wei, K.-K., Teo, H.-H., Chan, H. C., & Tan, B. C. Y. (2011). Conceptualizing and testing a social cognitive model of the digital divide. *Information Systems Research*, *22*(1), 170–187.

Worrall, L., Rose, T., Howe, T., McKenna, K., & Hickson, L. (2007). Developing an evidence base for accessibility for people with aphasia. *Aphasiology*, *21*(1), 124–136.

World Health Organization (WHO). (2010). *Report on the second global survey on eHealth*. Geneva, Switzerland: World Health Organization.

Zhang, X., & Zhang, N. (2011). An open, secure and flexible platform based on internet of things and cloud computing for ambient aiding living and telemedicine. *Paper presented at International conference on Computer and Management (CAMAN)*. Changsha, China: Hunan University.

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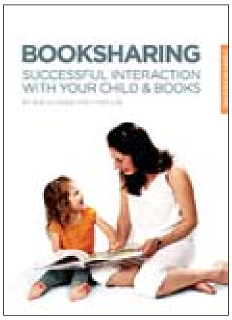
Speech pathology resources

Gawned, S., & Lee, M. (2012). ***Booksharing: Successful interaction with your child & books***. **Perth: Noah's Ark (WA) Inc.; book: ISBN 978 0 646 57359 5, 33 pages; DVD. Available from noahsarkwa.org.au for AU$24.95.**

Elizabeth Lea



Booksharing: Successful Interaction with Your Child & Books is a resource book and DVD created by speech pathologists Sue Gawned and Mary Lee from Child Development Services at WA Health. Gawned and Lee define booksharing as "interacting with your child when you read books together" (p. 10) and aim to provide parents with the strategies to support their child "to develop a love of books and language" (p. 6). After introducing the reader to research related to booksharing, the authors identify a number of ways that booksharing empowers parents to support their child's learning and development. Colour photographs of parents and their children depict different examples of booksharing and we revisit these families when watching the DVD, which is useful for recalling key points made in the book.

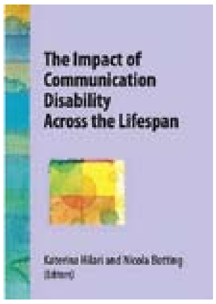
After highlighting the importance of booksharing, Gawned and Lee introduce four strategies to assist parents to engage in successful booksharing interactions with their children. The first strategy is the "Booksharing triangle", which describes the optimal way for parents to sit with their child so that both parties can interact with the story and see each other's faces. Strategy two outlines how parents can use their face and voice to make the story come alive and the book directs parents to the DVD for further examples of how to implement this strategy. The third strategy addresses the need for turn-taking during booksharing and presents several examples of the ways parents and children can take turns. Strategy four discusses the use of words and text and provides a rationale for parents to use their own words to talk about a story rather than reading every word on a page. The authors also explain when parents should adhere to the text in a story, for example, when reading rhymes and singing songs.

Each of the four booksharing strategies is clearly described but without the use of too much text and the authors use dot points to provide examples for further information. Photographs of parents and children demonstrating each strategy and the DVD film clips provide the parent with a clear understanding of how to implement each strategy.

As both a speech pathologist and parent to a toddler, I found that this resource reinforced the importance of sharing books with children and will be useful for parents looking for clear, practical strategies to further assist them to instil a love of books in their children.

Hilari, K., & Botting, N. (Eds.) (2011). ***The impact of communication disability across the lifespan***. **London: J&R Press; ISBN 978 1 907826 03 0; pp. 298; £24.99 (paperback) plus postage and packing; www.jr-press.co.uk**

Jane McCormack



While numerous books are available that describe the prevalence and characteristics of specific communication disorders (impairments), few document the way in which such communication disorders influence and impact on the lives of those who experience them. Knowledge of the effects of communication disorders is important to ensure interventions aimed at alleviating the effects are functional, relevant, and delivered in a timely manner. This book aims to address the current gap in the literature by presenting the *impact* of communication disorders, rather than the *nature* of the disorders.

The book is divided into two sections: the first contains chapters which describe the impact of developmental (childhood) communication disorders (including autism, developmental speech sound disorders/language impairment, learning disabilities, stuttering, and deafness); the second contains chapters which describe the impact of communication disorders in adulthood (including aphasia, dementia, acquired motor speech, TBI, voice, and head and neck cancer).

Each chapter, written by an expert in the field, contains a brief overview of a particular communication disorder; the focus then shifts to a description of the areas of impact most relevant to that communication disorder. For instance, authors of the chapters relating to developmental communication disorders describe a range of potential and wide-reaching effects; however, common impacts are educational and/or social difficulties. The authors often discuss factors that may influence the extent of the impact, including persistence/progression of the disorder, and support networks available (including family context).

All chapters within the book include a section on clinical implications, which provide evidence of the impact of communication disorder and interventions available to address the impact. Current gaps in knowledge are identified and directions for future research are highlighted.

In addition, the final chapter in each section is co-written by people with communication disabilities. These two chapters provide individuals with communication disabilities with a voice to describe their lived experiences, and provide readers with an insight into communication disorders from the perspective of those who live with them. The child/youth chapter includes artwork completed by the co-authors and is used to help illustrate their experiences.

This book provides a useful summary of research investigating the impact of particular communication disorders across the lifespan. It would be a good starting point for those wishing to learn about the effects of communication disorders and each chapter contains references which direct readers to related research and information. The unique focus of this book (on impact) and the inclusion of chapters from people with communication disorders ensure it would be a valuable text for health professionals, students, parents, and researchers involved in planning and delivering services to children and adults with communication difficulties.

Love, E., & Reilly, S. (2011). ***Talking pictures*****; A$50.00; www.loveandreilly.com.au**

Diane Jacobs

Talking Pictures has been developed to facilitate pragmatic skills and social awareness for the school-aged population. The pack comprises five A4 coloured picture scenes (schoolyard, swimming pool, birthday party, street scene, and train station), one double-sided A4 sheet outlining ideas for the use of picture boards, and a magnifying glass. The pictures are designed predominantly to develop students' ability to observe, hypothesise about, and interpret verbal and non-verbal pragmatic information, as well as develop the higher level skills of prediction, comparison, and recount. Additionally, like many previous Love and Reilly publications, the pictures can be used to facilitate morpho-syntactic and semantic development.

One point is that the pictures are "busy". Although speech bubbles and a magnifying glass are provided to enable the clinician to draw a student's attention to specific picture details, for some children the pictures may be too distracting and for a minority even overwhelming. In addition, while the authors state that the pictures include individuals of varying "cultural background and ability" this was not very apparent, particularly for the former.

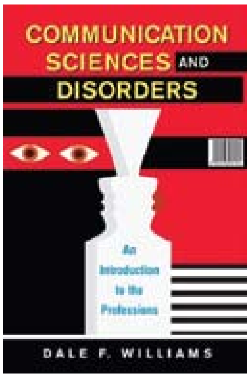
Overall, Love and Reilly products have been well known to, and well regarded by, Australian speech pathologists for many years. The latest offering from these two professionals will be a welcome addition to the speech pathology toolkit of many clinicians. That said, the main wish of clinicians will be for more pictures, hence many will await *Talking Pictures 2*.

Williams, D. F. (2011). ***Communication sciences and disorders: An introduction to the professions*****. New York: Psychology Press. ISBN 978 0 8058 6181 5 (hardback); pp. 448; US$79.95; www.psypress.com**

Deborah Hersh

I originally picked up this book assuming it would be an introduction to speech-language pathology for those students beginning their journey towards qualification … and indeed it is, but it is not what I was expecting.

I quickly realised that this book is, at least in part, a chat with the author. Professor Williams engages the reader as one might in conversation over a drink. He uses illustrations by his children, photos of his work-related trip to Rwanda, personal recollections of receiving speech-language pathology intervention, his children's speech and language development, and his own clinical experience. He regularly drops humour into the text and even managed a "laugh-out-loud", tear-inducing reaction from me in the chapter on research (where I would have least expected it). His section on treatment includes a number of pearls of wisdom such as: "Rule 1: Avoid saying stupid things" (p. 87) and a reminder to wear deodorant (p. 89). So, in many ways, this book is more appealing and readable than suggested by its title and its inclusion of case examples, explanations of vocabulary, discussion questions at the end of each chapter, and recommended readings are all useful. However, I recommend it with a few notes of caution.



First, it is geared to an American readership such that chapter 16 (Professional issues: Preparation and practice) is only minimally relevant to students in Australia and the interesting chapter 15 on Multicultural issues (written with Professor Li-Rong Lilly Cheng) understandably focuses on African American and Hispanic clients. Second, there were a few holes; for example, only a passing mention of evidence based practice. I was also surprised that the old "impairment, disability, handicap" distinction was mentioned (p. 69) rather than alerting students to the updated ICF terminology of the World Health Organization. Finally, eight of the 17 chapters are co-written with colleagues from particular clinical fields (including neurogenic disorders, speech sound disorders, voice and resonance disorders, the auditory system, AAC and swallowing) so there are inevitable shifts from Williams' writing style in parts of the book. On the whole, the co-written chapters are helpful summaries of a great deal of information but, their readability, level of detail, and quality of information are variable. Professor Williams writes the early general chapters as well as those on language disorders, fluency, and work settings. So, this book is a good introduction and I hope students enjoy their drink with Professor Williams – by and large, I did.

Around the journals

Using the* Transporters *DVD as a learning tool for children with Autism Spectrum Disorders (ASD)

Young, R.L. & Posselt, M. (2012). Using the *Transporters* DVD as a learning tool for children with autism spectrum disorders (ASD). *Journal of Autism and Developmental Disorders*, *42*, 984–991.

Phyllis Chan

People with autism spectrum disorder (ASD) are argued to have impaired ability to understand and interpret the emotions of others, which then leads to unsuccessful social interactions. The aim of this study was to determine whether emotion recognition and understanding can be taught, and if so, whether this understanding facilitates social development and improves the social interactions of individuals with ASD.

Participants were 25 children aged between 4 and 8 years, who met the DSM-IV diagnostic criteria for a Pervasive Developmental Disorder and also obtained a minimum score of 11 on the Social Communication Questionnaire (SCQ). The children were randomly allocated to either the intervention group who watched the *Transporters* DVD or the control group who viewed another purpose-made *Thomas the Tank Engine* DVD. The *Transporters* and the *Thomas the Tank Engine* DVD both aimed to teach emotions or affect, but the *Transporters* DVD was designed specifically for children with ASD, characterised by greater emphasis on emotions, a bland and featureless backdrop to encourage attention to the character's faces and the display of real human faces possibly allowing greater generalisation.

To measure the children's ability to recognise affect, the Affect recognition subtest of a developmental Neuropsychological Assessment (2nd ed.) (NEPSY-II) was used. Results indicated a mean increase of 5.85 in emotion recognition scores in children after viewing the *Transporters* DVD which was considered as significant ($p < .001$), whereas there was no improvement observed in the group of children who watched the *Thomas the Tank Engine* DVD. This indicates that emotional recognition can be taught via DVDs, but only when the DVDs are specifically designed to meet the needs of children with ASD.

Children who watched the *Transporters* DVD were also expected to generalise the newly learnt social skills into real life situations. These social skills were assessed through parents' observation of an increase in social peer interest and eye contact, a decrease in gaze aversion and stereotyped behaviours. However, both group of participants showed a significant improvement in social behaviour, suggesting that the content of the *Transporters* DVD did not make a difference in improving children's social skills in real settings.

In summary, this study supports the effectiveness of the *Transporters* DVD as a tool for teaching emotion recognition and social behaviour to children with ASD. However, parents of participants reported their child showed improvement in social behaviour, irrespective of the DVD they watched. This is likely to be a result of repetition of viewing the DVDs, and the social stories that aimed to improve the understanding of emotions in both DVDs. The study was limited by the small number of participants, making it difficult to generalise from the results. It requires replication with a larger sample to substantiate the findings. In addition, future research is indicated to examine the long-term effect of the *Transporters* DVD and its effect on social behaviour.

A single case design evaluation of a software and tutor intervention addressing emotion recognition and social interaction in four boys with ASD

Lacava, P. G., Rankin, A., Mahlios, E., Cook, K., & Simpson, R. L. (2010). A single case design evaluation of a software and tutor intervention addressing emotion recognition and social interaction in four boys with ASD. *Autism*, *14*(3), 161–178. doi: 10.177/1362361310362085

Melissa Finn

Individuals with autism spectrum disorders (ASD) often have difficulties recognising others' emotions. This can have an impact on social behaviour affecting skills such as the initiation of interactions, responses to others and the development of peer relationships. Recently, intervention for people with ASD has begun to utilise computer software and virtual reality. This technology has been used to address emotion recognition (ER) deficits in this population, and overall findings indicate the benefits of using this method to teach basic ER skills. This study investigated the relationship between the use of a computer software program (Mind Reading: The Interactive Guide to Emotions), ER and social behaviour change in children with ASD.

The participants were four boys aged between 7 and 10 years old, diagnosed with an ASD without cognitive disability. They had no experience with Mind Reading, were judged as text and computer literate by their teachers, attended public schools, and had varying degrees of daily support from adults throughout the day (for academic, behaviour or social reasons). A multiple-baseline across-participants experimental design was used. The procedure required participants to use Mind Reading with an adult tutor present for 7 to 10 weeks, 1 to 2 hours per week. Mind Reading is a multimedia computer software program designed to teach emotion and mental state recognition to children and adults who have deficits in emotion recognition. The Cambridge Mindreading Face-Voice Battery for Children (CAM-C) pictures and schematic cartoon faces were used to assess ER after the intervention.

The participants were required to identify basic emotions from the pictures and cartoon faces. The CAM-C, a computerised task that assesses the recognition of 15 emotional concepts, required the participants to recognise emotions from presentations of the face and voice stimuli that were trained in Mind Reading. Social behaviour change was measured through observations of positive social interactions, subjective evaluations completed by parents and school staff and performance comparisons of the participants with typically developing peers.

Results indicated an improvement in participants' ER scores on the CAM-C and in their ability to identify basic emotions from pictures and cartoon faces after using Mind Reading. However, a significant and consistent effect on social interactions was not found. Nevertheless, the authors state that there were positive social interaction increases in observations of the participants from baseline to intervention phases. Anecdotal reports from parents and/or teachers also indicated a general increase in the participants' empathy towards others and use of emotion words. However, there was no empirical evidence to support these reports.

This study has several limitations that need to be taken into account when considering findings. For instance, the research design does not account for any events outside of the study or uncontrolled changes in the participants (e.g., maturation) between repeated measures of the dependant variables; pre-test influence; and regression towards the mean. Overall, the study design makes it difficult to determine what was responsible for the participants' improvements in the ER tasks. Furthermore, the small sample size and lack of information about the participants (i.e., their language ability) limit generalisation. Despite these limitations, this study makes a valuable contribution to the growing body of evidence contributing to the understanding of the use of computer software as a mode of intervention for people with ASD.

Applying technology to visually support language and communication in individuals with autism spectrum disorders

Shane, H.C., Laubscher, E.H., Schlosser, F.W., Flynn, S., Sorce, J.F., & Abramson, J. (2012). Applying technology to visually support language and communication in individuals with autism spectrum disorders. *Journal of Autism and Developmental Disorders*, *42*, 1228–1235.

Megan Howe

The growing role of technology in society has provided opportunities for individuals with autism spectrum disorders (ASD) to access new types of augmentative and alternative communication (AAC). This shift towards the use of mainstream technology for AAC is largely due to the increasing range of handheld media devices that are universal, transportable and socially acceptable. This article provides an insight into the way in which AAC use for individuals with ASD has evolved and the way in which current technology may be used to enhance the communication of individuals with ASD.

A wide variety of AAC devices has been developed for individuals with ASD, including specialised low-tech tools, and high-tech special- and general-purpose hardware and software. Initially, AAC strategies for individuals with ASD focused mainly on the use of manual signs. Special purpose low-tech AAC then emerged with the use of tools such as communication boards and graphic symbols, with pointing or exchange based systems. As AAC use became more widespread for individuals with ASD, high-tech special-purpose hardware and software were developed. These were initially used for expressive communication purposes only, then expanded to include other dimensions such as comprehension and higher level language functions (e.g., organisation of time). The authors note that these special-purpose systems can be expensive, difficult to personalise, and may serve to stigmatise the user.

More recently, general-purpose hardware and software have been used to create AAC devices for individuals with ASD. General-purpose hardware may also run special-purpose software which can serve as full AAC systems, or support functions such as choice making. The authors indicate that these general-purpose devices may be smaller, lower cost, more readily available and more socially acceptable than special-purpose high-tech AAC. Despite these innovations, the authors indicate that it is important to match the correct type of communication technology with a particular individual, and to continue to pair this with appropriate methods of intervention.

A focus of this article is the way in which the visual immersion program (VIP) can be used to improve communication and language instruction. The VIP is a program that uses visual supports to teach individuals with ASD how to communicate better in everyday interactions. Within VIP, technology can be used to improve the graphic representation of challenging concepts such as verbs, as they may be represented by personalised animations rather than static images. Concept understanding within the context of particular syntactic structures may also be improved by combining the use of colour-coded language elements with visual scenes to assist users to create meaningful, grammatically correct sentences. The authors state that the use of handheld devices has expanded the use of the VIP in everyday communication by improving the use of static and dynamic scene cues. Furthermore, current technology allows for the personalisation of symbols to increase comprehension and improve language instruction.

This article offers new ideas for the way in which current technology may be used by individuals with ASD, providing suggestions for the way in which this can be implemented in clinical practice to improve language instruction. These new technological developments may facilitate more effective language instruction than traditional methods, assisting in improved outcomes for individuals with ASD.

Prevalence and correlates of screen-based media use among youths with autism spectrum disorders

Mazurek, M.O., Shattuck, P.T., Wagner, M., & Cooper, B.P. (2011). Prevalence and correlates of screen-based media use among youths with autism spectrum disorders. *Journal of Autism and Developmental Disorders*, *42*(8), 1757–1767.

Evelyn Tan

Autism spectrum disorders (ASD) are characterised by poor performance in the areas of social functioning and degree of independence. Research show that the use of screen-based media such as television, computer and video games can have an influence on the adaptive functioning and social engagement among youths with ASD, but this issue has not been examined thoroughly.

This study aimed to examine the prevalence and correlates of screen-based media use among a large and representative sample of youths with ASD. Data was taken from the National Longitudinal Transition Study-2 (NLTS2) in the United States. The 920 participants (aged 13–16 years) in this study received special education under the primary disability category of autism.

The data was collected from parents or caregivers of the participants via computer-assisted telephone interviewing. Alternatively, an abbreviated questionnaire was mailed to parents that were not available for phone calls. The interview included a question "How frequently does the youth interact with others using email or taking part in chat rooms?" which the parents were asked to rank from "several times a day" to "less often". The question "During the past few weeks, how has the youth spent most of his/her time when she/he wasn't working or going to school?" was asked, and the responses provided were then categorised into 1) uses electronic or computer games, 2) uses computer for Internet or email, and 3) watches TV or videos. Parents were also required to rank their children's conversational ability and social competence using an ordinal scale. The youths with ASD were compared with youths with (a) intellectual disabilities (n = 850); (b) speech/language impairments (n = 860); and (c) learning disabilities (n = 880).

Results revealed that 64.2% of the youths with ASD spend most of their time engaging in nonsocial media. This was significantly different ($p < .001$) to individuals in the speech/language impairment group (33.5%) and those in the learning disability group (34.9%). They were also significantly more likely ($p < .01$) to watch TV and use electronic games, compared to the other groups. The group with ASD was less likely to use computers for email, chat or to access the Internet (13.2%).

The authors noted that the group with ASD had a significantly higher percentage of youths with no conversation ability compared to the other groups; and individuals in the ASD group were more likely to have a computer at home. These findings may influence the results. The percentage of youths with ASD who spent most of their free time watching television was about the same as the group with intellectual disabilities. This may indicate that the intellectual ability may not be a significant predictor of television use.

There were several limitations in this study. As the sample included youths who are eligible for special education services under the autism category, it is highly specific and the results may or may not generalise to all the ASD population. In addition, there were no standardised measures of communication skills, cognitive ability or social interactions included in the data. The survey methodology mainly depended on parent-report which may be subject to bias. These limitations might affect the ability to replicate the study or generalise the results in the future. Despite the limitations, this study provides a useful contribution to literature regarding screen-based media usage among ASD population.

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Number 3, 2013	12 April 2013	27 June 2013	Inter-professional education and practice
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