Profile of Australian preschool children with speech sound disorders at risk for literacy difficulties

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Abstract

Background: Speech sound disorders are a common communication difficulty in preschool children. Teachers indicate difficulty identifying and supporting these children.

Aim: To describe speech and language characteristics of children identified by their parents and/or teachers as having possible communication concerns.

Method: 275 Australian 4- to 5-year-old children from 45 preschools whose parents and teachers were concerned about their talking participated in speech-language pathology assessments to examine speech, language, literacy, non-verbal intelligence, oromotor skills and hearing.

Results: The majority (71.3%) of children demonstrated lower consonant accuracy than expected for their age, 63.9% did not pass the language-screening task, 65.5% had not been assessed and 72.4% had not received intervention from a speech-language pathologist. The 132 children who were identified with speech sound disorder (phonological impairment) were more likely to be male (62.9%) who were unintelligible to unfamiliar listeners, and had poor emergent literacy and phonological processing skills, despite having typical hearing, oral structures, and intelligence.

Conclusion: Children identified by parents and teachers with concerns may have a range of speech, language and communication needs requiring professional support.

Profile of Australian preschool children with speech sound disorders at risk for literacy difficulties

In Australia's recent history, quality nation-wide early childhood education has become a priority. Historically, attendance in preschool services was relatively low. For example, in 1991, 58% of Australian 4-year-old children attended a preschool service and this level maintained until at least 2001 when 56% of 4-year-old children attended preschool. In 2008, the Australian Government committed to high-quality, universal access to preschool services for all Australian children in the year before they started school. Building on the initiative of universal access, a National Quality Framework was developed in 2012 to support consistency in education services in the preschool year. As of 2015, a total of 325,273 Australian children were enrolled in a preschool program for the year before they start school. The 2015 enrolment rates reflect a considerable increase with 89% of 4-year-old children being enrolled.

One of five key standards included within the national Early Years Learning Framework is that children will become effective communicators (Commonwealth of Australia, 2009). The explicit inclusion of communication as an outcome reflects the importance of communication in children's everyday lives. It is a basic human right. Most children will acquire good oral and written communication skills as they develop and interact with the world around them, supported by stimulating early childhood environments and positive communication models. However, a significant number of children have difficulty with speech and language development and require additional support. McLeod and Harrison (2009) found approximately one quarter of Australian preschool children were identified with concerns about their talking, and the most common cause of concern was difficulty with speech sound production.

The term speech sound disorders (SSD) refers to difficulty that children have with perception, processing, planning and producing speech (McLeod & Baker, 2017). SSD, which manifest as difficulties saying the sounds in words correctly, contrasts with language difficulties which manifest as difficulties using and understanding correct grammar, vocabulary, and social language. SSD can be mild or severe, ranging from a single sound substitution or distortion (such as an interdental lisp) to unintelligible speech. There are different types of SSD, with the most common type being a phonological impairment—difficulty learning speech sounds and the rules about how speech sounds combine to form words. While known origins of SSD include hearing loss, cerebral palsy, cleft lip and palate, the cause for most children with SSD remains unknown (Shriberg et al., 2010). Children with SSD may have concomitant language difficulties (Macrae & Tyler, 2014) and may also be at risk for having difficulties with literacy, numeracy, and socialisation at school (Harrison, McLeod, Berthelsen, & Walker, 2009; McCormack, Harrison, McLeod, & McAllister, 2011; McLeod, Harrison & Wang, 2016). Indeed, Anthony et al. (2011) indicated that between 30 and 77% of school-aged children with speech sound disorders might have difficulties reading at school. In fact, it is thought that even children who have a resolved SSD when they start school may be at a greater risk of literacy difficulties than those without early speech difficulties (Lewis & Freebairn, 1992; Raitano, Pennington, Tunick, Boada, & Shriberg, 2004). This may be due, in part, to early difficulties processing the sound information required to learn early phonological awareness skills (Preston & Edwards, 2010; Preston, Hull, & Edwards, 2013).

Intervention to support children's speech development may assist children with SSD (Baker & McLeod, 2011; Law, Boyle, Harris, Harkness, & Nye, 2000), but direct speech and language services for children are not always available. Indeed, recent mapping of speech and language services in Australia found many communities lacked direct access, particularly in rural and remote areas of the country (McCormack & Verdon, 2015). Limited awareness of speech-language pathology services, and delays in receiving services due to long waiting lists are other barriers to access (McAllister, McCormack, McLeod, & Harrison, 2011; O'Callaghan, McAllister, & Wilson, 2005; Ruggero, McCabe, Ballard, & Munro, 2012). Due to the provision of universal preschool services for a large number of children, and the limited access to direct speech-language pathology services, several solutions to increasing children's access to services have been proposed. One of these is through the implementation of interventions for children with specific speech and language difficulties within the early childhood education environment. However, this requires early childhood educators and teachers to be able to identify children with communication difficulties, refer children to appropriate speech-language pathology services, and have access to the knowledge, skills and resources to support children with SSD.

Teachers frequently indicate that they have difficulty identifying these children with speech and language difficulties, and knowing how to support them (Dockrell & Lindsay, 2001; Marshall, Ralph, & Palmer, 2002; McLeod & McKinnon, 2010; Mroz & Hall, 2003). One way to address a gap in knowledge is to examine the characteristics of children with communication difficulties, based on parent and/ teacher reports of concern. Many studies either provide a broad description of children with speech and language difficulties, or describe a clinical sample. There is a need for Australian data to profile the details of Australian children in preschool settings who have speech sound disorders who may be at risk for future literacy difficulties.

Aim

The aim of this paper was to describe the characteristics of preschool-aged children whose parents and/or teachers were concerned about their speech and language development. A secondary aim was to describe the profiles of children with the most common type of SSD of unknown origin—phonological impairment, with regard to speech, language, emergent literacy and phonological processing abilities, and attitudes to communication. This second aim considers children beyond the accuracy of their speech sounds to build a more holistic profile of preschool children, beyond the area of communication expressed as an area of concern by their parent and/or teacher.

Method

Participant recruitment

The children described in this study were participating in the Sound Start Study, a cluster randomised controlled trial designed to examine the effectiveness of a computerised intervention for children with SSD (McLeod et al., 2016). The Sound Start Study was conducted in 45 early childhood education centres in Sydney, Australia. These centres were run by the Department of Education and Communities (government) (*n* = 22, 48.9%), independent/private companies (*n* = 7, 15.6%), the local council (*n* = 5, 11.1%), or were community-based (*n* = 11, 24.4%).

The study comprised of six stages of data collection: (1) screening of children's developmental status via parent and teacher report (*n* = 1,205), (2) direct screening assessment of children identified by parents/teachers with difficulty "talking and making speech sounds" (Glascoe, 2000) whose difficulties could not be attributed to a known cause such as hearing loss or cleft palate (*n* = 275), (3) comprehensive assessment of children with SSD (specifically phonological impairment) to identify those eligible for the intervention trial (*n* = 132), (4) intervention/control, (5) immediate post-intervention follow-up and, (6) delayed post-intervention follow up. Exclusionary criteria were: (1) if children were identified to have a history of hearing loss, cleft lip and/or palate, or an intellectual disability (based on parent report), (2) if children spoke English as a second language and English language proficiency was not as strong as additional language proficiency (based on parent report), (3) if children did not demonstrate an SSD with phonological error patterns that could be targeted in the intervention software, (4) if children demonstrated low non-verbal intelligence, (5) if children demonstrated receptive vocabulary outside the typical range, (6) if parents did not provide consent or children did not provide assent for participation.

In the current study, the results of data collected in stages 2 and 3 of the Sound Start Study are reported. Stages 2 and 3 occurred after the children had been screened, but before the intervention was implemented. The derivation of participants described in this study are depicted in Figure 1; first those children who completed a screening assessment at stage 2 (described as the Concern group), and then a subgroup of children identified during the speech-language pathology assessment in stage 2 as having a phonological impairment of unknown origin (the most common type of SSD, described as the SSD subgroup). This latter subset of children completed more comprehensive communication assessment at stage 3 in addition to the assessment that they completed at stage 2.

Insert Figure 1 here

Participants

The Concern group were 275 children who were assessed in stage 2 of the Sound Start Study. Most of the children in the Concern group (*n* = 153, 55.6%) were identified based on their parent and teacher reporting concerns about the child's talking and making speech sounds from responses to a written questionnaire, which included the Parents' Evaluation of Developmental Status (PEDS, Glascoe, 2000). Sixty-three (22.9%) children were identified by parents only reporting concern ("yes" and "a little" concern based on the "talking and making speech sounds" PEDS question) and 59 (21.5%) were identified by teachers only reporting concern (i.e., the parents of these children did not report concern). The participants' ages ranged from 48 to 66 months (*M* = 54 months; *SD* = 4.26 months), and over half were male (*n* = 170, 61.8%). Participants' socio-economic status (SES) was measured using the Index of Relative Socioeconomic Advantage and Disadvantage (IRSAD, Australian Bureau of Statistics, 2011) that is based on residential postcode. Areas with a decile of 1 are considered the most disadvantaged areas while areas with a decile of 10 are considered the most advantaged areas. The mean was 5.7, median was 6.0, and range was from 1 to 10, indicating that the participants were drawn from the entire spectrum of SES. Prior to involvement in the Sound Start Study, the majority had not had either a speech-language pathology assessment (*n* = 180, 65.5%) or speech-language pathology intervention (*n* = 199, 72.4%).

The SSD subgroup included 132 children whose ages ranged from 48 to 65 months (*M* = 55.0, *SD* = 4.26). Over half were male (*n* = 83, 62.9%) and the mean IRSAD index score was 6.1 (median = 7.0, range 1-10). Prior to the Sound Start Study 87 (65.9%) of these subgroup participants had not had a speech-language pathology assessment and 94 (71.2%) had not had speech-language pathology intervention.

Procedure

Following the collection of parent and child assent to participate, participants were assessed by one of two experienced speech-language pathologists in a quiet space within the early childhood centre that they attended. Assessments sessions took 30-60 minutes each, with breaks available for participants who required them. Assessments were audio and/or video recorded with a Zoom H1 audio recorder and a Panasonic HC-V700 video camera with external Hahnel Mk100 microphone. Assessments were all scored and transcribed at the time of the assessment, with the content of all transcriptions later checked by the assessing speech-language pathologist using audio recording. Stage 2 and 3 assessments were usually completed on separate days.

Assessments.

Concern group. The participants in the Concern group, whose parents and/or teachers were concerned about their talking, underwent screening assessments in stage 2 (see Figure

1) to examine speech accuracy, oromuscular structure and function, voice and fluency, language, nonverbal intelligence, and hearing skills. Participants' speech accuracy was directly measured using the 50 single words of the Diagnostic Evaluation of Articulation and Phonology - Phonology subtest (Dodd, Zhu, Crosbie, Holm, & Ozanne, 2002) and indirectly measured (via parent report) using the Intelligibility in Context Scale (ICS, McLeod, Harrison, & McCormack, 2012). Participants' speech oral structure and function was examined using the 80 item Oral and Speech Motor Control Protocol (Robbins & Klee, 1987) which evaluated the structure and function of the lips, jaw, teeth, tongue, velopharynx (soft palate and back of the throat), larynx (voice box), and coordinated speech, prosody, and voice. Participants' expressive and receptive language, social communication skills, fluency, and voice were screened using the Preschool Language Scale-5 Screening Test (PLS-5S, Zimmerman, Steiner, & Pond, 2013). Nonverbal intelligence was examined using the Primary Test of Nonverbal Intelligence (PTONI, Ehrler & McGhee, 2008). Participants' hearing was screened at 40dB using pure tones at 0.5, 1, 2, and 4 kHz bilaterally with a MA1 Ultra Portable Audiometer fitted with Peltor cups.

SSD subgroup. All SSD subgroup participants were offered the opportunity to participate in stage 3 assessments (in addition to the screening assessment completed at stage 2). The comprehensive assessments completed at stage 3 examined participants' speech sounds, language, emergent literacy skills, phonological processing skills, and attitudes towards communication. More comprehensive measures of speech sound accuracy were also conducted in stage 3. Stimulability is a measure used to identify the consonants that children can say in isolation. Participants' stimulability for all 24 English consonants was assessed by asking participants to imitate consonants in isolation (e.g., say /p/). Participants' production of polysyllabic words (words with three or more syllables) was assessed using the 30 single word Polysyllable Preschool Test (POP, Baker, 2013b). Participants' receptive vocabulary was assessed using the Peabody Picture Vocabulary Test – 4 (PPVT-4, Dunn & Dunn, 2007) and their use of grammatical word endings was assessed using the 20 item Children's Assessment of Morphophonemes (CHAMP, Baker, 2013a). Participants' emergent literacy skills were assessed using two tasks. First, participants were asked to identify the names and sounds of the 26 letters of the English alphabet (based on Anthony et al., 2011). Second, participants' print knowledge was examined using the Preschool Word and Print Awareness test (PWPA, Justice, Bowles, & Skibbe, 2006). Phonological processing skills were assessed using seven subtests of the Comprehensive Test of Phonological Processing (CTOPP-2, Wagner, Torgesen, Rashotte, & Pearson, 2013): (1) elision, (2) blending words, (3) sound matching, (4) memory for digits, (5) nonword repetition, (6) rapid colour naming, and (7) rapid object naming. Participants' attitudes to their own speech and communication was considered using the Communication Attitude Test (KiddyCAT, Vanryckegham & Brutten, 2006) and Speech Participation and Activity for Children (SPAA-C, McLeod, 2004).

Questionnaires.

One 12-page questionnaire was provided to the parents of participants in the Concern group (stage 2). Within the questionnaire parents were asked to describe their child's: speech, language, developmental, and health history; prior access to speech-language pathology services; home language, literacy, and technology environment; and family history. An additional 6-page questionnaire was provided to the parents of participants in the SSD subgroup (stage 3). Within the stage 3 questionnaire parents were asked to describe their child's: reading skills, communication skills (including the Focus on the outcomes of Communication Under Six [FOCUS], Thomas-Stonell et al., 2012), and psychosocial development (including the Strengths and Difficulties Questionnaire [SDQ], Goodman, 1997).

Data analysis

Raw data were entered into SPSS (IBM, 2015). Where standardised assessments provided tables of normative data to calculate standard scores, these were used as per the test manual instructions and entered to SPSS. Data were analysed in terms of frequency, central tendency, variability, and completeness. Phonetic transcriptions from the DEAP Articulation and Phonology subtests (Dodd et al., 2002) were entered into the PROPH+ module of Computerized Profiling (Long, Fey, & Channell, 2008), with phonological patterns and percentage of consonants correct (PCC), percentage of vowels correct (PVC), and percentage of phonemes correct (PPC) values extracted.

Reliability

Point-by-point transcription reliability was completed for the DEAP Phonology Assessment based on a randomly selected sample of 30 assessments from stage 2 (10.9%), totalling 6,629 data points. For broad phonetic transcription intra-judge agreement was 91.5% and inter-judge agreement was 90.1%. This level of reliability demonstrates "acceptable agreement" (Shriberg & Lof, 1991, p. 255).

Results

The assessment results of the Concern group (*n* = 275) are presented in the subsequent sections followed by the assessment results of the SSD subgroup (*n* = 132) (see Figure 1). Not all participants in the sample completed each of the assessment tasks. For this reason, valid percentages are reported in the following sections.

Concern group: Characteristics

Family history

Questionnaires were returned by 249 parents of the 275 participants. Parents reported a higher percentage of speech, language, and literacy difficulties in brothers (*n* = 39, 15.7%) and sisters (*n* = 30, 12.0%) of participants than in fathers (*n* =15, 6.0%) and mothers (*n* = 14, 5.6%).

Languages used.

All participants were exposed to environments where spoken English was used. All participants spoke English as one of their languages with thirty other languages being spoken. Participants were reported to speak between one and four languages, with the majority speaking English only (*n* = 205; 74.5%). Sixty-six (24.0%) participants spoke two languages, three (1.1%) spoke three languages, and one (0.4%) spoke four languages. The most common other languages used by the participants were Arabic (*n* = 12), Greek (*n* = 6), Hindi (*n* = 5), Spanish (*n* = 5), Filipino (*n* = 4), Indonesian (*n* = 4), Korean (*n* = 4), Cantonese (*n* = 3), Maori (Cook Island) (*n* = 3), Punjabi (*n* = 3). Just over half of the participants (based on 272 responses) were rated by their parents as speaking English very well (*n* = 146; 53.7%); however, the remaining participants were rated as speaking English somewhat well (*n* = 108, 39.7%), or not very well (*n* = 18, 6.6%).

Insert Table 1 here

Speech accuracy.

Based on the results of the DEAP Phonology assessment (Dodd et al., 2002), most participants in the Concern group had a low PCC (*M* = 72.65, *SD* = 14.37, range 29.10-98.60) compared to the expected consonant accuracy for their age, with only 28.7% achieving scores that were within normal limits (see Table 1). Their accuracy of vowel production was also lower than that expected for their age (*M* = 92.42, *SD* = 6.88, range 46.50-100.00) with 25.1% achieving a score within normal limits. Phonological processes (or phonological patterns) are patterns of errors that can be identified in children’s speech output. Children presented with a range of different processes that affected the accuracy and intelligibility of their speech (see Table 2). Cluster reduction (e.g., saying *top* for *stop*) was the most common phonological pattern with 128 (46.5%) participants demonstrating this error.

Insert Table 2 here

The intelligibility of participants' speech with different communication partners was described by their parents using the ICS (McLeod et al., 2012) where a higher score indicated children who were rated as being more intelligible to a variety of communication partners (family, friends, extended family, acquaintances, and strangers). Overall, the mean total score for participants was 3.90 (*SD* = 0.66) out of a maximum possible score of 5. This was lower than the mean score of 4.6 (*SD* = 0.5) for typically developing Australian children (McLeod, Crowe & Shahaeian, 2015). Parents' ratings of participants' intelligibility varied across communication partners. Participants were described as being most intelligible to the parent completing the questionnaire (*M* = 4.41, *SD* = 0.61) followed by other immediate family members (*M* = 4.08, *SD* = 0.75), teachers (*M* = 3.97, *SD* = 0.74), the child's friends (*M* = 3.97, *SD* = 0.80), extended family members (*M* = 3.77, *SD* = 0.78), acquaintances (*M* = 3.63, *SD* = 0.85) and strangers (*M* = 3.50, *SD* = 0.93).

The speech-language pathologists completed ratings of participants' global speech skills using the AusTOMs (Perry & Skeat, 2004) for 272 participants in stage 2 (see Table 1). The AusTOMs describe speech along 4 scales with a score of between 0 (most severe) and 5 (no difficulty or impairment) across the ICF categories of impairment of structure/function, activity limitation, and participation restriction, and an additional category describing the child's distress/wellbeing due to their speech skills. Participants were rated as having most difficulty with regard to the severity of their speech impairment (*M* = 3.95, *SD* = 0.61) and the least impact on their wellbeing/distress (*M* = 4.69, *SD* = 0.53).

Oromuscular structure and function.

Participants' (*n* = 263) oral structure and function was examined using the Oral and Speech Motor Control Protocol (Robbins & Klee, 1987) (see Table 1). The majority (*n* = 218, 82.9%) presented with typical oral structures, reflecting appropriate symmetry of the lips, jaw and tongue, and tooth alignment and gaps. However, only 43 (16.4%) of participants demonstrated typical oral functioning, reflecting scores outside the normal range on movements such as retraction and rounding of the lips, and production of rapid coordinated speech movements (e.g., saying *papapapapa*) and producing polysyllabic words.

Voice and fluency.

Speech-language pathologists described participants' (*n* = 266) voice and fluency using descriptions from the PLS-5S (Zimmerman et al., 2013). The majority were described as having typical voice characteristics (*n* = 249, 93.6%) and typical speech fluency (*n* = 261, 98.1%).

Language.

Participants' (*n* = 266) expressive and receptive language skills were screened using the PLS-5S (Zimmerman et al., 2013). Using the PLS-5S criteria, only 96 (36.1%) participants achieved the "pass" criteria. The remaining 169 (63.5%) participants did not achieve the pass criteria and were recommended for further investigation of their language skills. However, the majority of participants (*n* = 251, 94.4%) were described as having social and interpersonal communication skills that were acceptable for children of their age.

Nonverbal intelligence.

Participants' (*n* = 273) non-verbal intelligence was assessed using the PTONI (Ehrler & McGhee, 2008) (see Table 2). The PTONI has a standard score of 100 and standard deviation of 15. The mean standard score of participants was 95.74 (SD = 21.03, range 54-149) and the distribution of scores showed a normal pattern (skewness = 0.10, kurtosis = -0.72). The PTONI prescribes descriptors of children's performance based on the standard score that they achieve. The participants performed in the following ranges: very superior (*n* = 11, 4.0%), superior (*n* = 23, 8.4%), above average (*n* = 40, 14.7%), average (*n* = 87, 31.9%), below average (*n* = 34, 12.5%), low (*n* = 35, 12.8%), and very low (*n* = 43, 15.8%).

Hearing.

Screening audiometry was completed by 257 participants during stage 2. A pass result required responses to tones at 0.5, 1, 2, and 4kHz at 40dB bilaterally. The majority of participants (*n* = 229, 89.1%) received a pass result, while 28 (10.9%) were referred for further hearing testing. Ambient noise levels in the early childhood environment where testing occurred were sampled during 82 (31.9%) screening audiometry assessments with a mean level of noise was 47.7dBA (*SD* = 8.47, range 35-71dB) using A-frequency-weighting and slow-time-weighting.

Characteristics: SSD subgroup

Parent-reported strengths and difficulties.

The Strengths and Difficulties Questionnaire (SDQ, Goodman, 1997) was completed by the parents of 106 (80.3%) participants in the SSD subgroup who returned a written questionnaire (the parents of 26 participants did not return the questionnaire). Parents' responses on the SDQ are used to consider children's performance across five domains of psychosocial development: emotion, conduct, hyperactivity/inattention, peer relationships, and prosocial behaviour. The subgroup's overall SDQ scores were below that expected, and indicated the majority of participants had difficulties with 28 (26.4%) scoring in the "borderline band" and 51 (48.1%) scoring in the "abnormal band". The majority of participants fell in the "normal band" on four of the five subscales: emotional symptoms scale (normal *n* = 96, 90.6%; borderline *n* = 5, 4.7%; abnormal *n* = 5, 4.7%), hyperactivity scale (normal *n* = 87, 82.7%; borderline *n* = 12, 11.3%; abnormal *n* = 6, 6.6%), conduct problems scale (normal *n* = 67, 63.2%; borderline *n* = 16, 15.1%; abnormal *n* = 23, 21.7%), and the prosocial scale (normal *n* = 62, 58.5%; borderline *n* = 23, 21.7%; abnormal *n* = 21, 19.8%). The opposite pattern was evident on the peer problem scale with the majority of participants in the abnormal band (*n* = 61, 57.5%), followed by borderline (*n* = 29, 27.4%) and only 16 (15.1%) of participants in the normal band.

The Focus on the Outcomes of Communication Under Six (FOCUS, Thomas-Stonell et al., 2012) was used to examine children's participation in life activities. Parents of 104 subgroup participants completed all items, and a further six parents completed some of the FOCUS items (see Table 4). When ranked, parents provide the most positive responses to questions relating to children's receptive language and attention, coping strategies and emotions, and independence.

Insert Table 3 here

Speech sounds in isolation and polysyllabic words.

Participants' (*n* = 131) consonant stimulability in isolation was assessed for all 24 English consonants (see Table 3). Between 75% and 89% of participants were able to produce the sounds /θ, v, z, ʒ, ʧ, ʤ, ɹ/ (i.e., v, z, zh, ch, j, ɹ, and voiceless th). Only 63% of participants were able to produce the voiced th sound /ð/.

Participants' (*n* = 129) production of polysyllabic words (e.g., *computer*, *thermometer*, and *caterpillar*) was assessed using the POP (Baker, 2013b). Participants demonstrated decreased consonant, vowel, and phoneme accuracy when saying polysyllabic words compared to their speech accuracy on the DEAP, which contains mainly monosyllabic words. The mean PCC was 64.41 (*SD* = 11.11, range 28.13-85.94), the mean PVC was 83.88 (*SD* = 8.23, range 60.44-99.02), and the mean PPC was 72.99 (*SD* = 8.87, range 43.91-88.70).

Language.

Participants' (*n* = 132) receptive vocabulary skills were explored using the PPVT-4 (Dunn & Dunn, 2007). The PPVT-4 has a standard score of 100 and standard deviation of 15. The mean standard score of participants was 95.28 (*SD* = 14.47, range 45-126) and the distribution of scores showed a normal pattern (skewness = -0.20, kurtosis = 0.10). Using the PPVT-4 definition of typical performance (standard score ≥70), 127 (96.2%) of participants had receptive vocabulary skills that were within the normal range, and five (3.8%) participants did not.

Participants' (*n* = 126) use of morphophonemes was described using the CHAMP (Baker, 2013a). Data collected from the CHAMP was analysed to identify participants' use of non-finite morphemes (e.g., plurals *cows*, possessives *boy's*), finite morphemes (e.g., third person singular *cries*, regular past tense *played*, copula and auxiliary verbs *is skipping*), and total morphemes in different phonological contexts. Of four opportunities participants used a mean of 2.91 (*SD* = 1.22, range 0-4) non-finite morphemes. Of 12 opportunities participants used a mean of 7.89 (*SD* = 2.85, range 1-12) finite morphemes. Total morpheme use (of 16 opportunities) was a mean of 10.81 (*SD* = 3.73, range 2-16).

Emergent literacy.

Participants' (*n* = 110) knowledge of the names of letters and the sounds that letters represent revealed subgroup participants were able to provide, on average, the names of six letters (*M* = 6.08, *SD* = 7.91, range 0-26) but only the sounds for 1 letter (*M* = 1.36, *SD* = 3.68, range 0-22).

Participants' (*n* = 129) print knowledge and awareness of print concepts was examined using the PWPA (Justice et al., 2006). Scores on this test are converted to a Print-Concept Knowledge (PCK) score with a mean of 100 and a standard deviation of 15 (Justice et al., 2006). Participants had a mean PCK score of 94.24 (*SD* = 15.43, range 46-134) with 9 (7.0%) scoring below a 70, 119 (92.2%) scoring between 70 and 130, and 1 (0.8%) scoring above 130. The items on which participants scored best related to identifying the front of the book (*n* = 98, 76.0%), identifying a letter in the text (*n* = 81, 62.8%), and describing text directionality (*n* = 71, 55.0%). The items on which participants scored least related to understanding the function of print (*n* = 19, 14.7%) and contextualising print (*n* = 26, 20.2%).

Phonological processing.

Participants' (*n* = 130) phonological processing skills were examined using seven subtests of the CTOPP-2 (Wagner et al., 2013). The scaled scores for all subtests of the CTOPP-2 have a mean of 10 and a standard deviation of 3. Participants performed best on the two rapid naming subtests where they were required to name a set of coloured squares (*n* = 87, *M* = 9.05, *SD* = 3.53) or pictures of common objects (*n* = 115, *M* = 8.76, *SD* = 2.94) as quickly as possible. The assessment protocol for the CTOPP-2 indicated that no score is to be recorded once children demonstrate more than four naming errors on the rapid naming task. Thus, not all children were able to achieve a score on these subtests. Although means of all subtests were below 10, children's mean score was within the normal range for the following subtests: memory for digits (e.g., repeat 4, 5, 9, 6, 4) (*n* = 129, *M* = 8.54, *SD* = 2.90); sound matching (e.g., which word starts with /s/ like *sock*?) (*n* = 129, *M* = 8.40, *SD* = 2.17); elision (e.g., say *meet* without saying /t/) (*n* = 128, *M* = 8.23, *SD* = 2.08); blending words (e.g., what word does /ɪ/+/t/ make?) (*n* = 129, *M* = 7.37, *SD* = 1.75). Children had much more difficulty with the nonword repetition subtest (e.g., say *sart*) with a mean score of only 3.13 achieved (*n* = 129, *SD* = 2.03).

Three composite scales were calculated using the CTOPP-2 (Wagner et al., 2013), phonological awareness, phonological memory, and rapid non-symbolic naming, where composite scales had a mean of 100 and a standard deviation of 15. The mean composite score for phonological awareness (*n* = 130) was 87.73 (*SD* = 10.97), 74.81 (*SD* = 12.58) for phonological memory (*n* = 129), and 91.16 (*SD* = 20.67) for rapid non-symbolic naming (*n* = 95).

Attitudes towards speech.

Participants' (*n* = 129) attitudes to talking were assessed using the KiddyCAT (Vanryckegham & Brutten, 2006), which required them to respond to 12 yes/no questions (e.g., "Do you like to talk?"). Lower scores indicated more positive attitudes to communication and participants had a mean score of 3.84 (SD = 2.49, range 0-11). The KiddyCAT defined typical attitudes as having a score in the range 0-4. Half of the participants (*n* = 76, 58.9%) had typical attitudes with less (*n* = 53, 41.1%) having atypical attitudes.

Participants' (*n* = 129) feelings about talking in different communication situations were assessed using the SPAA-C (McLeod, 2004), which allows children to respond to questions (e.g., "How do you feel about the way you talk?") by pointing to pictures describing ☺ "happy", 😐 "in the middle", ☹ "sad", ? "don't know", or giving a different response across 10 questions. The mean number of times participants reported that they were ☺ "happy" was 6.24 (*SD* = 3.08, range 0-10) of a maximum possible score of 10.

Discussion

The characteristics of preschool-aged children whose parents and/or teachers were concerned about their speech and language development are described in this study to consider the profiles of children with the most common type of SSD of unknown origin—phonological impairment—with regard to speech sound accuracy, language skills, emergent literacy, phonological processing, and attitudes to communication. Results of this study indicate that 71.3% of children identified by parents and teachers with concerns about their talking demonstrated lower consonant accuracy than expected for their age and 63.9% did not pass the language-screening task. The results will be discussed in the following sections with regard to each of the groups described (Concern group and SSD subgroup) and the broader literature.

Profile of Children whose Parents/Teachers were Concerned

There were more male participants (61.8%) than female participants in the Concern group which is consistent with the over-representation of male participants in community-based samples of children with communication difficulties (e.g., Roulstone et al., 2003). Few participants had a positive family history of speech, language, and literacy difficulties (5.6%-15.7%). Shriberg (2010) suggested that up to 56% of children with SSD may have a genetic basis. Although up to 30% of children with SSD may have fluctuating hearing levels and otitis media with effusion (Shriberg, 2010), the number of participants who demonstrated hearing loss on the day of their screening was much lower in the current study at 10.9%. The results of this current study suggest that even children who pass a hearing screening and have no family history of speech, language, and literacy difficulties may have speech sound difficulties prominent enough to be of concern to their parents and teachers. The participants' IRSAD deciles ranged from 1 to 10, indicating that participants were drawn from every socioeconomic status (SES) grouping in Australia, from the least to most advantaged. Within the sample, the majority (*n* = 205, 74.55%) of the participants were monolingual English speakers with the remaining participants speaking other languages in addition to English (these participants' spoke 1-3 additional languages). Generally, being multilingual does not increase or decrease the risk of speech and language difficulties (McLeod, Harrison, Whiteford & Walker, 2016).

The participants in the Concern group typically demonstrated low consonant accuracy and the presence of phonological patterns (e.g., cluster reduction was demonstrated by 46.5% of participants). The participants' scores on the nonverbal intelligence test indicated normal distribution within the sample. Participants' scores on the nonverbal intelligence test highlighted that children can have difficulties with speech sound development with all levels of nonverbal intelligence. Given the diversity of language use by the parents and children in this study (and in the broader Australian population), parent report may be one of the few indicators to educators that a child is having difficulty developing a language other than English.

Profile of Children with SSD

Examination of the profile of children with phonologically-based SSD of unknown origin (n = 132) highlighted the varied performance of these children on most of the measures collected. Of particular interest was children's performance on language, emergent literacy and phonological processing tasks and the impact of their speech sound difficulties on children's participation.

In the stage 2 assessments completed by all main group participants, 63.9% did not pass a language screening task (PLS-5S, Zimmerman et al., 2013). When the language skills were probed more specifically in stage 3, most participants (96.2%) demonstrated receptive vocabulary skills that were within the typical range but demonstrated difficulties with expressive language skills. In particular, many demonstrated low use of morphophonemes (e.g., grammatical markers for third person singular, past tense). These results are consistent with previous reports of children with phonological impairment being at risk of expressive (but not necessarily receptive) language difficulties (Mortimer & Rvachew, 2010). The relatively poor performance of these children on measures of emergent literacy and phonological processing was also consistent with previous reports (e.g., Anthony et al., 2011; Eadie et al., 2014), suggesting an increased risk of future literacy difficulties among children with phonologically-based SSD of unknown origin.

The measures of speech accuracy (DEAP, ICS) indicate that these children may have considerable difficulty being understood by peers and unfamiliar communication partners. However, these measurable difficulties may not have impacted children's participation and performance negatively. Parent responses on the FOCUS (Thomas-Stonell et al., 2012) indicate that the top ranked items include positive responses to one area describing body function and capacity (receptive language/attention) and two areas of communication performance (coping strategies/emotions, and independence). However, parents' reports on the SDQ (Goodman, 1997) indicate 57.5% of participants fall outside the typical range with regard to the peer problem scale. It may be that parents recognise their children desire communication interactions and seek opportunities to engage with others, but also recognise the challenges that this can present when interacting with peers (in contrast to family and supportive adults).

Limitations

There were three main limitations of this research. First, there was no attempt to assess the children whose parents did not report concerns about their speech and language. A series of these assessments could have provided a comparison of the sensitivity of the screening tool (PEDS, Glascoe, 2000) used to identify children with communication concerns in preschool. Second, we focused on children with the most common type of SSD-phonological impairment. Profiling children with other types of SSD such as articulation impairment (e.g., lisp), dysarthria associated with cerebral palsy, or SSD of known origin (e.g., cleft lip) would provide valuable information about similarities and difference among children across the broader SSD group. Third, the sensitivity and reliability of the parent questionnaire data requires further investigation. The AusTOMs and the FOCUS have both been developed as outcome measures to report changes in communication after a period intervention. There are no normative data available to determine the typical variability of responses in a sample of preschool-aged children. In terms of the AusTOMs, reliability of some of the subscales is reportedly low (Morris et al., 2005). A robust measure to determine the quality of children's activity and participation at baseline is required.

Conclusion

Preschool-aged children with SSD, specifically those with phonological impairment, tend to be boys, are from a diverse range of SES backgrounds, are often unintelligible to unfamiliar listeners, and have poor emergent literacy and phonological processing skills, despite having typical hearing, oral structures, and intelligence. Knowledge about the typical profiles of preschool-aged children with SSD will assist educators to identify these children in need of support prior to starting school. It is important that parents and teachers discuss concerns that they have about children's communication development and refer to a speech-language pathologist who can provide advice about children's speech, language, and literacy. Speech-language pathologists may provide assessments and intervention to support children's speech, language, or literacy to enhance their social and educational outcomes at school.

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Table 1

Characteristics of Participants in the Concern Group (assessed at stage 2; n = 275)

Domain	**Assessment**	**Sub-domain**	**Findings**			
			Mean (*SD*)	**Range**	**WNL *n* (%[a])**	**Valid data[b]**
Language use	Reported via parent questionnaire	Number of languages spoken	-	1-4	-	275
Speech accuracy	Diagnostic Evaluation of Articulation and Phonology (DEAP, Dodd et al., 2002)	Percentage of consonants correct	72.65 (14.37)	29.10-98.60	79 (28.7%)	275
		Percentage of vowels correct	92.42 (6.88)	46.50-100.00	69 (25.1%)	275
		Percentage of phonemes correct	78.64 (11.12)	47.30-98.60	61 (22.2%)	275
	Preschool Language Scale-5 Screening Test (PLS-5S, Zimmerman et al., 2013)	Articulation accuracy	-	-	178 (67.4%)	264
	Intelligibility in Context Scale (ICS, McLeod et al., 2012)	Intelligibility (max = 5)	3.90 (0.66)	-	-	275
	Australian Therapy Outcome Measures for speech and participation (AusTOMs, Perry & Skeat, 2004)	Severity of speech impairment (max = 5)	3.95 (0.61)	2-5	-	272
		Limitation to activity (max = 5)	4.32 (0.77)	1-5	-	272
		Restriction to participation (max = 5)	4.52 (0.65)	2-5	-	272
		Wellbeing/distress (max = 5)	4.69 (0.53)	2-5	-	272
Oromuscular structure and function	Oral and Speech Motor Control Protocol (Robbins & Klee, 1987)	Structure (max = 24)	22.47 (1.97)	10-24	218 (82.9%)	263
		Function (max = 112)	94.82 (10.54)	31-110	43 (16.4%)	263
Voice and fluency	Preschool Language Scale-5 Screening Test (PLS-5S, Zimmerman et al., 2013)	Voice	-	-	249 (93.6%)	266
		Fluency	-	-	261 (98.1%)	266
Language	Preschool Language Scale-5	Receptive and expressive	-	-	96 (36.1%)	266

	Screening Test (PLS-5S, Zimmerman et al., 2013)	language				
		Social Communication	-	-	251 (94.4%)	266
Nonverbal intelligence	Primary Test Of Nonverbal Intelligence (PTONI, Ehrler & McGhee, 2008)	Nonverbal inteligence [c]	95.74 (21.03)	54-149	-	273
Hearing	Pure-tone audiometry	Play audiometry	-	-	229 (89.1%)	257

Note. WNL = within normal limits. [a] Valid percentage reported. [b] Valid data indicates the number of children who completed each assessment and/or subtest in full, [c] standard score of 100 with SD of 15.

Table 2
Phonological Patterns Demonstrated by Participants in the Concern Group (assessed at stage 2; n = 275)

Phonological pattern	**Description**	**Children demonstrating this phonological pattern *n* (%)**
Cluster reduction	Not saying all the sounds when consonants are grouped together. For example saying ***pl****ash* for ***spl****ash*	128 (46.5%)
Stopping	Replacing longer sounds with shorter sounds. For example saying ***t****ee* for ***s****ee*	55 (20.0%)
Fronting	Replacing sounds made towards the back of the mouth with sounds made further forward in the mouth. For example saying ***t****up* for ***c****up*	64 (23.3%)
Final consonant deletion	Not saying the final consonant in words. For example saying *ca* for *ca****t***	20 (7.3%)
Gliding	Replacing ‘r’ and/or ‘l’ with ‘w’ and/or ‘y’. For example saying ***w****abbit* for ***r****abbit*	102 (37.1%)
Voicing	Making errors on related to the voicing of sounds. For example saying ***b****ig* for ***p****ig*	30 (10.9%)
Deaffrication	Replacing afffricate sounds (e.g., ‘ch’ as in *chip*) with fricative sounds (e.g., ‘sh’ as in *ship*)	6 (2.2%)
Weak syllable deletion	Not saying all of the syllables in a word. For example, *raffe* for ***gi****raffe*	87 (31.6%)

Table 3.
Characteristics of the SSD Subgroup (assessed at stage 3; n = 132)

Domain	**Assessment**	**Sub-domain**	**Findings**		
			Mean (*SD*)	**Range**	**Valid data**[a]
Speech sounds	Sound stimulability	Ability to produce English consonants (max = 24)	22.13 (1.90)	15-24	131
	Polysyllable Preschool Test (POP, Baker, 2013b)	Percentage of consonants correct	64.41 (11.11)	28.13-85.94	129
		Percentage of vowels correct	83.88 (8.23)	60.44-99.02	129
		Percentage of phonemes correct	72.99 (8.87)	43.91-88.70	129
Language	Peabody Picture Vocabulary Test – 4 (PPVT-4, Dunn & Dunn, 2007)	Receptive vocabulary (standard score [b])	95.28 (14.47)	45-126	132
	Children's Assessment of Morphophonemes (CHAMP, Baker, 2013a)	Morphophonemes (max = 16)	10.81 (3.73)	2-16	126
Emergent literacy	Sound and letter knowledge (based on Anthony et al., 2011)	Letter name knowledge (max = 26)	6.08 (7.91)	0-26	110
		Letter sound knowledge (max = 26)	1.36 (3.68)	0-22	110
	Preschool Word and Print Awareness test (PWPA, Justice et al., 2006)	Print concept knowledge [c]	94.24 (15.43)	46-134	129
Phonological processing	Comprehensive Test of Phonological Processing (CTOPP-2, Wagner et al., 2013)	Phonological awareness [d]	87.73 (10.97)	50-116	130
		Phonological memory [d]	74.81 (12.58)	34-101	129
		Rapid non-symbolic naming [d]	91.16 (20.67)	43-131	95
Attitudes to communication	Communication Attitude Test (KiddyCAT, Vanryckegham & Brutten, 2006)	Attitudes towards talking (max = 12) [e]	3.84 (2.49)	0-11	129
	Speech Participation And Activity for Children (SPAA-C, McLeod, 2004)	Responded as being "happy" when talking (max = 10)	6.24 (3.08)	0-10	129

Note. [a] Valid data indicates the number of children who completed each assessment and/or subtest in full, [b] mean standard score of 100 with SD of 15, [c] Print Concept Knowledge score has a mean of 100 and a SD of 15 (Justice et al., 2006), [d] composite scales with a mean of 100 and SD of 15, [e] Lower scored indicated more positive attitudes to children's own communication

Table 4.
Areas of Communication Reported by Parents in Rank Order from Most Like their Child to Least Like their Child on the Focus on the Outcomes of Communication Under Six (FOCUS, Thomas-Stonell et al., 2012)

Rank	ICF-CY		Example items
	Area of communication	Domain	
1.	Receptive Language/Attention	Body Function/Capacity	- My child will sit and listen to stories - My child can respond to questions
2.	Coping strategies/Emotions	Performance	- My child is confident communicating with adults who know my child well - My child gets along with other children
3.	Independence	Performance	- My child can communicate independently - My child can communicate independently with other children
4.	Intelligibility	Performance	- My child can be understood by other children - My child is understood the first time when talking with adults who do not know my child well
5.	Expressive language	Body Function/Capacity	- My child conveys her/his ideas with words - My child uses new words
6.	Expressive language	Performance	- My child can talk to other children about what s/he is doing - My child can tell stories that make sense
7.	Social/Play	Performance	- My child talks while playing - My child joins in conversations with her/his peers
8.	Pragmatics	Body Function/Capacity	- My child uses words to ask for things - My child will ask for things form adults s/he knows well
9.	Speech	Body Function/Capacity	- My child speaks slowly when not understood - My child talks a lot

Note. Higher ranked areas of communication indicate higher average responses by parents than lower-ranked items based on items in FOCUS Part 1 that are recorded from 1 (not at all like my child) to 7 (exactly like my child) and FOCUS Part that are recorded from 1 (can not do at all) to 7 (can do always without help).

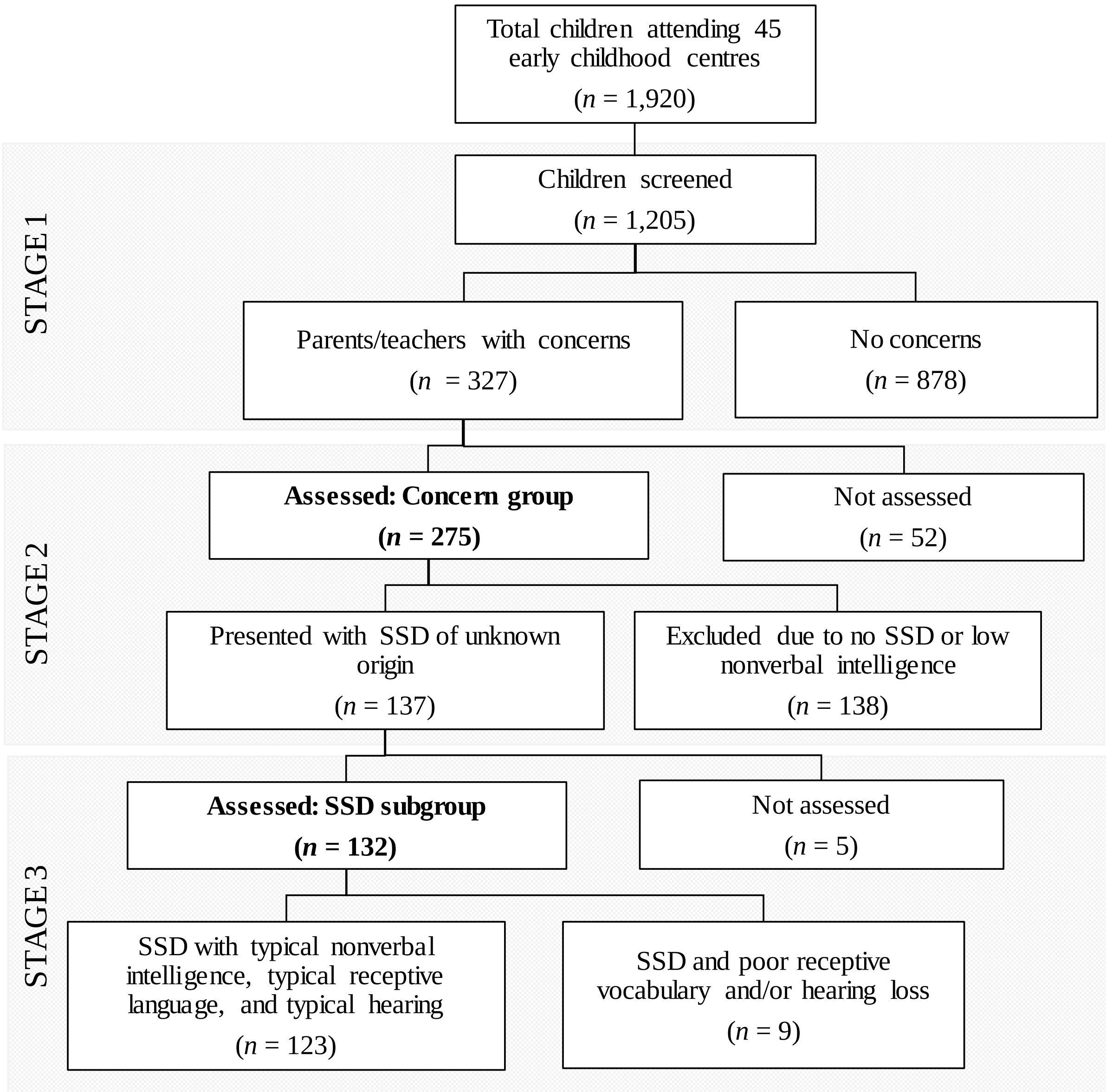

Figure 1. Derivation of participants described in the current study. **Bolded text** indicates participants described in this study. SSD = speech sound disorder.