Using the Language Use Inventory to Examine Toddlers' Social Pragmatic Communication Trajectories to Inform Clinical Practice

Utiliser le questionnaire *Language Use Inventory* (Inventaire sur l'utilisation du langage) pour examiner les trajectoires de la communication sociale pragmatique des enfants et informer la pratique clinique

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Abstract

Our aims were (a) to examine the growth trajectories of toddlers' social pragmatic communication using a standardized parent-report measure, the Language Use Inventory, and (b) to help distinguish typical variation and the potential for positive outcomes despite low initial functioning from trajectories that are suggestive of persistent language difficulties, and to thereby inform clinical practice and developmental surveillance with respect to 2-year-olds, for whom addressing late talking is of greatest concern. Parents of 138 2-year-olds completed the Language Use Inventory five times, at 3-month intervals from 24 to 36 months. Growth was examined using both children's total raw scores as defined for the measure and the corresponding percentile scores calculated according to the norms. Children's individual patterns of growth from 24 to 36 months showed a significant positive linear trend accompanied by significant variation in initial starting point and growth rate, with boys starting lower and growing faster than girls. Further exploration of the individual trajectories of 15 children initially falling at or below the 7th percentile at 24 months revealed two children with persistently low scores and the remainder moving outside of a realm of clinical concern by 36 months. Nevertheless, performance remained in the bottom tertile for the majority of this latter group. The findings further support existing recommendations for early, multiple-time-point surveillance of language using standardized measures in the 24- to 36-month period to aid in early identification of 2-year-olds who may benefit from intervention prior to the age of 3 years.

Abrégé

Nos objectifs étaient (a) d'examiner la trajectoire de développement de la communication sociale pragmatique des enfants au moyen d'un questionnaire parental normalisé, le *Language Use Inventory* (Inventaire sur l'utilisation du langage), et (b) de distinguer les variations dans les trajectoires de développement associées à des habiletés de langage ultérieures dans les limites de la normale en dépit d'un faible score initial au *Language Use Inventory* de celles associées à des difficultés de langage persistantes. De telles informations sont importantes pour informer la pratique clinique et les initiatives de surveillance du développement auprès des enfants âgés de deux ans, chez qui la prise en charge des retards langagiers est une grande préoccupation. Les parents de 138 enfants âgés de deux ans ont répondu au *Language Use Inventory* à cinq reprises entre 24 et 36 mois, à des intervalles de trois mois. Le développement des habiletés de communication sociale pragmatique de ces enfants a été examiné en utilisant les scores totaux bruts obtenus à ce questionnaire parental et les percentiles correspondants calculés à l'aide des normes disponibles. Les résultats ont révélé que les trajectoires individuelles de développement des enfants suivaient une tendance linéaire positive significative entre 24 et 36 mois. Ils ont également révélé une grande variabilité dans les habiletés de communication sociale pragmatique initiales des enfants et dans la rapidité de leur acquisition, les garçons commençant avec des habiletés plus faibles et qui progressaient plus rapidement que celles des filles. Une exploration plus approfondie des trajectoires de développement des 15 enfants ayant obtenu un score total brut au *Language Use Inventory* égal ou inférieur au septième percentile à 24 mois a subséquemment été réalisée. Elle a révélé que deux de ces enfants ont obtenu des scores constamment faibles, alors que les 13 autres ont obtenu des scores n'étant plus considérés comme cliniquement préoccupants avant d'atteindre 36 mois. Les scores de ces enfants sont toutefois demeurés à l'intérieur du tertile inférieur. Les résultats appuient les recommandations existantes prônant une surveillance précoce et répétée du développement du langage entre 24 et 36 mois au moyen d'outils de mesure normalisés afin de favoriser l'identification précoce des enfants de deux ans à qui une intervention pourrait être profitable avant l'âge de 3 ans.

Longitudinal studies of children's early language and communication are essential to distinguish growth trajectories characterized by positive outcomes, despite low initial functioning, from trajectories that indicate persistent language and communication difficulties or disorder (Bornstein et al., 2016; Dale et al., 2003). It is well recognized that there exist toddlers who are "late bloomers" or "late talkers" (Rescorla & Dale, 2013). These children's trajectories may remain low for some period during the 3rd year of life, but then show accelerated growth that results in a level of functioning above a threshold of clinical concern (typically > 10th percentile in the research literature or the 7th percentile [–1.5 SD] in clinical evaluation settings) by around 4 years of age (Dale et al., 2003; Reilly et al., 2010; Rescorla & Dale, 2013; Zambrana et al., 2014). Knowledge of the extent of variation in children's growth trajectories, and more importantly, the likelihood and timing of recovery for initially low-functioning children, can provide a basis for clinical decisions regarding further monitoring or referral for further assessment and intervention. Moreover, when knowledge about trajectories related to specific measures is applied in clinical practice, it can contribute to evidence-based practice in speech-language pathology, regarded as critical to providing high-quality clinical care (e.g., American Speech-Language-Hearing Association, 2004; Speech-Language and Audiology Canada [SAC], 2012) with ecological relevance.

The need for longitudinal studies of individual children's language and communicative growth trajectories before the age of 3 years is particularly acute given calls by professional associations of speech-language pathologists and audiologists across different countries for the identification of speech and language difficulties before this age (e.g., Pierson, 2014; SAC, 2012). Learning about these trajectories in 2-year-olds aligns with these goals for early identification. Epidemiological and longitudinal outcome studies have shown that low levels of language and communicative functioning prior to 3 to 4 years of age places children at risk for continued low functioning once they enter school in the domains of language (McKean et al., 2017; Pesco & O'Neill, 2012; Rice et al., 2008), social-emotional understanding and peer relationships (Forrest et al., 2020), behaviour (Ketelaars et al., 2010), and other academic areas, including mathematics (Matte-Landry et al., 2020) and literacy (Rescorla, 2009). Such findings strongly underscore the need to identify children before the age of 3 who are likely to be on a persistent trajectory of difficulty or disorder in language and communication. Learning about early trajectories also aligns with recognition of the importance of developmental surveillance to identify developmental delays by monitoring development over at least two time points and involving parents or caregivers (LeBlanc & Williams, 2017). The use of standardized tests that provide percentile scores can also address calls for greater use of common metrics that can aid in interpretation of test results and recommendations for measurement-based care in clinical research and practice (de Beurs et al., 2022).

When 1- and 2-year-olds' language and communicative growth has been examined in longitudinal studies, the measures have largely focused on vocabulary size and grammar and have often utilized standardized parent-report questionnaires such as the MacArthur-Bates Communicative Development Inventories (Fenson et al., 2007) or the Language Development Survey (Rescorla, 1989). In such studies, the term *late talkers* generally refers to toddlers who, in the absence of developmental disorders or hearing impairment, demonstrate a late onset in first words, a significantly reduced vocabulary size (e.g., fewer than 50 words), no word combinations at age 2, and whose scores fall at or below thresholds of clinical concern such as the 10th percentile or 1.25 standard deviations below the mean (Rescorla & Dale, 2013). Given a focus on vocabulary in some studies, the term "expressive vocabulary delay" has also been used (e.g., Collisson et al., 2016). Prevalence rates of late talkers among 2-year-old children have generally been found to range from 12%–19% (Collisson et al., 2016; Dale et al., 2003; Rescorla, 1989, 2011; Zubrick et al., 2007). Longitudinal studies looking at the outcomes for late talkers identified at or prior to 2 years based largely on vocabulary-focused measures have found that half or more of these late talkers perform above thresholds of clinical concern by even 30 months, leading to the term "transient late talkers" (Dale et al., 2003; Henrichs et al., 2011; Rescorla et al., 2000). Some have argued that vocabulary-based identification of late talkers at or before 2 years of age possesses relatively low predictive value for persistent language difficulties or disorder (Duff et al., 2015; Fisher, 2017).

Part of the difficulty in predicting trajectories and outcomes may lie in the incomplete view of children's language development provided by measures of vocabulary and/or grammar alone (Fisher, 2017). In addition to form (phonology and syntax) and content (semantics, including vocabulary use), pragmatics is commonly regarded as the third major component in language ability (Ninio & Snow, 1996). Although definitions of pragmatics vary, most focus on the ability to use language effectively and appropriately in social interactions with other people (Bates, 1976). The label for pragmatics can also vary, and common alternatives include social (pragmatic) communication, (social) language use, or pragmatic language. By its very nature, pragmatics draws on existing knowledge of form and

content (Matthews et al., 2018; Pesco & O'Neill, 2012). For example, sharing a complex story with a listener will require sophisticated vocabulary and grammatical structures. Indeed, studies involving several clinical groups of children found that children's vocabulary and grammatical abilities as assessed via the MacArthur-Bates Communicative Development Inventories (Fenson et al., 2007) progressed in tandem with pragmatic language use as assessed via the Language Use Inventory (LUI; O'Neill, 2009), but scores on both measures contributed differently to later skills such as word combining, where LUI scores were a better predictor (Foster-Cohen & van Bysterveldt, 2016; Luyster & Arunachalam, 2020). Pragmatics will be influenced to a great extent by developments in cognitive, social cognitive, and social understanding that come into play to achieve successful communicative exchanges with people across different contexts (Matthews et al., 2018; O'Neill, 2012). As such, assessing children's social pragmatic communicative ability may provide a more sensitive and broader measure of children's early language than assessing vocabulary/grammar alone.

The availability of the LUI (O'Neill, 2009), a standardized parent-report measure developed specifically to assess pragmatics in children under the age of 4 years, has led to the further study of pragmatics in early childhood among neurotypical and neurodivergent children (e.g., Caynes et al., 2021; Di Sante et al., 2019; Foster-Cohen & van Bysterveldt, 2016; Miller et al., 2015) and across different languages (Pesco & O'Neill, 2023).

The LUI is premised on an understanding of language as inherently social and a view of language development as entwined with growth in social cognition, especially children's understanding of minds (O'Neill, 2007). The LUI is divided into three parts roughly reflecting children's passage from use of gestures to words and to sentences. Over 14 subscales, parents are asked about children's use of language in a range of everyday settings, with various interlocutors, and for a variety of purposes. For example, some of the early subscales ask parents about how their child asks for help and uses words to get them to notice something, while later subscales ask about the child's comments and questions about things, themselves, and other people, and how the child adapts their communication to others, such as when sharing an event with someone who was not there when it happened (see details in Method section).

The LUI has a functional orientation consistent with contemporary models of health and disability (e.g., the International Classification of Functioning, Disability and Health approved by the World Health Organization in 2001) that identify activity and participation in natural environments as a critical element of evaluation. Parents also uniquely possess extensive knowledge about their young child's language use across a wide variety of settings that is difficult to replicate and evaluate via direct assessment (Bishop & McDonald, 2009; O'Neill, 2007). Their reports have been shown to provide important complementary information along with traditional language tests in the diagnostic process for language impairment (Bishop & McDonald, 2009; Foster-Cohen & van Bysterveldt, 2016; Glascoe & Dworkin, 1995). For toddlers and preschool-aged children, parents have been shown to be reliable reporters when asked about their child's current skills (Fenson et al., 2007) and a large meta-analysis has concluded that parent-report screening measures are as accurate as measures directly administered to children under the age of 4 years (So & To, 2022). These measures are also time and cost-efficient and easily scalable for use in a wide variety of settings.

The standardization of the LUI (N = 3563) demonstrated the rapid growth in pragmatics exhibited by children from 18 to 47 months, a finding that has been replicated in studies that have developed and examined LUI translations and confirmed the LUI's strong psychometric properties (e.g., Bialecka-Pikul et al., 2019; Pesco & O'Neill, 2016). Studies of the original LUI attested to its high test-retest reliability, discriminative validity (e.g., sensitivity and specificity of 95.9% in O'Neill, 2007; Miller et al., 2015), and concurrent validity with direct measures of early pragmatics such as Wetherby and Prizant's (2003) Communication and Symbolic Behavior Scales (O'Neill, 2009) and children's everyday functional communication (Caynes et al., 2021). The LUI's functional focus could also explain the developmental sensitivity of the measure found for several translations of the LUI to other languages (for a review, see Pesco & O'Neill, 2023). Moreover, several of the translations (Pesco & O'Neill, 2023) have found lower scores for boys than girls, especially in the 18- to 30-month period, as did the standardization study of the LUI, leading to separate norms for girls and boys (O'Neill, 2009). These early sex effects in the domain of pragmatics are in line with previous studies showing a similar pattern in the toddler years with respect to other aspects of language, such as vocabulary (Bornstein et al., 2004).

The results of a study of the predictive validity of the LUI (Pesco & O'Neill, 2012) are particularly relevant to the present study. Children (N = 348) whose parents had completed the LUI when their child was between 18 and 47 months old were reassessed at age 5 to 6 years

using composite scores from three standardized, norm-referenced language measures (Clinical Evaluation of Language Fundamentals-Preschool-2, Core Language, Wiig et al., 2004; Diagnostic Evaluation of Language Variation-Norm Referenced, Language Composite, Seymour et al., 2005; Children's Communication Checklist-2, General Communication Composite, Bishop, 2006). Correlations between children's LUI Total Scores and their scores on these measures showed the strongest and most consistent results at 30–35 months (r = .51, p < .01 for all three measures). The study also derived a cut-off score on the LUI of –1.64 standard deviations and calculated sensitivity and specificity for that cut-off at various base rates of language delay. For the children 24–47 months as a whole, and at a base rate of 10% as one might expect in a screened population, sensitivity and specificity were .81 and .93 respectively, meeting the .80 criterion recommended for language screening measures (Plante & Vance, 1994). Positive predictive validity was .56 and negative predictive validity was .98, values which exceed or match the values for tools evaluated in recent systematic reviews for screening for expressive language in young children (Bao et al., 2024; Sim et al., 2019; So & To, 2022).

Exploring children's early trajectories with respect to pragmatic ability is important for several other reasons. First, pragmatics can be an area of language of significant difficulty, or even of greatest impairment, among varied groups of children. Using the LUI (O'Neill, 2009), researchers have documented significant social pragmatic communication difficulties among autistic children and their siblings (Miller et al., 2015; Qian et al., 2022), children with multisystem disabilities (Foster-Cohen & van Bysterveldt, 2016), children with cerebral palsy (Caynes et al., 2021), deaf and hard-of-hearing children (Blaiser et al., 2021), and children experiencing neglect (Di Sante et al., 2019). Indeed, the LUI has been recommended as a benchmark measure to assess spoken pragmatic functioning among young children with autism (Tager-Flusberg et al., 2009). Children's scores on the LUI have also been shown to correlate concurrently with their symptom severity scores on the Autism Diagnostic Observation Schedule, Second Edition (Lord et al., 2012) at 3 years of age, supporting its utility in identifying children with an elevated likelihood of autism (Blume et al., 2024). Thus, knowing about early trajectories may enable earlier identification of pragmatic difficulties documented among these groups of children. Furthermore, the *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.; American Psychiatric Association, 2013) introduced the diagnostic category of social (pragmatic) communication disorder (SPCD). Although there is debate surrounding the validity of this diagnosis and who meets its criteria (Swineford et al., 2014), SPCD may capture, for example, the pragmatic difficulties observed via use of the LUI among young siblings of autistic children (Miller et al., 2015). In addition, pragmatics can be impacted for children with developmental language disorder (DLD), along with other aspects of language such as phonology, semantics and morphosyntax (Bishop et al., 2017; Sansavini et al., 2021). The LUI is among measures recommended in a review of screening tools to for DLD (Bao et al., 2024). Evidence of pragmatic impairment in all these clinical groups is further reason to better understand trajectories of pragmatics, and possibly varied profiles amongst children in the years that would precede different diagnoses.

The negative outcomes of low pragmatic abilities later in childhood and into adulthood, such as behavioural problems (Ketelaars et al., 2010), difficulties with peer friendships and psychosocial functioning (Whitehouse et al., 2009), and low quality of life ratings (Blaskova & Gibson, 2012) are also indicative of the importance of pragmatics. Moreover, Law et al. (2014) found that young children's pragmatic abilities mediated the association between their structural language and performance on measures of emotional and behavioural development.

In summary, the strong psychometrics and monthly norms for the LUI can facilitate its use clinically at more than one time point in line with recommendations with respect to developmental surveillance (LeBlanc & Williams, 2017) of 2-year-olds. A longitudinal exploration of children's LUI scores from 24 to 36 months can further illuminate typical and atypical variation in trajectories during a time when late talking is often a presenting concern. It can thus contribute to early and accurate identification of children potentially at risk of pragmatic difficulties due to disorder (e.g., autism, DLD, SPCD, attention-deficit/hyperactivity disorder) or other conditions (e.g., hearing impairment, neglect). Although some detailed longitudinal studies of a smaller number of toddlers' growth in pragmatics have been conducted (e.g., Ninio & Snow, 1996), even among late talkers (MacRoy-Higgins & Kliment, 2017), the present study aimed to examine variation in the growth of pragmatics on the LUI amongst a larger group of children between the ages of 24 and 36 months, with data collected at 5 time points (3-month intervals).

Two main research questions were addressed. First, what do children's individual longitudinal pattern(s) of growth for pragmatics look like between the ages of 24 to 36 months, as measured by raw LUI Total Scores, and are different patterns of growth observed for girls and boys?

We anticipated that boys would show a lower score at Time (T)1 than girls, but we made no prediction about the slope (e.g., boys might remain on a slower trajectory or catch up via steeper growth). This question was addressed through growth curve analyses. Our second main research question asked, via examining percentile scores, how were girls' and boys' growth trajectories over the year influenced by their initial 24-month percentile score? This question was addressed via percentile scores and descriptive analyses that focused on (a) the trajectories of children placed into one of six groups based on their initial onset percentile score at T1 (24 months) and (b) the individual percentile score trajectories of all the lowest performing children who, at 24 months, initially fell at or below the 7th percentile (≤ –1.5 SD) to see whether there was a time point before 36 months by which many had moved out of a range of clinical concern (i.e., showed a visible upward shift in scores). Given that Rescorla et al. (2000) found a later-appearing rise between 34 and 36 months among a subgroup of 2-year-old late talkers, we were interested as to whether we might find a similar result for pragmatics.

Method

Participants

Ethical approval for the research was granted by the Human Research Ethics Board at the University of Waterloo (ID # 30106) and all parents gave informed consent before taking part. A total of 140 families volunteered to participate in response to advertisements posted in community locations such as daycares and doctor's offices and via social media outlets such as Twitter (now X) and Facebook. In an initial phone call, we checked if the child met any of the study's exclusion criteria. Based on the LUI's standardization study (O'Neill, 2009), these criteria included prematurity of more than 2 weeks and low birth weight below 2400 g, receipt of a diagnosis relating to a developmental disorder such as autism, or greater than 20% exposure to language(s) other than English (see details below). No exclusions were necessary, but for three families, one of two twins was randomly chosen to participate. Attrition among the 140 families meeting inclusion criteria was minimal (n = 2) and was due to the death of the mother in one family and participation at only T1 for one family. The final sample consisted of 138 2-year-old children (67 girls & 71 boys; age $M_{overall}$ = 24.03 months, range 23–25 months; M_{girls} = 24.07 months, SD = .27, range 24–25 months; M_{boys} = 23.99 months, SD = .21, range 23 –25 months).

Once the lab visit for T1 (24 months) was arranged by phone, parents were mailed the LUI in its standard version available to all speech-language professionals, which includes at the end several questions regarding the child's birth and health history as well as asking the parent "to estimate how much of the time your child is regularly exposed to a language(s) other than English" for which they are provided with a Likert-scale from *0%* to *100%* in 10% increments. They were also asked to provide the language(s) and who was speaking that language with their child. Exclusion for more than 20% exposure represents children whose parent reported exposure to language(s) other than English above 20% on this scale (contact first author to view the LUI in full). In addition to the LUI, parents completed a short questionnaire about family demographics (e.g., cultural background, family composition, income), family history of language impairment (*yes*/*no*) similar to the LUI's standardization study (O'Neill, 2009; contact author for copy). These questionnaires were returned at the T1 lab visit.

With respect to demographics, cultural background was asked of parents in an open-ended manner and coded for visible minority and Aboriginal identity status, as in the most recent census at the time of the study. Among the 138 families, 93.5% reported their cultural background as Canadian, French Canadian, and/or Western and Eastern European (e.g., German, Scottish, Polish, Croatian); 3.6% as visible minority (e.g., Jamaican, Chinese, Nigerian), and 2.9% as Aboriginal (e.g., First Nations, Métis). The percentages for visible minority and Aboriginal identity were 15.0% and 1.3% for the region at the time the study was conducted. Concerning language exposure, 20% of children were exposed to a language other than English at home (for < 20% of waking hours) and 8 different languages were reported. Among mothers, 67% had a university education, 27% held a college diploma, and 6% had attained a high school diploma. Among 135 fathers for whom this information was provided, 54% had a university education, 33% held a college diploma, 11% had attained a high school diploma, and 2% had not completed high school. Most families (135) were dual-parent and 3 were single-parent. Of the 135 families who reported their income, 5% had low incomes according to cut-offs that consider family size and the region's population (Region of Waterloo, 2014). At T1, no parent reported suspected speech/language delay/impairment or other developmental condition for the child. A family history of language impairment was reported among 16 (12%) of the 138 families.

Measures

1. The Cognitive Subtest of the Bayley Scales of Infant and Toddler Development, Third Edition Screening Test (Bayley-III; Bayley, 2006) was administered individually to children at the T1 (24 month) lab visit to screen for possible cognitive delay/impairment (leading to exclusion). This test is considered a gold

standard for child development assessment (Walder et al., 2009). All children scored above the at-risk cut-off score for their age as defined in the test manual. Thus, this measure is not discussed further.

2. LUI (O'Neill, 2009): Further to its description in the introduction, the LUI is composed of 180 items organized into 14 subscales. The LUI Total Score out of 161 is derived from 10 expressive subscales. Of this LUI Total Score, 152 points derive from items with yes/no responses, with scores of 1/0 respectively, and nine from items using a Likert scale. Of the four remaining subscales, two involve unscored open-ended questions about a child's interests when talking and playing, and two assess gestures, but are excluded from the LUI Total Score which focuses on spoken language. All completion instructions for parents are included on the questionnaire. Most items include examples of what a child might say (e.g., when asking whether a child talks about wanting to do something on their own, the examples given are "I want to do it" and "Me do it"). These examples support parents' understanding of the questions and hence, the reliability of their reporting, while also allowing for some individual variation in the form of a child's utterance, including use of a language other than their dominant language (allowed, as noted in the LUI's instructions to parents). Monthly percentile norms for the LUI for girls and boys from 18 to 47 months of age, derived from its standardization with over 3500 children, are reported in the LUI manual (O'Neill, 2009). Readers can email the first author to view the full content of the LUI as well as the LUI Child Report produced with percentile scores.

Procedure

T1 Lab Visit (24 months)

The families' single visit to the lab took place at T1 in a set of two adjoining small, child-friendly lab rooms with a one-way mirror between them. Four tasks were part of this visit, but only the first task, administration of the Cognitive Subscale of the Bayley-III (Bayley, 2006), is pertinent to and reported in this article, as the other tasks were related to further study of parent-child activities (e.g., book sharing; pretend-play). At the beginning of the visit, the parent was welcomed by the researcher (the fourth author) and was provided with an overview of the year-long study. Consent was obtained to participate and to be videotaped. During this time, the researcher also played a bit with the child. Once the child was comfortable, the researcher and the child moved to sit at a small table in the adjoining room, while the parent could look on and listen through the one-way mirror and a microphone set-up. The researcher, who had doctoral training in psychoeducational, cognitive, and clinical assessment, administered the Cognitive Subscale of the Bayley-III according to the test manual. At the end of the lab visit, the children received a study t-shirt and the first book (and holding case) of a set of 12 books that they would receive over the year in thanks for taking part.

T2 to T5 Questionnaires by Mail

At four additional time points over the following year – when the child was 27, 30, 33, and 36 months of age – parents received and returned the LUI by mail once completed. In addition, the family information form was resent with each LUI questionnaire in case any updates to a child's health information and/or a family's situation were warranted (e.g., doctor's referral for further assessment related to language or other developmental concerns). At each time point, we took several actions to help ensure continued participation and enthusiasm in the study that we believe contributed to our very low attrition rate: (a) materials were mailed out 2 weeks ahead of time to ensure on-time delivery and parents were alerted by phone about the mailing so they could report any unreceived questionnaires and a new copy could be delivered; (b) 2 days before the required completion date, a reminder call was made; (c) another reminder call was made if the materials were not received a week after the deadline; (d) upon receipt of the materials from parents, a hand-written thank-you card was sent along with 1–2 books; and (e) at 36 months the final books were sent along with a thank-you and birthday card for the child.

In accordance with procedures agreed upon with our university's Office of Research Ethics, we informed parents of persistently low scores. Specifically, if a child's LUI Total Score fell consistently at or below the 5th percentile according to LUI norms from T1 to T4, and a parent did not indicate seeking input from a speech or health professional regarding their child's language development in updates to the family information form, we phoned the parent at T4 to notify them and recommend they seek further assessment with a speech-language professional. Two parents received a phone call for this reason (and remained in the study).

Completion of Questionnaires

The LUI was completed at all five time points by 133 (96%) families. Of the remaining five families (involving 4 boys and 1 girl), three completed four time points (T1, 2, 3, 5 for two, and T1, 2, 3, 4 for one); one completed three time points (T1, 2, 5) and one completed only two time points (T1, 4). Thus, 136 (98.6%) families completed the LUI at four time points. T5 data was missing for only 2 children. Children's raw LUI

Total Scores and the conversions to percentile scores were calculated per the LUI manual instructions (O'Neill, 2009).

Results

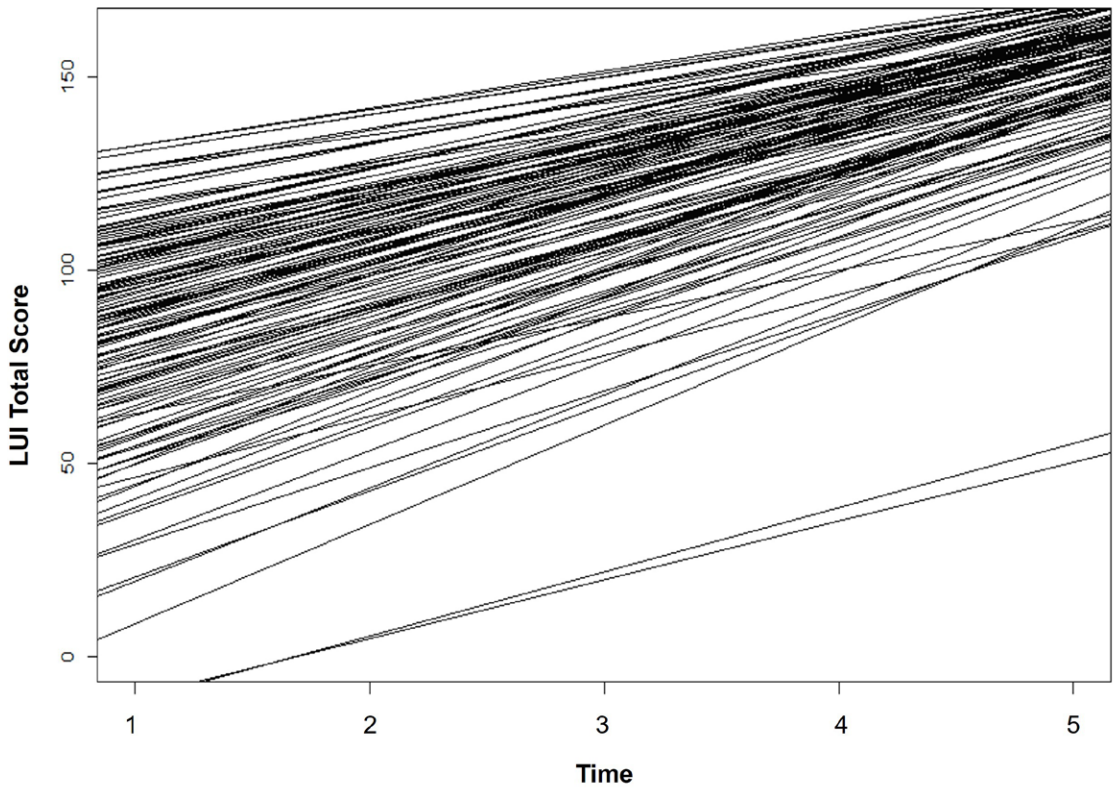
Individual Patterns of Growth for Pragmatics for Girls and Boys Using Raw Scores

Figure 1 shows the individual growth slopes of children's raw LUI Total Scores from T1 (24 months) through T5 (36 months) for all 138 children. Growth in pragmatics was examined by conducting a growth curve analysis in R using a hierarchal linear modeling approach (specifically, the five-step random coefficients modelling process described by Bauer & Reyes, 2010). This analysis first revealed an intraclass correlation coefficient value of .33, suggesting that 33% of the variance in LUI Total Scores lay between children, whereas a substantial 67% constituted within-child variance over the T1 to T5 period (24–36 months). We found a significant positive trend in children's LUI Total Scores across the five time points ($\gamma = 17.03$, $SE = 0.62$, $p < .001$).

When all individual slopes were examined for valence (flat, increasing, and decreasing), we found that all were increasing from T1 to T5, as can be seen in **Figure 1**. Our analyses also revealed significant variability in how LUI Total Scores changed over time (i.e., variability in slope). We thus proceeded to examine participant sex as both (a) a predictor of between-person (e.g., intercepts) variability in LUI Total Scores and (b) a moderator of within-person change (e.g., trajectories or slopes) in LUI Total Scores over time.

Participant sex accounted for significant between-person variance in LUI scores ($\gamma = 21.15$, $SE = 4.49$, $p < .001$), accounting for 53% of the variance in initial LUI Total Scores at 24 months (i.e., the intercept value) and growth to 36 months. On average, the intercept value at 24 months (one could consider this a T1 onset score) was significantly higher for girls at 93, compared to 72 for boys. Furthermore, participant sex explained significant within-person changes in LUI Total Scores over time (Time × Sex $\gamma = -2.04$, $SE = 0.89$, $p = .023$), accounting for 27% of the variance in

Figure 1



Individual Growth Slopes for All 138 Children from Time 1 (24 Months) to Time 5 (36 Months)

Note. LUI = Language Use Inventory. Time intervals were 3 months.

score changes over time. Changes in LUI Total Scores over time were significantly more pronounced for boys ($\gamma = 17.03$, SE = 0.62, $p < .001$) than for girls ($\gamma = 14.99$, $SE = 0.64$, $p < .001$). On average, boys' LUI Total Score grew by 17 points every 3 months, whereas girls' growth for the same period was approximately 2 points lower.

Examination of Children's LUI Percentile Score Trajectories from T1 to T5

For speech-language professionals using the LUI, the trajectories of children's percentile scores will be of most relevance and importance, as these normed scores are the most likely to be used in clinical practice. For the analyses that follow, the results of which are provided largely at a descriptive level, children's raw LUI Total Scores at T1 through T5 were converted to LUI percentile scores according to the LUI norms which are provided in 1-month age bands for boys and girls separately (O'Neill, 2009). Thus, looking at percentile scores over time can provide a clearer picture of whether children are progressing enough as they get older relative to their peers of the same sex and age in months. That is, although a child's raw scores may increase with age, their percentile rank could fall if their raw score isn't increasing as rapidly as those of their age- and sex-matched peers.

To examine children's percentile scores, we first divided all 138 children, and separately for girls and boys, into one of six T1 LUI Total percentile groups based on their percentile score at T1: 1st–16th percentile ($n = 21$; 15.2% of the sample); 17th–33rd ($n = 17$; 12.3%); 34th–49th ($n = 18$; 13.0%); 50th–66th ($n = 17$; 12.3%); 67th–84th ($n = 33$; 24.0%), and 85th–99th ($n = 32$; 23.2%). An interval of 16 percentile points was chosen as it led to meaningful groupings (e.g., children 1.0 or more SD from the mean; the lowest third of children, or all children below the 50th percentile, etc.). Plots of the mean LUI Total percentile scores from T1 to T5 for each of the six T1 percentile groups are provided in **Figure 2** for girls and for boys.

As **Figure 2** shows, change in the mean percentile scores ranged from a slight downward trend from 24 to 36 months among the very highest groups to a much more pronounced upward trend, especially among the lowest 1st–16th T1 LUI Total percentile group ($n = 21$), who would be of most clinical interest. Indeed, among both girls and boys, the largest difference in mean percentile scores between T1 and T5 was observed among this lowest group: for the 8 girls, $M_{T1} = 5.88$ ($SD = 1.8$; range 1.0–15.0) and $M_{T5} = 49.13$ ($SD = 5.2$; range 31.0–78.0); for the 13 boys, $M_{T1} = 5.46$ ($SD = 1.4$; range 1.0–14.0) and $M_{T5} = 31.0$ ($SD = 4.3$; range 1.0–66.0). Despite these increases, mean percentile scores remained below the 50th percentile at T5 for both boys and girls who were in the lowest scoring group at T1.

One further result of note is that for one boy we saw a fairly steady decrease in percentile scores from 46 (T1) to 20.0, 27.0, 12.0, and 4.5 at 36 months. This was the only child other than those described above to fall below the 7th percentile at T5. This type of trajectory profile with respect to language skills has also been observed to be rare in previous studies (Hentges et al., 2019; McKean et al., 2017)

Further In-Depth Look at the Trajectories of Children Scoring at or Below the 7th Percentile at T1

In this last section, we provide an even closer look at the trajectories of the subset of 15 children (10.9% of the sample) who scored at or below the 7th percentile (≤ 1.5 *SD*) at T1. This more in-depth look is of value and clinical utility as it aligns with the criterion often applied to identify significant impairment and establish children's eligibility for further assessment and intervention services (e. g., Early Childhood Technical Assistance Center, 2015). The 15 children included 9 boys and 6 girls: a considerable number of girls relative to other studies that we attribute to the LUI's separate norms for boys and girls.

For obvious ethical reasons, during the study we could not control whether or not parents sought out further evaluation or treatment for their child, whether possibly as a result of completing the LUI or for other reasons. We did however ask all parents in the study, when they were completing the LUI at Times 2 through 5, to also report any concerns or "treatment information," including any language and/or hearing assessments, diagnoses, or intervention services that occurred during the intervening period. Note that at T1 (24 months) no concern or treatment information was noted by any parent among all 138 children.

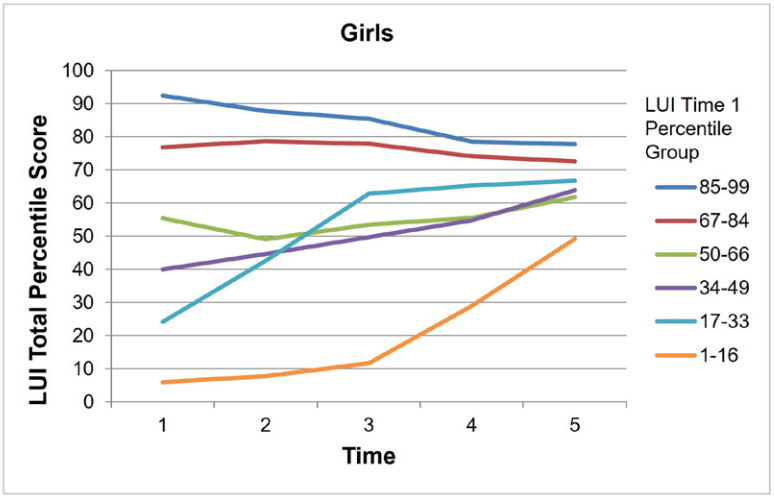
No Concern/No Treatment Children

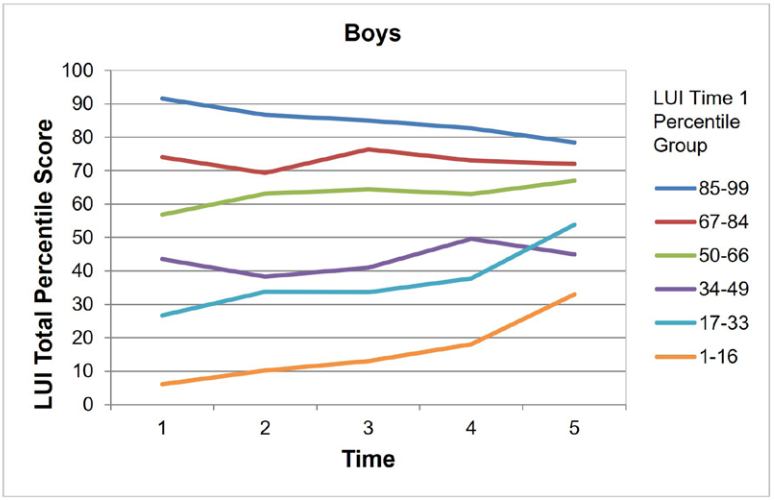
This subset of 8 children (5 girls, 3 boys) out of the 15 children scoring at or below the 7.0th percentile at T1 were children for whom no further concerns or treatment information were reported to us by parents during the study. Their trajectories of percentile scores from T1 to T5, shown in **Figure 3** (blue lines), reveal if and when individual children's performance rose above the 7.0th percentile. Their mean T1 LUI Total percentile score was 4.5. By 33 months, only one child remained below this clinical threshold, at the 1.5th percentile, and the remaining 7 children were performing from the 9.0th to 52.0nd percentile. By 36 months, however, all were performing at or above the 15.0th percentile.

Concern/Treatment Children

This subset of 7 children (1 girl, 6 boys) out of the 15 children scoring at or below the 7.0th percentile at T1, were

Figure 2





Girls' and Boys' Mean LUI Total Percentile Scores From Time 1 (24 Months) to Time 5 (36 Months), Grouped by Time 1 Score Ranges

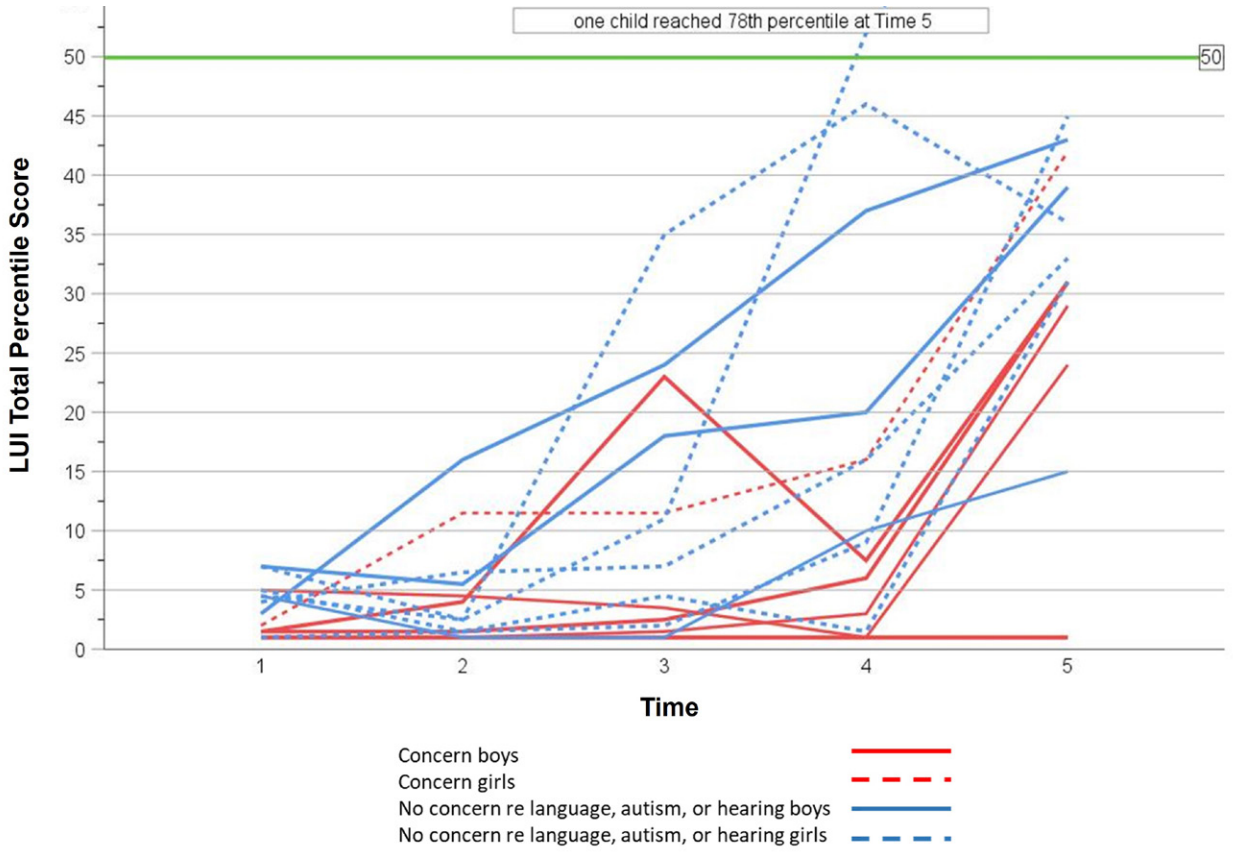
Note. LUI = Language Use Inventory. Time intervals were 3 months.

children for whom parents reported concern or treatment at T2 through T5. Their trajectories of percentile scores from T1 to T5 are also shown in **Figure 3** (red lines). Among these 7 children, two boys' scores remained at the 1st percentile across all 5 time points. One of these boys was diagnosed with severe speech delay at 27 months and began treatment at 30 months for suspected apraxia. The second boy, whose mother expressed concern at 27 months, was diagnosed with autism at 30 months, but by 36 months he had not yet received any professional services.

Among the remaining 5 children, at 33 months, 4 children remained below the 7.0th percentile and one was at the 7.5th percentile. By 36 months, the 5 children all performed at or above the 24.0th percentile. At 36 months, parents' reports also noted that 2 children had been diagnosed with hearing impairment: one of whom underwent surgery to receive tubes and one whose parent had completed Hanen's "It Takes Two To Talk" 8-week program (https://www.hanen.org/Programs/For-Parents/It-Takes-Two-to-Talk.aspx). Among the other three children, one had received a diagnosis of expressive language delay and the other two were on a waitlist for further language assessment. Two of their parents had also completed the same Hanen program mentioned above.

Thus, in summary, among all 15 children scoring at or below the 7.0th percentile at 24 months, only two concern/treatment boys remained in this range at 36 months. For the remaining children, regardless of concern or treatment status, performance was beyond the 7.0th percentile by

Figure 3



LUI Total Percentile Scores From Time 1 (24 Months) to Time 5 (36 Months) for All 15 Children Scoring At or Less Than the 7th Percentile at Time 1

Note. LUI = Language Use Inventory. Time intervals were 3 months.

36 months, but remained below the 50th percentile for all but one child and was at or below the 33.0rd percentile for 9 children. Further interpretation and implications of these findings for clinical practice are presented in the discussion, especially given that no parents had mentioned any concerns at T1 (24 months).

Family History of Language Disorder

With respect to the 16 children (6 girls, 10 boys) out of 138 for whom a family history of language disorder was reported by the parent, 4 (25%) scored at or below the 7.0th percentile at T1. Among the remaining 12 children, at T1, 7 scored below the 50.0th percentile (range 8.5th to 49.0th) and 5 scored at or above the 50.0th percentile (range 51.0st to 98.5th). At T5, none of the 16 children with a reported family history remained in the lowest 0–16th percentile range (17th–33rd, $n = 3$, lowest was at 29th; 34th–49th, $n = 4$; 50th–66th, $n = 3$; 67th–84th, $n = 5$; 85th–99th, $n = 1$).

Discussion

In this longitudinal study, we examined the growth trajectories of social pragmatic communication of children from age 24 to 36 months using a standardized, norm-referenced measure, the LUI. The research is timely given increasing recommendations for developmental surveillance of children in the 2-year-old age range (e.g., Lipkin et al., 2020; SAC, 2012) and provides a nuanced picture of the range of variability in performance among children across the 3rd year of life when late talking can be of most concern. We looked at the results in terms of percentile scores, in addition to raw scores, to increase their clinical relevance and utility to speech-language professionals.

The results of this longitudinal study have further confirmed the period from 24 to 36 months as one of significant growth in toddlers' social pragmatic communication (O'Neill, 2007, 2009), but also one of

significant variability in individual trajectories. About 67% of the variability among children in growth in children's LUI Total raw scores was due to how much their LUI Total raw scores changed over the year; that is, whether their scores changed a lot or a little. There was also significant variability in how quickly children's LUI Total Scores changed over time, with some children showing a quicker, steeper rise in scores and some a slower, flatter rise in scores than others. Sex also mattered to growth (accounting for 27% of the variance in slope); although boys on average scored lower on the LUI than girls at 24 months, they demonstrated more rapid growth over the year than girls. Similar findings for boys have been observed in previous studies with other early language measures (Rescorla, 2011; Rice et al., 2008).

For our examination of percentile scores, we first placed boys and girls into one of six groups based on their percentile score at T1 (i.e., 1st–16th, 17th–33rd, 34th–49th, 50th–66th, 67th–84th, and 85th–99th, representing successive intervals of 16 percentile points). The largest change in mean percentile score between T1 and T5 was observed among the lowest group for both boys and girls but, despite this, their mean percentile scores remained below the 50th percentile at T5.

Finally, we examined the individual trajectories of all 15 children at 24 months who had scores that placed them 1.5 standard deviations or more below the mean (≤ 7th percentile) and were thus in a commonly recognized range of clinical concern. These 15 children comprised 10.9% of our sample at 24 months, in line with prevalence rates for early language delays reported in other recent Canadian studies (12.6% using M-CDI, Collisson et al., 2016; 13% using ASQ, Hentges et al., 2019; 11.9% using adaptations of the M-CDI to French, Matte-Landry et al., 2020).

Among these 15 children, 2 had LUI Total Scores that remained below the 7th percentile at all 5 time points and they were diagnosed with apraxia and autism respectively during this year. Among the remaining 13 children, a rise in scores was observed, at the latest between 33 and 36 months. This rise was observed both for children whose parents had reported having no concerns and for children whose parents reported concern and/or that an evaluation and intervention (e.g., autism assessment, parent intervention with Hanen program) and/or treatment (e.g., ear tubes) had taken place. This finding of a similar rise by 36 months in the latter two groups and its relation to early treatment would need exploration with a larger sample of children in more controlled contexts than in this study. But it is consistent with a finding of Rescorla et al. (2000) who observed, among 2-year-old late talkers, a group with a "later-appearing rise" only after 30 months of age with maximal variance observed between 34 to 36 months.

What do our results mean for recommendations for developmental surveillance of language among 2-year olds? Consistent with the findings of other previous studies, we observed that children with low scores on the LUI at age 2 may include those who experience only transient delay and score outside a range of clinical concern by 3 years of age (Hawa & Spanoudis, 2014, Hentges et al., 2019), as well as those who may experience persistent delays that may, at that time or later, be attributed to a number of different diagnosed disorders such as autism or speech-language disorders (e.g., Sansavini et al., 2021), or to other diagnoses such as hearing impairment (Blaiser et al., 2021). Although only 2 children in our study performed below the 7th percentile at all time points, our findings may actually underestimate those who might have stayed low for longer without the further evaluation/treatment parents reported. That is, it should be remembered that at 24 months, none of the 138 parents reported a concern with their child's language development. Nevertheless, among the group of 15 children who were at or below the 7th percentile at 24 months (which was not communicated to parents), 7 parents reported concern, treatment, or a diagnosis at a later time point(s) during the study (and they were the only ones in the sample of 138 to do so). We do not know exactly why parent concerns emerged later and completion of the LUI might even be one reason. Moreover, we think it is important to note that, among this group of 15 children, all but one remained below the 50th percentile by 36 months and 9 out of these 15 continued to rank at or below the 33rd percentile at 36 months. Previous studies have found long-term language weaknesses even into adulthood for children exhibiting delayed onset and progression of expressive language in the 2-year-old period (for reviews see Hawa & Spanoudis, 2014; Roos & Weismer, 2008). The field would benefit from further research and/or metareviews using a common metric such as percentile scores to determine performance and from comparing the outcomes of children who at around 36-months old have language levels below a clinical threshold to children whose scores are above threshold but still weak (e.g., 8th–16th percentile). This could be especially important for pragmatic measures given that during the preschool and school years, expectations for language use will increase significantly as peer interactions become more frequent, sophisticated, and challenging and as children encounter new environments with many more children, adults, and types of communicative interactions.

Our results offer further evidence against wait-and-see approaches. Indeed, the finding that most children's scores moved out of clinical range by 33 to 36 months of age (as found in other studies reviewed) shows how important a check of children's language progress during the 2-year-old

period may be, given that it is still not entirely predictable for whom this will be the case (nor will it ever likely be). The use of a standardized in-depth language assessment such as the LUI in the early half of the 2-year-old period may, however, help to quickly identify and prioritize a relatively small subset of clinically low-scoring children for further evaluation and assessment (e.g., Blume et al., 2024), especially when results are considered alongside further information about the child that a clinician may have (e.g., parent concern, family and child history). Recall that only 10.9% of children were at or below the 7th percentile at 24 months, and this percentage was reduced by half to 5% of children by 30 months. And even for children that the LUI might reveal to be performing slightly above clinical thresholds – particularly if parent concerns had motivated the assessment – the process would align with best practice recommendations in having explicitly acknowledged parents' concerns (Sices et al., 2009) by having them complete the assessment. Furthermore, for these children the process would also open up an opportunity for a speech-language professional to find out more about the language environment of the child and provide recommendations for language stimulation at home should they judge this to be potentially valuable. The use of the LUI at a minimum of two time points, with at least a reassessment close to 36 months of age to check for a robust increase by this age, would align with recommendations for developmental surveillance over more than one time point to improve early identification of delays (Barger et al., 2018; LeBlanc & Williams, 2017). It would also be in line with recommendations across countries for greater developmental surveillance of children's language using standardized tools in the 2-year-old period (Duff et al., 2015; Gascoigne, 2021; Lipkin et al., 2020). Furthermore, as suggested by Sices et al. (2009), making at least one in-depth assessment of a child's expressive language part of a routine check during the 2-year-old period could also avoid parents' perception that they are being targeted or somehow to blame for their child's delays.

Limitations and Future Directions

Our longitudinal study has limitations. Four of the children scoring below the 7th percentile at T1 had a positive family history of language impairment, but we know little about the nature of this impairment. Note, however, that strong evidence for predictors of language outcomes other than initial expressive language in the 2-year-old period has proved elusive in epidemiological studies (see reviews Bishop et al., 2017; Rescorla, 2011).

A reader may have concerns regarding the repeated administration of the LUI with parents. However, the increasing pattern of scores varying in slope would be difficult to achieve via teaching to the test as it is not at all obvious what exact increase over a 3-month period would produce this pattern. Moreover, parents mailed back their completed questionnaires and would not likely have made a copy to refer to in the meantime.

Our sample also had a greater proportion of children scoring above the 50th percentile at T1 than would be expected. However, despite this, the variability of T1 scores encompassed the full range from the 1st percentile onwards, and indeed there were also a greater number of children below the 7th percentile at T1 than could have been expected. Our sample also had a high proportion of children whose parents had high education levels. Future longitudinal research with finer gradations of income level, in conjunction with more detailed information about the environmental factors (within and beyond the family) that may impact social inequalities in children's language development (Di Sante & Potvin, 2022), would be needed to investigate their long-term effects on language difficulties and performance on standardized language assessments over the 3rd year of life.

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