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Citation of this paper:
Cunningham, Barbara Jane; Hanna, Steven E.; Rosenbaum, Peter; Thomas-Stonell, Nancy; and Oddson, Bruce, "Factors Contributing to Preschoolers' Communicative Participation Outcomes: Findings From a Population-Based Longitudinal Cohort Study in Ontario, Canada" (2018). *American Journal of Speech-Language Pathology* 7.
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RUNNING HEAD: PRESCHOOLERS' COMMUNICATIVE PARTICIPATION OUTCOMES

Factors contributing to preschoolers' communicative participation outcomes: Findings from a population-based longitudinal cohort study in Ontario Canada

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Abstract

Purpose. To identify predictors of communicative participation outcomes for a large cohort of preschoolers with communication disorders.

Method. A secondary analysis of longitudinal program evaluation data from Ontario Canada's Preschool Speech and Language Program (PSLP). Data available for 46,872 children 18-67 months of age (M = 41.76 mo, SD = 11.92, 68% male) were previously used to predict children's communicative participation skill development in five levels of function. Demographic and intervention-based variables were added to the models to identify new predictors of growth.

Results. Three demographic and three intervention-based variables were statistically significant predictors of children's communicative participation outcomes. Clinically significant predictors included participation in an early learning environment, receipt of speech-language interventions, and the amount of time spent in intervention. These variables impacted predicted outcomes differently depending on a child's level of communicative function.

Conclusions. This population-based study of preschoolers with speech and language disorders identified predictors of growth in communicative participation skills – an outcome important and meaningful to families but, not often explored. A broad picture emerged of factors that may influence the development of communicative participation skills, and may be used to predict outcomes for preschoolers. Given the large sample size, these robust findings may be used to predict outcomes outside the PSLP as well.

Keywords. Communicative participation, outcome, predict, development, growth

The World Health Organization's International Classification of Functioning, Disability, and Health – Children and Youth Version (ICF-CY) provides a useful framework for thinking about how outcomes are evaluated in speech-language pathology (WHO, 2007). Within the ICF-CY framework, outcomes can be thought of as being evaluated within three main components: Body Functions and Structures, Activity, and Participation (WHO, 2007). Within the Body Functions and Structures component, outcomes may be related to parts of the body and how they move (e.g., improved speech intelligibility, fluency, or quality). In the Activity component, outcomes may be related to tasks children execute (e.g., use/understand of vocabulary or grammar). In the Participation component, outcomes are focused more broadly, and relate to social participation. Example outcomes include increased play with peers, engagement in conversation, or involvement in other social activities (Cunningham, Washington, Binns, Rolfe, Robertson & Rosenbaum, 2017a).

Outcomes related to the Body Functions and Structures and Activity components of the ICF-CY have been extensively studied in preschoolers with speech and language disorders, allowing researchers to identify a number of factors associated with those outcomes. Age of first intervention is an important predictor of outcomes for preschoolers with hearing loss (Boons et al., 2012; Holzinger, Fellinger & Beitel, 2011). Severity and frequency of stuttering are important predictors of outcomes for preschoolers with fluency disorders (Cook, Donlan & Howell, 2013; Guitar, Kazenski, Howard, Cousins, Fader & Haskell, 2015). Intensity of service delivery and parent-child interaction style are associated with outcomes for preschoolers with language and social communication disorders (Luiselli et al. 2000; Mazurek, Kanne & Miles, 2012; McDuffie & Yoder, 2010; Roberts & Kaiser, 2012); and age, speech sound development prior to starting

treatment, and expressive language ability predict change in phonological skills following intervention for preschoolers with speech sound disorders (Tyler, Lewis & Welch, 2003).

Information about impairment-based outcomes and factors associated with those outcomes is used in intervention and service delivery planning and policy development. As a result of research identifying predictors of outcomes clinicians consider the severity of a child's stutter when determining whether to recommend intervention, or how much treatment to offer (Guitar, et al., 2015). Varying intervention formats, settings, and timing are considered depending on degree of impairment for children with speech sound disorders (ASHA, n.d.), and the type of intervention to recommend (e.g., parent training vs. individual therapy) is considered for very young children with expressive language delay (Roberts & Kaiser, 2011). Policy makers in multiple countries have used information predictive of outcomes for children with hearing impairment to develop and implement national strategies for early hearing screening, identification, and intervention for newborns (e.g., Speech-Language & Audiology Canada (SAC), 2014a); and to promote early speech-language intervention programs for young children with speech and language delays (ASHA, 2008; SAC, 2014b).

An understanding of impairment-based outcomes is useful in many ways, but provides only a snapshot of a child's communication, noting changes related to specific skills. It does not show the whole picture of a child's communication development – specifically, it does not demonstrate the gains children make in their ability to use their communication functionally and engage in the activities that are most meaningful to them (Cunningham, Hanna, Rosenbaum, Thomas-Stonell & Oddson, 2017b). A continued focus on outcomes within the Body Functions and Activity components does not allow clinicians and researchers to understand and evaluate how speech-language pathology services impact the everyday lives of children and their families. Families are

interested in broadly-focused participation outcomes (e.g., Will my child make friends? Will we be able to have a conversation? Will my child be able to participate in a school/preschool classroom?), and value these achievements over the more traditional speech-language outcomes (e.g., Did my child learn to use the /s/ sound in all word positions? Did my child learn to use he/she pronouns correctly?) (Lindsay & Dockrell, 2004; Thomas-Stonell, Oddson, Robertson & Rosenbaum, 2010).

It is important to consider outcomes beyond those related to impairment and also explore outcomes related to participation and engagement. In doing this, clinicians and researchers can concentrate efforts on helping children achieve their own individual potential, as opposed 'fixing' or normalize them (Rosenbaum & Gorter, 2012); parents may be more invested in the therapy process, as outcomes will be more meaningful to their family (Watts Pappas, McLeod, McAllister & McKinnon, 2008); and it may be easier for both clinicians and researchers to demonstrate the important impact of speech-language services.

Past systematic reviews have questioned the effectiveness of speech-language interventions, particularly for some specific types of impairment (e.g., receptive language) (Glogowaska, Roulstone, Enderby & Peters, 2000; Law, Garret & Nye, 2003). This lack of effectiveness may be due to the constructs being evaluated. Most outcomes research related to preschoolers measures growth within the ICF-CY's Body Functions and Structures and Activity components (Cunningham et al., 2017a), and under this approach important changes in children's functional communication skills may be missed. Clinically, children may make gains that are meaningful and important to families (e.g., learning to articulate a sibling's name; following directions at home), but these important changes may not be captured with impairment-focused assessment tools (i.e., the child remains in the same centile or with a similar standard score).

Participation-based outcome measures capture clinically-meaningful changes that are important to families for children at all levels of impairment and with all types of communication disorders.

By exploring how participation-based communication skills develop, and by identifying predictors of that development, researchers can contribute meaningful knowledge to inform participation-focused intervention and service delivery planning. One new participation-based construct that has recently garnered attention in the literature is 'communicative participation'. For preschoolers, this means *'how the child uses communication to interact in real world situations at home, school, or in the community'* (Eadie et al., 2006). Communicative participation is an important and desired outcome of speech-language therapies; however, the evidence base related to this relatively new construct is limited, particularly for children (Cunningham et al., 2017a).

A few studies have explored these outcomes for preschoolers, showing that children's communicative participation skills do change as a result of speech-language interventions, but it is not yet known whether gains in communicative participation skills vary by degree of impairment (Thomas-Stonell, Washington, Oddson, Robertson & Rosenbaum, 2013a; Washington, Thomas-Stonell, McLeod & Warr-Leeper, 2015; Thomas-Stonell, Robertson, Oddson & Rosenbaum, 2016).

Other studies have identified predictors of children's communicative participation outcomes, identifying factors related to the child (e.g., social skills, presence of motor impairment) (Washington et al., 2015); therapy environment (e.g., fun and engaging, child-therapist relationship) (Baxendale, Lockton, Adams & Gaile, 2013); and intervention (e.g., receiving therapy, number of sessions, intervention plan) (Pennington, Roelant, Thompson, Robson, Steen & Miller, 2013; Thomas-Stonell et al., 2016) as predictive of outcomes. More evidence is needed

both to substantiate the relevance of those factors already identified and to identify additional factors that are likely associated with communicative participation outcomes.

Knowledge about which factors predict communicative participation outcomes and how outcomes vary by degree of impairment will help parents, clinicians, administrators, and policy makers to plan and deliver individualized early intervention services that are both effective and meaningful (Coleman, Weir, Ware & Boyd, 2015; Paul & Roth, 2011; Thomas-Stonell et al., 2010; Tyler et al., 2003; Yoder & Compton, 2004).

Our research group is in a unique position to contribute to the developing knowledge base related to preschoolers' communicative participation outcomes and to identify predictors of those outcomes. We are part of a team that worked collaboratively with Ontario Canada's Preschool Speech and Language Program (PSLP), a community-based publicly-funded government service, to establish a large-scale program evaluation using preschoolers' communicative participation as the primary outcome (Ontario Ministry of Children and Youth Services (OMCYS), 2013). The PSLP evaluates changes in children's communicative participation skills over the course of their time accessing services. In this program, children access a variety of assessment and intervention-based services. Typically, they attend an initial assessment appointment, which is followed by a period in which children are on a waiting list for intervention. The amount of time children wait varies and depends on the age at which they were referred as well as the type of communication impairment with which they present. The type and amount of intervention children receive also varies based on those same factors. The program offers various interventions including parent/childcare consultation and training, and group/individual intervention. Since 2012, all children who access PSLP services have been assessed using two published tools and one informal

checklist approximately every six months. Details on those tools are presented in the Method section.

Our team was granted access to the PSLPs anonymized datasets to explore communicative participation outcomes for all preschoolers accessing PSLP services across the province. We previously used the data to model the development of children's communicative participation skills by fitting separate growth curves for children in each of five levels of communicative function (Cunningham et al., 2017b). The curves provide a broadly-focused view of how communicative participation skills develop in preschoolers with communication impairments, but do not account for the many factors, apart from age and functional level, that likely influenced the development of those skills.

The objective of the present investigation was to test whether specific demographic and intervention-based variables predict growth in preschoolers' communicative participation skills and to explore whether predictors had a different impact depending on a child's level of communicative function. Predictor variables, and our hypotheses about their association with preschoolers' communicative participation outcomes are presented in Table 1. It is our hope that contributing knowledge about clinical predictors of change in preschoolers' communicative participation skills will help: clinicians plan therapy and counsel families; service providers allocate resources; and policy makers develop relevant guidelines.

Method

Ethics approval. The Hamilton Integrated Research Ethics Board approved the use of this anonymized dataset for this study.

Participants. Data were collected as part of the PSLP's prospective longitudinal program evaluation project. We previously used all available data (N = 46,872) to fit growth curves for children by Communication Function Classification System (CFCS) level (Cunningham et al., 2017b). This sample represented all children who had accessed PSLP services between October 1, 2012 and May 1, 2016 for whom outcomes data had been collected, and included children between 18 and 67 months of age (M = 41.76 mo, SD = 11.92, 68% male, 32% female). Details on this sample are presented in Table 2. Our primary objective in creating the growth curves was to understand how communicative participation skills developed in preschoolers – something that had not been reported in the literature. The first aim of the present work was to identify demographic predictors of that development and as such, all available data were included when entering demographic predictors into the models.

The second aim of the present study was to identify intervention-based predictors of communicative participation outcomes. In order to do this, we needed data for children who had received multiple assessments in the PSLP. Thus, when investigating predictors of outcome for intervention-based variables, we only used data for children with two or more assessments (N = 21,998). This resulted in a slightly different sample of children (M = 41.73, SD = 11.50, 69% male, 31% female). Details on this sub-sample are presented in Table 3.

Outcome Measures. Two outcome tools and an informal checklist were used at each assessment. *The Focus on the Outcomes of Communication Under Six (FOCUS©)* is a valid and reliable 50-item parent-report measure that evaluates changes in communicative participation skills for preschoolers with a range of communication disorder types and severities (Thomas-Stonell et al., 2010). On the first 34 items parents rate their child on a 7-point scale that ranges from 'Not at all like my child' to 'Exactly like my child'. On the last 16 items ratings are made

using a different 7-point scale with items ranging from '*Cannot do at all*' to '*Can always do without help*' (Thomas-Stonell et al., 2010). The FOCUS© has good reliability and validity for children from 18-months to six-years of age (Oddson, Washington, Robertson, Thomas-Stonell & Rosenbaum, 2013; Thomas-Stonell, Oddson, Robertson & Rosenbaum, 2009; Thomas-Stonell et al., 2013a; Thomas-Stonell, Oddson, Robertson & Rosenbaum, 2013b; Washington, Thomas-Stonell, Oddson, McLeod, War-Leeper, Robertson & Rosenbaum, 2013a; Washington, Oddson, Robertson, Rosenbaum & Thomas-Stonell, 2013b; Washington et al., 2015).

The Communication Function Classification System (CFCS) is a validated tool that classifies children's communication skills into one of five meaningful levels of function (Hidecker et al., 2011; Hidecker et al., 2012). The tool was originally developed for use with children with Cerebral Palsy, but has since been validated for use with preschoolers with a range of communication disorder types and severities (Hidecker, Cunningham, Oddson, Thomas-Stonell & Rosenbaum, 2017). Children in level I are *'consistent senders and receivers of information with all communication partners'*, and function best in terms of their communication, while children in level V are *'seldom effective senders or receivers of information, even with familiar partners'* and function least well in their communication (Hidecker et al., 2011). Clinically, a child in CFCS level I may have only a few speech sound or grammatical errors, while a child in CFCS level V may be an unintentional communicator on the autism spectrum.

Speech-language pathologists also completed an informal checklist at each assessment, on which they provided both demographic (sex, multilingual status, child's participation in an early learning environment) and intervention-based information (whether the child was in some form of intervention, the types of goals targeted in therapy) about the child.

Predictor Variables. Our ability to include relevant predictor variables in our analysis was limited by the content of the PSLP datasets; however, in order to maintain some methodological rigour, we selected from the available variables based on (a) knowledge of previously identified predictors of communicative participation and other impairment-based outcomes in the literature, and (b) clinical expertise and theoretical reasoning about which factors might contribute to communicative participation outcomes (Abbot et al., 2016). Table 1 presents a description of and rationale for each predictor variable included.

Procedure and Statistical Analysis. Data were analyzed using Stata Statistical Software – version 13.1 (Stata, 2013). In the original study (Cunningham et al., 2017b), mixed effects modelling, with a maximum likelihood (ML) estimator, was used to tested to fit growth curves for children in each of the five CFCS levels. Children were placed into CFCS levels based on how they were classified at study entry. The models included both fixed and random effects. Fixed effects included an intercept (predicted FOCUS© score at 18 months of age), a term for Age (centered at 18 months of age), and a squared term for Age^2 (centered at 18 months). The random effects included terms for Participant, Age (centered at 18 months), and Age^2 (centered at 18 months).

The models were estimated without constraint (i.e., with unstructured covariance) for all children except those in CFCS level IV. For the children in level IV, the pattern of repeated measures available per child led to a better model being estimated using the assumption of compound symmetry (Cunningham et al., 2017b). We believe that this reflects the relative smaller proportion of children with second and third evaluations in this group. Unstructured covariance estimates were made at the individual level (level 1). It was agreed we would provide as much information regarding the random effects as possible for children in each

CFCS level (i.e., we used an unstructured covariance matrix when we could). That decision was also applied to the present analyses.

The original study showed predicted mean group trajectories for children in each CFCS level. Predicted starting scores varied inversely with CFCS level. Rates of growth were similar for children in CFCS levels I-III (initially rapid and then levelling off), but less rapid for children in level IV. Growth was slow, but continual for children in level V. Individual variability around the group mean trajectory was greatest for children in level I and least for children in level V (Cunningham et al., 2017b). Estimates of the coefficients for the fixed and random effects of the original models are available as supplementary material (Cunningham et al., 2017b).

Those models were re-estimated here (again using the ML estimator) by including predictor variables into the previously fit models separately (i.e., sex was entered as a predictor and then removed, multilingual status was then entered as a predictor and removed, etc.). Predictors were examined separately for children in each of the five CFCS levels as we assumed children in each level were functionally different from one another and we therefore suspected predictors of outcome might also differ by CFCS level (Cunningham et al., 2017b).

Variables were entered into the fixed effects part of the models to identify predictors of communicative participation outcomes for children in each CFCS level. The resulting predictions have a curvilinear form. We comment on the main effects as they related to children's predicted FOCUS© scores at 18 months of age. The interaction between Age and each variable indicates the predicted slope of the curve at 18 months of age (i.e., How quickly are FOCUS© scores predicted to grow?). The interaction between Age^2 and each variable indicates either the deceleration or acceleration in predicted growth over time. Due to the large

sample size, we comment on both statistically significant and clinically meaningful differences. For the purposes of our analyses, a clinically meaningful change on the FOCUS© is 16 points (Thomas-Stonell et al., 2013a).

Results

Data for 46, 872 children were available to test for significant predictors of growth for the following demographic variables: sex, multilingual status of the family, and participation in an Early Learning Environment. As reported below, we had missing data for each of the demographic variables. Missing data was likely the result of problems with compliance with data collection, and we believe the data are missing at random, but have no way of confirming this. The data are provided by a publicly-funded population-based program, and are not derived from a controlled study where specific data fields were set a priori with data collected systematically. The results are meant to offer a descriptive account of a real-world program. At the same time we acknowledge the limitations of the data and propose further refinements to data collection within the PSLP's program evaluation project in the Discussion section. All available data were included in each analysis.

Sex. There were sex variable data for almost 41,000 children (67% male, 33% female). Females had higher predicted FOCUS© scores than males across all ages and CFCS levels. There were statistically significant main effects for Sex for CFCS levels III and IV, meaning that predicted FOCUS© scores at 18 months were significantly higher for females than for males. No significant interactions between Sex and Age or Sex and Age^2 were found in either CFCS level – indicating predicted rates of change were similar for boys and girls (see Table 4). While these findings were statistically significant, they did not reach the 16-point difference on the FOCUS© required for a clinically meaningful difference.

Multilingual status. Two factors were reported under multilingual status. First, the PSLP collected data on children's 'mother tongue' (language most commonly used at home) for 17,410 of the children. Of those, 15,657 (90%) reported English as their mother tongue. There were 66 other languages reported, with the three next most commonly reported being French (2.7%), Spanish (1%), and Arabic (0.81%). Second, SLPs reported multilingual status (i.e., whether children were multi- or mono-lingual) for 11,753 children (82% monolingual). It was this variable (multi- vs. mono-lingual) that was entered into the models as a predictor of growth. Unfortunately, we can only discuss whether children were multi- or monolingual, not whether they spoke two or more languages at home, because of the way the question was worded (i.e., Multilingual – yes/no). We are currently working to improve data collection within the program and hope to be able to differentiate outcomes for mono-, bi-, and multi-lingual children in the future.

Multilingual status was a statistically significant predictor of outcome in CFCS level IV. There was a significant main effect, in which multilingual children had higher predicted FOCUS© scores at 18 months than their monolingual peers. Both interaction terms were significant, indicating that predicted growth for multilingual children was more linear than the growth for monolingual children, and at the upper limit of the curve, multilingual children had higher predicted FOCUS© scores than their monolingual peers (see Table 4). These differences were not clinically meaningful (i.e., there was not a 16-point difference on the FOCUS©).

Participation in an Early Learning Environment. An early learning environment was defined as a registered childcare or preschool program. Data for this variable were recorded for 11,753 children, with 62% participating in an early learning environment. This was a statistically significant predictor of outcome for all children but those in CFCS level V. Main

effects for Early Learning were significant for CFCS levels I – IV, indicating predicted FOCUS© scores at 18 months were higher for children who participated in an early learning environment than those who did not. Considering only the main effects, predicted FOCUS© scores at 18 months were both statistically and clinically different for children in CFCS levels I, II and III (see Table 4). The main effect was statistically, but not clinically significant for children in CFCS level IV. Interaction terms were also significant for this variable. Interaction terms for Early Learning x Age were significant and negative for CFCS levels I – III, indicating predicted slopes at 18 months were less steep for the children who were in an early learning environment. Interaction terms were significant for Early Learning x Age^2 for CFCS levels I – IV. These interaction terms were positive but small, indicating slightly less deceleration (i.e., more linear growth) in predicted scores over time for those children who participated in an early learning environment (see Table 4 and Figure 1).

It should be noted that this variable accounts only for whether children participated in an early learning environment, and does not consider the family's socioeconomic status – a possible confounding variable. Many low-income families of children with special needs (including those with communication disorders) in Ontario are eligible for publically-funded childcare, but it may be that children in childcare came from higher SES homes.

For the intervention-based variables, only data for children who received multiple (i.e., two or more) assessments in the PSLP were included in the analysis. This amounted to data for 21,998 children being used to test for significant predictors of growth for the following variables: intervention status, length of time in intervention, and goals targeted in intervention. Unstructured covariance was removed from the original models of growth to run the analysis for these predictors.

Intervention status. Data for the intervention-status variable were available for the full sample of children who received multiple assessments in the PSLP (*N* = 21,998). Intervention status was a significant predictor in all CFCS levels but level V. Main effects were statistically significant for CFCS levels I-IV and predicted mean FOCUS© scores at 18 months were higher for children who were in intervention than those who were not. The main effects reached the 16 FOCUS© points required to be clinically meaningful for children in CFCS levels II-IV, and those in level I were approaching this criterion for clinical significance. Interaction terms were significant for Intervention status x Age for CFCS levels II – IV. These interaction terms were small and negative, indicating smaller predicted slopes at 18 months of age for children receiving intervention. Interaction terms were significant for Early Learning x Age^2 for CFCS levels I – IV and all terms were small and positive, indicating slightly less deceleration in the growth line over time for those children receiving intervention (see Figure 2 and Table 4).

Time in Intervention. Time in intervention was defined as the amount of time a child spent in the PSLP (i.e., time since their first assessment). While it is likely that this time represents more intervention, we did not have a way to confirm this for certain. There may be some children who were followed every six months, but received little or no intervention, but based on our clinical experience working in this program, this is an unlikely scenario. Data for this variable were also available for the same full sample of children who received multiple assessments (*N* = 21,998). Time in intervention was a significant predictor of outcome, and both interaction terms were significant for all CFCS levels. Main effects were statistically significant for CFCS levels I-IV and predicted mean FOCUS© scores at 18 months increased with increasing time spent in intervention. The predicted increase in FOCUS© scores for each 3-month interval did not reach clinical significance in any of the CFCS levels. The Time in

Intervention x Age interaction was small and negative for all CFCS levels, indicating a slightly smaller predicted slope with increasing time spent in intervention. The Time in Intervention x Age^2 interaction term was positive but small for all CFCS levels, indicating slightly less deceleration in the growth line with increasing time spent in therapy. The impact of time spent in intervention was greatest for children in the lower CFCS levels (i.e., levels IV and V). In these latter levels, additional months in intervention yielded greater outcomes at 67 months of age, whereas additional months in intervention yielded statistically similar outcomes at 67 months of age for children in CFCS levels I-III (see Figure 3 and Table 4).

Intervention goals. Data related to intervention goals were available for 20,502 of the children with multiple assessments. The breakdown of goals targeted in intervention was as follows: speech only = 19.5%, language only 52.8%, both speech and language 26%, fluency 1.5%, voice 0.05%, feeding & swallowing 0.03%, emergent literacy 0.1%. Since the majority of children accessing PSLP services received intervention targeting speech, language or a combination of speech and language goals, our analysis of this predictor focused on those skills. Outcomes for children with speech-only, language only, and both speech and language goals were compared for all CFCS levels. Only outcomes for children with speech-only versus language-only goals were significantly different from each other, and this was only true for children in CFCS levels II and III. The main effects of treatment goals (i.e., speech-only vs. language-only goals) were statistically and clinically significant for children in CFCS levels II and III. Differences in mean predicted scores were examined at 30 months since children did not typically have speech goals until that time (see Table 4). Both interaction terms were significant in CFCS level II, indicating that children with speech-only goals had predicted slopes that were less steep and curves with less deceleration over time than children with

language-only goals (see Table 4). Only the interaction between Treatment Goals x Age^2 was significant for CFCS level III, indicating the two groups had similar predicted slopes, but children with speech-only goals had less deceleration in growth over time than those with language-only goals.

Discussion

In this series of analyses, variables were added to previously developed models of growth that used only age to identify factors predictive of preschoolers' communicative participation outcomes (Cunningham et al., 2017b). This work contributes to knowledge in that it identified new predictors of preschoolers' communicative participation outcomes and demonstrated that predictors may affect growth differently depending on a child's level of communicative function. Particularly relevant predictors of growth identified in this study included: a child's participation in an early learning environment, receipt of speech-language intervention services, and the amount of time a child spent in the program.

Clinically meaningful differences in predicted outcomes were found for children who participated in an early learning environment versus those who did not, but the impact of these factors was dependent on a child's level of communicative function. For example, there were clinically meaningful differences in predicted outcomes for children in CFCS levels I, II, and III who were in/out of early learning environments (i.e., main effects) and children in these levels who participated in an early learning environment also had different predicted growth trajectories (i.e., slopes and rates of acceleration/deceleration). This may indicate that an early learning environment is beneficial for developing communicative participation skills in children with higher levels of communicative function. Main effects were not clinically significant for children in CFCS levels IV and V, which suggests that children in the lower levels of function

may benefit less from being in an early learning environment. This should however be interpreted with caution.

Similarly, children receiving intervention had better predicted communicative participation outcomes than those who were not. In the context of this work, when children began intervention, they got a significant increase in predicted FOCUS© scores, but again the impact of starting intervention varied by level of communicative function. For instance, the coefficient for the main effect for Intervention Status was in excess of the 16 points determined to be clinically meaningful change on the FOCUS© for children in CFCS levels II, III and IV, but not for those in levels I and V. Predicted slopes (i.e., rate of growth in FOCUS© scores) were less steep for those children receiving intervention, likely because of their higher predicted starting scores (i.e., they had less far to go to reach the maximum score). Additionally, there was less predicted deceleration in the curvature of the growth lines for children receiving intervention – meaning that growth was more linear for those children receiving intervention.

Looking at these predicted outcomes, it may be tempting to conclude that intervention was ineffective for children in CFCS levels I and V, but it is important to note that these models demonstrate the impact of starting intervention, not the outcomes of prolonged periods of intervention. Findings were approaching clinical significance for children in level I, indicating the need for further exploration. The lack of significant findings for children in level V indicates that those children at the lowest levels of function may not experience the same increase in communicative participation skills when they begin intervention. This is not surprising however, because those children are the most impaired and may need more time before the benefits of intervention can be seen.

The Time in Intervention variable also yielded different models of growth for children depending on their level of communicative function. More time children spent in intervention resulted in greater predicted communicative participation outcomes for children in all CFCS levels. For children in the higher CFCS levels (i.e., I, II and III) this was true at younger ages, but by 67 months of age children had similar outcomes regardless of the amount of time they spent in treatment. For children in the lower CFCS levels, more time spent in intervention resulted in higher predicted outcomes at both 18 and 67 months. This suggests that children in the lower levels of function may require more time in treatment than those in the higher levels of function. For children in the higher levels of function, less treatment may result in a similar outcome as more treatment (i.e., more is not always better).

It should be noted that while, based on discussions with administrators and policy makers and our own clinical experience working in the program, we believe that most children with multiple assessments in the program were receiving some kind of speech-language intervention, it is possible that some were simply followed over multiple assessment points without receiving intervention, but these cases (if any) are minimal. We are currently working with the PSLP to establish more precise methods of collecting data, which will allow us to explore the impact of this factor more systematically in the future.

While our data show that many children made clinically meaningful gains in communicative participation skills when they started speech-language therapy and when they spent more time in therapy programs, we cannot comment on the impact of specific interventions. Our intervention variable referred to speech-language intervention broadly – and all types of intervention were grouped together. This was because of the way data were collected within the program – assessments were not always aligned with the start/end of

specific interventions. In the PSLP intervention types include: individual 1:1 therapy; group therapy; parent training; parent or caregiver consultation; and home programming. Our findings indicate some benefit of starting speech-language interventions generally within the program. We are currently working closely with the PSLP and its clinicians to demonstrate the benefits of more systematic data collection methods (i.e., in line with the start and end of specific interventions). In spite of these limitations, we believe that even these less-than-detailed findings provide support regarding the value of SLP interventions for the development of preschoolers' communicative participation skills, and a challenge to the field to define the nature of our interventions in ways that are both reliable and valid.

This work has applicability for both clinicians and policy makers who work with and plan services for preschoolers with communication disorders. First, we have identified both intervention-based and demographic predictors of communicative participation outcomes. Clinicians could use this knowledge about predictors of growth with families to demonstrate the value of both an early learning environment and participating in speech-language interventions. Both policy makers and clinicians may use knowledge related to time spent in intervention to predict how long a child will need to be in speech-language therapy to achieve optimal outcomes. If administrators and policy makers have knowledge of the range of CFCS levels for the children accessing their services, they may be better positioned to make informed decisions about service delivery planning and resource allocation.

There are limitations to this work that must be acknowledged. Data used for this study were collected as part of the PSLP's program evaluation project. As such, data collection was not done as systematically as would be desirable in a structured research program. Data for many of the variables included as predictors were collected by SLPs who used an informal

checklist to report. We are not confident that the checklist yielded valid or reliable data for at least one of the variables included here (treatment goals). For example, clinicians were asked to indicate goals targeted in intervention by checking goals from a list of 12 possibilities including 'articulation', 'phonology', 'motor speech', 'expressive language', 'receptive language', and 'social communication'. Due to the well-recognized issues with terminology and terms being used interchangeably in the field (Walsh, 2006), we cannot be sure that SLPs used these terms in the same way across the PSLP. In an attempt to circumvent this issue, we combined all 'speech' goals together (i.e., articulation + phonology + motor speech) and all 'language' goals together (i.e., expressive + receptive + social communication) to compare outcomes by goals broadly targeted in intervention.

A second limitation lies in the nature of the PSLP datasets. We did not have access to information related to the types of communication disorders with which children presented. In some ways, this can be inferred based on the types of goals targeted in therapy, but this was not done because, as described above, it was impossible to tell whether a child with speech-only goals did not also have a language disorders and vice versa. We are in the process of developing a tool to improve the precision of data collection in the program. We also lacked information about the types of interventions children received in the program. Since data were collected at approximate six month intervals, data collection did not align with the start/end of particular interventions, making it impossible for us to determine whether outcomes differed for children with similar impairments/functional skills accessing different interventions. We are working collaboratively with the PSLP to develop new methods for collecting data and understanding the various interventions offered in the program, so that we can later report on this reliably.

A third limitation is that we had missing data for many of the predictor variables examined here. This was the result of incomplete datasets – and is in part the result of SLPs in the program not consistently completing outcome measures for all of the children they see. This means our results are based on the data that are available to us. No attempt was made to impute missing values because in the absence of evidence to the contrary, we assume the data are missing at random rather than systematically.

Finally, it is important to note that one of the limitations of the statistical model we used (i.e., including quadratic terms in the models) is that it may not provide the best fit for the oldest children in the program. We remain uncertain as to whether the decline in predicted FOUCS© scores seen in the upper ages is a true phenomenon (e.g., Perhaps when children start school their communicative participation scores decrease because of increased communicative demands) or whether it is a function of the model we selected. This is something we plan to explore further in this program of research.

Despite these limitations, we feel there is important new knowledge to be gained from this work. Using an unprecedentedly large dataset we have provided additional evidence for some already identified predictors of children's communicative participation skills. We have also identified several new predictors of communicative participation outcomes for preschoolers with speech-language impairments. Importantly, we have demonstrated that starting speech-language intervention can have a clinically meaningful impact on the development of preschoolers' communicative participation skills.

The importance of examining both outcomes and predictor variables by level of communicative function has also been demonstrated here. We found that predictor variables impacted outcomes differently depending on a child's level of communicative function – a level

of investigation not possible before the CFCS was created or without a dataset large enough to stratify by this variable. It may be important for clinicians and researchers to consider a child's level of communicative functioning when recommending intervention and examining the outcomes of intervention efforts. Our future studies, using the next waves of this database, will hopefully include more precise data, allowing us to investigate the associations between these predictors with greater confidence. Future studies will also seek to understand how children move between CFCS levels as their communicative participation skills improve. Under these improved circumstances it may become clearer and easier to ascribe direct causal connections between interventions and changes in preschoolers' communicative participation skills.

References

Abbott, K.V., Barton, F.B., Terhorst, L. & Shembel, A. (2016). Retrospective studies: a fresh look. *American Journal of Speech-Language Pathology, 25*(2), 157-163.

American Speech-Language-Hearing Association. (2008). *Roles and responsibilities of speech-language pathologists in early intervention* [Position statement]. Retrieved from www.asha.org/policy.

American Speech-Language-Hearing Association (n.d.). *Childhood Apraxia of Speech* [Position Statement]. Retrieved from http://www.asha.org/policy/PS2007-00277/.

Baxendale, J., Lockton, E. Adams, C. & Gaile, J. (2013). Parent and teacher perceptions of participation and outcomes in an intensive communication intervention for children with pragmatic language impairment *International Journal of Language and Communication Disorders, 48* (1) 41-53.

Boons, T., Brokx, J.P.L., Dhooge, I., Frijns, J.H.M. Peeraer, L., Vermeulen, A., Wouters, J. & van Wieringen, A. (2012). Predictors of spoken language development following pediatric cochlear implantation. *Ear and Hearing, 33* (5), 671-639.

Bornstein, M.H., Hahn C.S. & Haynes, O.M. (2004). Specific and general language performance across early childhood: stability and gender considerations. *First Language, 24*(3), 267–304.

Coleman, A., Weir, K., Ware, R.S. & Boyd, R. (2015). Predicting functional communication ability in children with cerebral palsy at school entry. *Developmental Medicine and Child Neurology, 57*(3), 279-285.

Cook, S., Donlan, C. & Howell, P. (2013). Stuttering severity, psychosocial impact and lexical diversity as predictors of outcome for treatment of stuttering. *Journal of Fluency Disorders, 38* (2), 124-133.

Cunningham, B.J., Washington, K.N., Binns, A., Rolfe, K., Robertson, B. & Rosenbaum, P. (2017a). Current methods of evaluating speech-language outcomes for preschoolers with communication disorders: A scoping review using the ICF-CY. *Journal of Speech, Language, and Hearing Research, 60*(2), 447-464.

Cunningham, B.J., Hanna, S.E., Rosenbaum, P., Thomas-Stonell, N. & Oddson, B. (2017b). A population-based study of communicative participation in preschoolers with speech-language delays. *Developmental Medicine and Child Neurology, 59(10),* 1049-1055.

Dodd, B., Holm, A., Hua, Z. & Crosbie, S. (2003). Phonological development: a normative study of British English-speaking children. *Clinical Linguistics and Phonetics, 17(*8), 617-43.

Eadie, T. L., Yorkston, K. M., Klasner, E. R., Dudgeon, B. J., Deitz, J. C., Baylor, C. R., Miller, R.M. & Amtmann, D. (2006). Measuring communicative participation: A review of self-report instruments in speech-language pathology. *American Journal of Speech-Language Pathology, 15* (4), 307-320.

Eriksson, M., Marschik, P.B., Tulviste, T., Almgren, M., Pérez Pereira, M., Wehberg, S., Marjanovič-Umek, L., Gayraud, F., Kovacevic ,M. & Gallego, C. (2012). Differences between girls and boys in emerging language skills: evidence from 10 language communities. *British Journal of Developmental Psychology, 30*(2), 326-43.

Fantuzzo, J.W., Rouse, H.L., McDermott, P.A., Sekino, Y., Childs, S. & Weiss, A. (2005). Early Childhood Experiences and Kindergarten Success: A Population-Based Study of a Large Urban Setting. *School Psychology Review, 34*(4), 571-588.

Fran, S.P., Liberman, Z., Keysar, B. & Kinzler, K.D. (2015). The Exposure Advantage: Early Exposure to a Multilingual Environment Promotes Effective Communication. *Psychological Science, 26*(7), 1090-97.

Glogowska, M., Roulstone, S., Enderby, P. & Peters, T.J. (2000). Randomised controlled trial of community based speech and language therapy for preschool children. *BMJ, 321* (7266), 923-926.

Guitar, B., Kazenski, D., Howard, A., Cousins, S.F., Fader, E. & Haskell, P. (2015). Predicting Treatment Time and Long-Term Outcome of the Lidcombe Program: A Replication and Reanalysis. *American Journal of Speech-Language Pathology, 24* (3), 533-544.

Hambly, C. & Fombonne, E. (2012). The impact of bilingual environments on language development in children with autism spectrum disorders. *Journal of Autism and Developmental Disorders, 42*(7), 1342-52.

Hidecker, M.J., Paneth, N., Rosenbaum, P.L., Kent, R.D., Lillie, J., Eulenberg, J.B., Chester, K., Johnson, B., Michalsen, L., Evat, M. & Taylor, K. (2011). Developing and validating the Communication Function Classification System for individuals with cerebral palsy. *Developmental Medicine and Child Neurology, 53*(8):704-710.

Hidecker, M.J., Ho, N.T., Dodge, N., Hurvitz, E.A., Slaughter, J., Workinger, M.S., Kent, R.D., Rosenbaum, P., Lenski, M., Messaros, B.M., Vanderbeek, S.B., Deroos, S. & Paneth, N.

(2012). Inter-relationships of functional status in cerebral palsy: analyzing gross motor function, manual ability, and communication function classification systems in children. *Developmental Medicine and Child Neurology, 54*(8), 737-742.

Hidecker, M.J.C., Cunningham, B.J., Thomas-Stonell, N., Oddson, B. & Rosenbaum, P. (2017). Validity of the Communication Function Classification System (CFCS) for use with preschoolers with communication disorders. *Developmental Medicine and Child Neurology*, 59(5), 526-530.

Holzinger, D., Fellinger, J. & Beitel, C. (2011). Early onset of family centred intervention predicts language outcomes in children with hearing loss. *International Journal of Pediatric Otorhinolaryngology*, *75*(2), 256-260.

Huttenlocher, J., Haight W., Bryk A., Seltzer M., Lyons T. (1991). Early vocabulary growth: relation to language input and gender. *Developmental Psychology*, 27(2), 236–248.

Jones, M., Onslow, M., Harrison, E. & Packman, A. (2000). Treating stuttering in young children: predicting treatment time in the Lidcombe Program. *Journal of Speech, Language & Hearing Research, 43(*6), 1440-1450.

Kay-Raining Bird, E., Genesee, F. & Verhoeven, L. (2016). Bilingualism in children with developmental disorders: A narrative review. *Journal of Communication Disorders, 63*:1-14.

Law, J., Garret, Z. & Nye, C. (2003). Speech and language therapy interventions for children with primary speech and language delay or disorder. *Cochrane Database of Systematic Reviews; 3*(3):CD004110.

Lindsay, G. & Dockrell, J.E. (2004). Whose job is it? Parents' concerns about the needs of their children with language problems. *Journal of Special Education, 37* (4): 225-235.

Luijk, M.P., Linting, M., Henrichs, J., Herba, C.M., Verhage, M.L., Schenk, J.J., Arends, L.R., Raat, H., Jaddoe, V.W., Hofman, A., Verhulst, F.C. & van IJzendoorn, M.H. (2015). Hours in non-parental child care are related to language development in a longitudinal cohort study. *Child: Care, Health & Development 41*(6), 1188-1198.

Luiselli, J.K., Cannon, B.O., Ellis, J.T., Sisson, R.W. (2000). Home-based Behavioral Intervention for Young Children with Autism/Pervasive Developmental Disorder: A Preliminary Evaluation of Outcome in Relation to Child Age and Intensity of Service Delivery. *Autism, 4* (4), 426-438.

Mashburn, A.J., Justice, L.M., Downer, J.T. & Pianta, R.C. (2009). Peer effects on children's language achievement during pre-kindergarten. *Child Development, 80*(3), 686-702.

Mazurek M.O., Kanne S.M. & Miles, J.H. (2012). Predicting improvement in social-communication symptoms of autism spectrum disorders using retrospective treatment data. *Research in Autism Spectrum Disorders, 6* (1), 535-545.

McDuffie, A. & Yoder, P. (2010). Types of Parent Verbal Responsiveness that Predict Language in Young Children with Autism Spectrum Disorder. *Journal of Speech, Language, and Hearing Research, 53* (4), 1026-1039.

National Institute of Child Health and Human Development (2000). The Relation of Child Care to Cognitive and Language Development. *Child Development,* 71(4), 960-980.

Oddson, B., Washington, K., Robertson, B., Thomas-Stonell, N. & Rosenbaum, P. (2013). Inter-rater Reliability of Clinician's Ratings of Preschool Children using the FOCUS©©: FOCUS© on Communication Outcomes under Six. *Canadian Journal of Speech-Language Pathology and Audiology, 37* (2), 170-174.

Ontario Ministry of Children and Youth Services (2013). *Results-Based Plan Briefing Book 2013-14* (ISSN1718-617X). Retrieved from http://www.children.gov.on.ca/htdocs/English/documents/about/Results_2013-2014.pdf.

Paul, R. & Roth, F.P. (2011). Characterizing and Predicting Outcomes of Communication Delays in Infants and Toddlers: Implications for Clinical Practice. *Language, Speech, and Hearing Services in Schools, 42* (3), 331-340.

Pennington, L., Roelant, E., Thompson, V., Robson, S., Steen, N. & Miller, N. (2013). Intensive dysarthria therapy for younger children with cerebral palsy. *Developmental Medicine and Child Neurology, 55* (5), 464-471.

Roberts, M., & Kaiser, A. (2011). The Effectiveness of Parent-Implemented Language Intervention: A Meta-Analysis. *American Journal of Speech-Language Pathology, 20*(3), 180-199.

Roberts, M.Y. & Kaiser, A.P. (2012). Assessing the effects of a parent-implemented language intervention for children with language impairments using empirical benchmarks: a pilot study. *Journal of speech, language, and hearing research, 55* (6), 1655-1670.

Rosenbaum, P.L. & Gorter, J.W. (2012) The 'F-Words' in Childhood Disability: I Swear This is How We Should Think! *Child: Care, Health and Development, 38*(4), 457-463.

Speech-Language and Audiology Canada (2014a). *SAC position paper on universal newborn hearing screening in Canada.* Retrieved from: http://sac-oac.ca/sites/default/files/resources/SAC-OAC-UNHS-PP_EN.pdf.

Speech-Language & Audiology Canada (2014b). *SAC Position Paper on Early Identification of Speech & Language Disorders.* Retrieved from: http://sac-oac.ca/sites/default/files/resources/EarlyID-PositionPaper-ENGLISH.pdf.

Stata Statistical Software Version 13.1 [computer software] (2013). College Station, TX: StataCorp.

Thomas-Stonell, N. L., Oddson, B., Robertson, B. & Rosenbaum, P. L. (2010). Development of the FOCUS© (FOCUS© on the Outcomes of Communication Under Six), a communication outcome measure for preschool children. *Developmental Medicine and Child Neurology, 52* (1) 47-53.

Thomas-Stonell, N., Oddson, B., Robertson, B., & Rosenbaum, P. (2009). Predicted and observed outcomes in preschool children following speech and language treatment: Parent and clinician perspectives. *Journal of Communication Disorders, 42* (1), 29-42.

Thomas-Stonell, N., Washington, K., Oddson, B., Robertson, B. & Rosenbaum, B. (2013a). Measuring communicative participation using the FOCUS©: FOCUS© on the Outcomes of Communication Under Six. *Child: care, health, and development, 39*, (4) 474–480.

Thomas-Stonell, N., Oddson, B., Robertson, B. & Rosenbaum, P. (2013b). Validation of the FOCUS© on the Outcomes of Communication under Six outcome measure. *Developmental Medicine & Child Neurology, 55*(6), 546-552.

Thomas-Stonell, N., Robertson, B., Oddson, B. & Rosenbaum, P. (2016). Communicative participation changes in pre-school children receiving augmentative and alternative communication intervention. *International Journal of Speech-Language Pathology, 18* (1), 32-40.

Tyler, A.A., Lewis, K.E., Welch, C.M. (2003). Predictors of phonological change following intervention. *American Journal of Speech-Language Pathology, 12* (3), 289-298.

Walsh. R. (2006). Terminology – Much more than a definition. *Acquiring Knowledge in Speech, Language, and Hearing*, 8(1), 39-41.

Washington, K.N., Thomas-Stonell, N., McLeod, S., & Warr-Leeper, G. (2015). Outcomes and predictors in preschoolers with speech-language and/or developmental mobility impairments. *Child Language Teaching and Therapy, 31* (2), 141-157.

Washington, K., Thomas-Stonell, N., Oddson, B., McLeod, S., Warr-Leeper, G., Robertson, B. & Rosenbaum, P. (2013a). Construct validity of the FOCUS©© (FOCUS© on the Outcomes of Communication Under Six): a communicative participation outcome measure for preschool children. *Child: care, health and development*, 39, 4, 481–489.

Washington, K., Oddson, B., Robertson, B., Rosenbaum, P. & Thomas-Stonell, N. (2013b) Reliability of the FOCUS© on the outcomes of communication under six (FOCUS©). *Journal of Clinical Practice in Speech-Language Pathology*, 15, 7–12.

Watts Pappas, N., McLeod, S., McAllister, L., & McKinnon, D. H. (2008). *Parental involvement in speech intervention: A national survey. Clinical Linguistics and Phonetics, 22* (4), 335-344.

Williams, L.A. (2012). Intensity in phonological intervention: Is there a prescribed amount? *International Journal of Speech-Language Pathology, 14*(5), 456-461.

World Health Organization. (2007). International Classification of Functioning, Disability and Health – Children and Youth Version. Geneva: World Health Organization.

Yoder, P. & Compton, D. (2004). Identifying predictors of treatment response. *Mental Retardation and Developmental Disabilities Research Reviews, 10* (3), 162-168.

Zeng, B., Law, J. & Geoff, L. (2012). Characterizing optimal intervention intensity: The relationship between dosage and effect size in interventions for children with developmental speech and language difficulties. *International Journal of Speech-Language Pathology 14*(5), 471-477.

Figure captions

Figure 1. Predicted scores for children in CFCS Levels I-IV who did/did not participate in an early learning environment.

Figure 2. Predicted FOCUS© scores for children in CFCS levels I-IV by Intervention Status.

Figure 3. Predicted FOCUS© scores for children in CFCS levels I-V by time spent in intervention.