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## Infants' and toddlers' language development during the pandemic: Socioeconomic status mattered



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### ABSTRACT

The disruption caused by the COVID-19 pandemic has raised concerns about children's development. Here, we examined the impact of the pandemic on Canadian infants' and toddlers' ( $N = 539$ ) language development. Specifically, we assessed changes in 11- to 34-month-olds' activities that are known to affect vocabulary development (i.e., screen and reading times). We also compared these children's vocabulary sizes with those of 1365 children collected before the pandemic using standardized vocabulary assessments. Our results show that screen and reading times were most negatively affected in lower-income children. For vocabulary growth, no measurable change was detected in middle- and high-income children, but lower-income 19- to 29-month-olds fared worse during the pandemic than during pre-pandemic times. Moving forward, these data indicate that educators and policymakers should pay particular attention to children from families with lower socioeconomic status during times of crisis and stress.

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## Introduction

The COVID-19 lockdowns had a clear detrimental effect on school-aged children's learning and development (e.g., Engzell et al., 2021). However, limited data are available regarding the pandemic's impact on society's youngest members. Here, we approached the pandemic's effects on early language acquisition from two angles. First, we assessed changes in infants' and toddlers' screen and reading times—factors known to affect language development (e.g., Chonchaiya & Pruksananonda, 2008; Farrant & Zubrick, 2012). Second, we compared children's vocabulary sizes during the pandemic with those of pre-pandemic age-matched children as a proxy measure for changes in overall language development (e.g., Lee, 2011). Our findings show that the pandemic appears to have negatively affected some lower-SES (socioeconomic status) children's day-to-day activities and language development.

Examining language development during the pandemic is important because early language development is critical for later language success. For example, vocabulary development supports phonological awareness (McDowell et al., 2007) and grammatical knowledge (McGregor et al., 2005), both of which are crucial to developing literacy skills (e.g., Whitehurst & Lonigan, 2001). Moreover, early vocabulary size predicts later cognitive abilities (Marchman & Fernald, 2008). On the flip side, language delays have been linked to later psychosocial and behavioral problems (e.g., McCabe & Marshall, 2006). Given the importance of language development to later literacy, cognitive, and social development, understanding how the pandemic disruptions have affected early vocabulary growth is crucial.

Language development is shaped by the types of interactions and shared activities children engage in with others, the quantity and quality of which may have been negatively affected by the pandemic. Here, we focused on how the pandemic influenced reading and screen times, two activities that have been shown to support (e.g., Farrant & Zubrick, 2012) and delay (e.g., Chonchaiya & Pruksananonda, 2008) vocabulary growth, respectively. Given the strain the pandemic placed on families (Calvano et al., 2022), parents may have been unable to engage in shared reading time as much as they would during pre-pandemic times (e.g., Karrass et al., 2003). With increasing demands on parents' time (e.g., parents working from home with no daycare or grandparents to help with child care), children may have experienced an increase in passive screen time (e.g., television), which is more detrimental to language development than interactive screen time (e.g., Zoom) (e.g., Roseberry et al., 2014). Taken together, these changes in children's daily routines could have negatively affected children's language development.

Importantly, the pandemic might not have affected all families equally. For example, although all children were at home more due to the lockdown measures, this does not mean that they all experienced increased enriching interactions with their parents. Research suggests that the pandemic hit lower-SES families particularly hard (e.g., Fong & Iarocci, 2020), and parental stress is associated with increases in screen time for children (Seguin et al., 2021). On the other hand, higher-income families may have had more resources to engage in enriching home activities with children during the pandemic, such as shared reading time (Hendry et al., 2022), insulating those children from potentially negative effects of the pandemic on language development. Thus, the differences we generally observe in vocabulary development between high- and low-SES children (e.g., Fernald et al., 2013) may have been exacerbated by the pandemic.

To date, one study has examined young children's language development during the pandemic (Kartushina et al., 2021). This study focused on how the pandemic affected vocabulary growth in children sampled from different countries. Surprisingly, the authors found slightly accelerated (rather than delayed) vocabulary growth during the pandemic relative to pre-pandemic times. Even more surprising, in contrast to past studies (e.g., Fernald et al., 2013), they found no effect of SES (as measured by maternal education) on vocabulary development. The authors concluded that increased home activities during the pandemic likely boosted vocabulary development, leveling the playing field for high- and low-SES families. Why did Kartushina et al. (2021) find no negative impact of the pandemic on children's vocabulary growth as opposed to our predictions outlined above? One factor to consider is the participant pool they studied. This study collapsed across data collected in 13 countries, with an

average of 76 data points per lab. Although this broad sampling allowed the authors to study the pandemic's effect more generally, the severity of lockdown measures experienced in those countries varied greatly. Indeed, some of the 13 countries had very mild lockdown responses to the pandemic. Moreover, the study used maternal education as a proxy for SES. Although maternal education can affect children's language development (e.g., Hoff, 2006), evidence that the pandemic was especially difficult on lower-SES families used family income as a proxy for SES (e.g., Vogelbacher & Attig, 2021). Thus, in the current study, we examined a large sample of data from a single location—Ontario, Canada—where children experienced one of the most extensive lockdowns in the world (see [Supplementary Fig. 1](#) in the online supplementary material). We compared children's day-to-day life (i.e., screen and reading times) and vocabulary size with those of their pre-pandemic, age-matched peers. For all measures, we examined whether family income was linked to how extensively children's routines and language development were affected by the pandemic.

Our predictions were as follows. First, given the severity of the lockdown measures in Canada, we anticipated changes to children's day-to-day life that would negatively affect language development; that is, there would be an increase in screen time and a decrease in reading time. Second, consistent with these changes in activities (along with other pandemic-related changes such as mask-wearing and family stress), we predicted that language development (as measured by standardized vocabulary assessments) would be negatively affected. Third, all these effects might be exacerbated in lower-income families who had fewer resources to mitigate the negative impact of the pandemic on their children's lives.

## Method

### Participants

We surveyed 539 families during the pandemic (401 of which reported family income). Household income was measured in CAD (Canadian dollars) on a 4-point scale, which roughly corresponded to (1) <33,750 USD (U.S. dollars), (2) 33,750 to 67,500 USD, (3) 67,500 to 105,000 USD, and (4) >105,000 USD.<sup>1</sup> These data were compared with baseline measures collected from 1365 families drawn from the same population during the 10 years pre-pandemic (501 of which reported family income). Families lived in the Greater Toronto Area of Canada and were raising their children monolingually (English exposure > 90%). Children were typically developing 11- to 34-month-olds (see [Supplementary Table 1](#) in the online supplementary material).

This research was approved by the University of Toronto research ethics board and was conducted in compliance with recognized standards for experimentation with human participants. Informed consent was obtained from all participating families.

### Materials

Because our sample included a wide age range, we used the vocabulary checklists from three age-appropriate MacArthur–Bates Communicative Development Inventory (CDI) forms to measure children's expressive vocabularies: Words and Gestures (W&G; 11–18 months), Words and Sentences (W&S; 19–29 months), and CDI–Third Edition (CDI-III;  $\geq 30$  months) (Fenson et al., 1994). Previous studies have demonstrated that parental CDI measures are a valid and reliable measure of children's language knowledge (e.g., Styles & Plunkett, 2009). We also assessed changes in children's screen and reading times during the pandemic via questionnaire. We asked caregivers whether their children's average daily reading and screen times were more than, less than, or the same as if we were not in a pandemic (note that parents felt more confident in giving coarse estimations rather than calculating precise differences in number of minutes). We then asked caregivers to estimate what proportion of

<sup>1</sup> The conversion is based on 1 CAD = 0.75 USD, which is equal to (1) <45,000 CAD, (2) 45,000 to 90,000 CAD, (3) 90,000 to 140,000 CAD, and (4) >140,000 CAD. A family of four with an annual income of less than 49,467 CAD is considered a low-income household in Canada (Statistics Canada, 2022).

their children's daily screen time was live interaction (e.g., video call) or passive (e.g., television). Classifying screen time was important given research suggesting that interactive (but not passive) screen time can support language development (e.g., [Roseberry et al., 2014](#)).

### Procedure

Baseline data were collected during the 10 years preceding the pandemic, and pandemic data were collected between 6 and 16 months after the initial lockdown in March 2020 (see [Supplementary Fig. 1](#)). All caregivers filled out a CDI form either in the lab (pre-pandemic) or at home (pre-pandemic and during pandemic), with the same detailed instructions provided by an experimenter by phone, over Zoom, or in-person. Only caregivers contacted during the pandemic filled out the screen and reading time questionnaire.

## Results

### Analysis of pandemic-related change to children's reading and screen times

We assessed changes in reading and overall screen time in children who were at least 6 months old at the beginning of the pandemic ( $N = 355$ ). We fit two ordinal logistic regression models to our data using the *clm* function of the "ordinal" package in R ([Christensen, 2018](#)). The ordinal response variables in the first and second models were change in reading time and change in screen time (less, same, or more), respectively. In both models, gender, income, age, and an Income  $\times$  Age interaction were entered as predictors. Gender was simple-coded (male =  $-0.5$ ; female =  $0.5$ ), and both income and age were mean-centered.

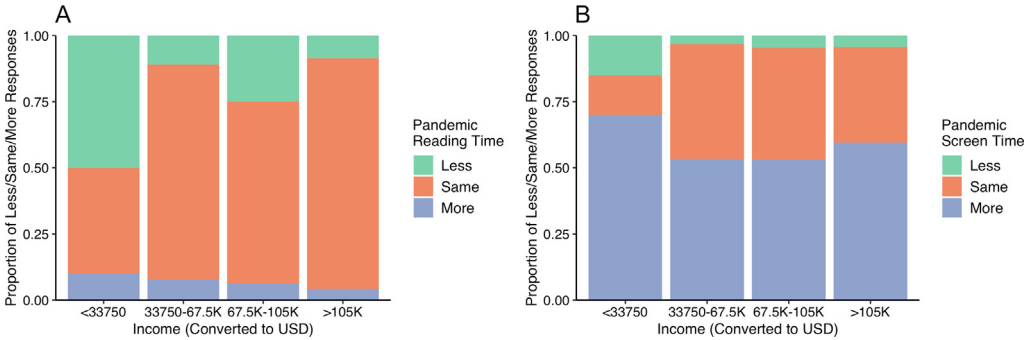
### Change in reading time

Our first model revealed a significant Income  $\times$  Age interaction ( $\beta = -0.08$ , 95% confidence interval (CI)  $[-0.15, -0.02]$ ,  $z = -2.50$ ,  $p = .01$ ). To explore this interaction, we compared the effect of Income for children 1 standard deviation above and below the mean age (17.41 and 30.92 months, respectively) by recentering the age variable. Our follow-up tests revealed a significant effect of Income with younger children ( $\beta = 0.90$ , 95% CI  $[0.49, 1.32]$ ,  $z = 4.24$ ,  $p < .001$ ), but not with older children, indicating that younger children from higher-SES families were more likely to have the same or more reading time compared with their peers from lower-SES families. Our findings show that reported reading time was mostly unaffected in higher-SES children (see [Fig. 1A](#)), but lower-SES children in some age brackets experienced reduced reading time (see [Supplementary Fig. 2](#)).

### Change in screen time

As predicted, more than half the children in our sample experienced increased screen time during the pandemic (see [Fig. 1B](#)). Even children under 2 years old, for whom zero screen time is recommended ([Canadian Paediatric Society, 2017](#)), experienced increases. However, this pattern was not uniform across all children, as revealed by a significant Income  $\times$  Age interaction ( $\beta = -0.08$ , 95% CI  $[-0.14, -0.03]$ ,  $z = -2.84$ ,  $p = .005$ ). We conducted follow-up tests to examine the effect of Income for children 1 standard deviation above and below the mean age by recentering the age variable. We found a significant effect of income with older children but not with younger children ( $\beta = -0.52$ , 95% CI  $[-0.95, -0.12]$ ,  $z = -2.47$ ,  $p = .01$ ), indicating that older children from higher-SES families were less likely to have increased screen time during the pandemic than those from lower-SES families (see [Supplementary Fig. 3](#)).

We next examined children's reported screen time by type—interactive (e.g., Zoom) versus passive (e.g., television). Because the data were bound from 0 to 1, we ran a fractional regression model with the *glm* function in R. The model predicted the likelihood of having interactive screen time from gender (male =  $-0.5$ ; female =  $0.5$ ), income (mean-centered), age (mean-centered), and an Income  $\times$  Age interaction. We found a significant main effect of Income ( $\beta = 0.29$ , 95% CI  $[0.10, 0.49]$ ,  $t = 2.98$ ,

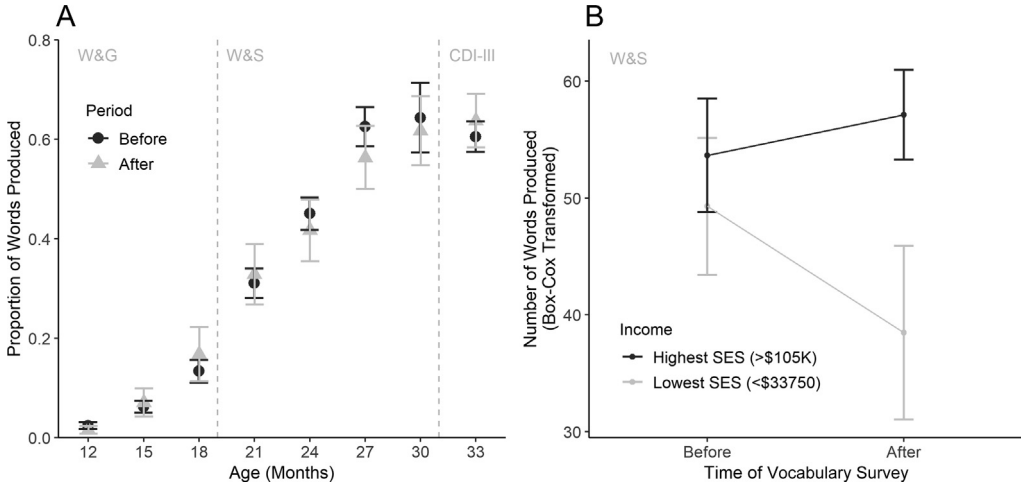


**Fig. 1.** (A) Caregivers were asked whether their children engaged in less, the same, or more reading time during the pandemic. This panel shows the proportion of responses by family income collapsed across age. Note that because many children were missing out on reading activities that normally take place in daycare, even children who experienced no change in the reading times at home likely experienced a net overall reduction in reading time during the strictest lockdowns. (B) Caregivers were asked whether their children received less, the same, or more overall screen time during the pandemic. This panel shows the proportion of responses by family income collapsed across age. USD, U.S. dollars.

$p = .003$ ), such that higher-SES children experienced relatively more interactive screen time than lower-SES children (see Supplementary Fig. 4).

*Vocabulary size*

All measures reported above suggest that children’s activities were affected in ways that are known to negatively affect language development. Moreover, these changes were more marked in lower-SES children. Next, we compared vocabulary size in children before and during the pandemic (see Fig. 2). Children’s vocabulary scores (collapsed across SES) look similar before and after the onset of the pandemic (see Fig. 2A). Because there was no single test appropriate for our whole age range, and analyzing raw CDI scores of three different tests in a single model was not possible, we performed separate analyses for the three different CDI forms: W&G (11–18 months), W&S (19–29 months), and CDI-III ( $\geq 30$  months). In each model, we fit a linear regression to our data using the *lm* function in R. To meet the assumptions of linear regression models, the data on W&G were log-transformed, whereas the W&S and CDI-III data were Box–Cox-transformed with  $\lambda = .63$  [scaled score = (raw score<sup>0.63</sup> – 1)/0.63] and with  $\lambda = 1.19$  [scaled score = (raw score<sup>1.19</sup> – 1)/0.63], respectively (Singh et al., 2022). Children’s transformed CDI scores were entered as the response variable. Period (before pandemic or after lockdown), income, and a Period  $\times$  Income interaction were entered as independent variables while controlling for gender and age. Period (before pandemic = –0.5; after lockdown = 0.5) and gender (male = –0.5; female = 0.5) were simple-coded, and income and age were mean-centered. Preliminary analyses found no evidence for an effect of lockdown duration (i.e., the results looked the same for children whose vocabulary was measured 6 months after lockdown onset as for those whose vocabulary was measured 16 months after lockdown onset), so this variable was not included in the final model. Consistent with previous literature (e.g., Fernald et al., 2013), we found a significant main effect of Income in W&S and CDI-III (see Supplementary Table 2), such that overall higher-SES children had larger vocabulary sizes than lower-SES children. A significant Period  $\times$  Income interaction was found in the middle age bracket (W&S), but not in the youngest (W&G) and oldest (CDI-III) age groups. To better understand this interaction, and how the pandemic may have differentially affected high- and low-SES children, we conducted follow-up tests to examine the effect of period for the highest (>\$105,000) and lowest (<\$33,750) income brackets. We found a significant effect of period in lower-SES children, ( $\beta = -10.25$ , 95% CI [–19.55, –0.94],  $t = -2.16$ ,  $p = .03$ ), such that lower-SES children had smaller vocabularies than their peers from before the pandemic, whereas no effect of period was found for higher-SES children (see Fig. 2B).



**Fig. 2.** (A) Proportion of words (number of words produced by children/total number of words in the checklist) produced before and after the onset of pandemic, collapsed across socioeconomic status (SES). Although we found no pandemic-related cohort effect in children’s vocabulary, a significant Period  $\times$  Income interaction was found, indicating that higher- and lower-SES children in the 19- to 29-month age range were differentially affected by the pandemic. (B) A follow-up analysis examining number of words produced by 19- to 29-month-old children before and after the onset of pandemic, broken down by SES, revealed the negative effect of the pandemic on lower-SES children’s vocabulary development. Error bars in both panels represent 95% confidence intervals. On average, higher-SES children were able to produce 52% and 53% of words from the checklist before and after the onset of pandemic, respectively; whereas lower-SES children were able to produce 48% and 34% of words from the checklist before and after the onset of pandemic, respectively. W&G, Words & Gestures; W&S, Words & Sentences; CDI-III, MacArthur–Bates Communicative Development Inventory–Third Edition.

**Discussion**

How did extensive and lengthy COVID-19 lockdowns affect children’s day-to-day life and their language development? Using a large sample of infants and toddlers in Canada, we explored changes in young children’s screen and reading times during the pandemic. We also compared these children’s vocabulary sizes with those of their age-matched peers tested pre-pandemic. Interestingly, our results suggest that the impact of the pandemic on children’s day-to-day life, as well as on their vocabulary growth, depended on children’s family income.

As predicted, we found that most infants and toddlers experienced an increase in screen time during the pandemic. Importantly, in line with other studies (e.g., Ribner et al., 2021), this increase in screen time was not uniform across SES. In particular, lower-SES children were more likely to experience an increase in screen time and a lower proportion of interactive screen time than their higher-SES counterparts. Lower-SES children were also more likely to experience decreased reading times. Given the well-established coupling between reading and screen times with language development (e.g., Chonchaiya & Pruksananonda, 2008; Farrant & Zubrick, 2012), these data are in line with our prediction that the pandemic more negatively affected language development in lower-income children.

On the whole, we found no evidence that children’s vocabulary sizes were significantly lower than those of age-matched children prior to the pandemic. However, we *did* find evidence that some lower-SES children were negatively affected by the pandemic. Specifically, for the 19- to 29-month-olds in our sample, we found a significant interaction between period and income, such that lower-SES children during the pandemic had significantly smaller vocabularies than their pre-pandemic age-matched peers; this change was not found in higher-SES children. This suggests that for some sections of the population the vocabulary gap that typically exists between low- and high-SES children may have been exacerbated by the pandemic. This finding provides a rationale to consider targeted interventions for low-income families who experienced extensive lockdowns.

That said, the SES effect on children's language development was not seen in all age groups. Why might we have observed an effect of SES in children aged 19 to 29 months but not in our younger and older samples? One possibility relates to the measurements used for different ages. Detecting the effect of SES in younger populations, for example, may have been particularly difficult due to a floor effect and/or a lack of variability in these infants' small vocabularies, whereas in older children it could have been difficult to identify the effect because the CDI-III they completed is less comprehensive and thus perhaps less sensitive. Another possibility is that the effect reflects a true age difference in the developmental impact of the pandemic on young Canadian children. In this age range, children typically undergo the vocabulary spurt (Fenson et al., 1994). Any delays in vocabulary acquisition caused by the pandemic, such as increased parental stress and limited social activities, may be most apparent during this rapid growth period. We suspect that both explanations played a role in the outcome of our study.

Although our results paint a positive overall picture, suggesting that children's language development was not as negatively affected by pandemic lockdowns and stress as one might fear, we should note that our sample nevertheless came from a country with a relatively strong social safety net. This could have protected lower-income families from some of the brunt of the pandemic. In countries with greater income inequality and fewer social protections (e.g., the United States), we might expect the influence of SES on vocabulary development during the pandemic to have been more pronounced. We also note that our sample was slightly skewed toward higher-income families and included only monolingual children. Multilingual families may have faced additional challenges during the pandemic, particularly for children whose only exposure to English occurs outside of the home (e.g., day-care). Finally, given that we used a coarse measurement of language development (reported vocabulary size) and *still* observed a negative effect of the pandemic on some children's language development, it is possible that a more sensitive measure may have revealed more cause for concern even in higher-SES children.

What is the take home message of this study for parents, policymakers, and researchers? The news for higher-income children is better than expected. Although they experienced increased screen time, no measurable negative impact on their vocabulary sizes was detected relative to pre-pandemic baselines. But the picture looks different for lower-income children. Not only did they experience more negative impacts on screen and reading times than higher-income children, but children in the vocabulary spurt period of development also had lower average vocabulary scores than their pre-pandemic age- and SES-matched peers. Given that outcomes during toddlerhood (e.g., vocabulary size) are predictive of subsequent development (e.g., Lee, 2011), moving forward we should continue to monitor potential pandemic effects on children's development. In a broader sense, our results provide a warning for how society should cope with future challenges—the lowest-SES children in society are often the most vulnerable.

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## Data availability

Due to our ethics protocol, the data for this study are not made publicly available.

## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jecp.2023.105744>.



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