Sustained Pacifier Use is Associated with Smaller Vocabulary Sizes at 1 and 2 Years of Age.

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Abbreviations: CDI - Communicative Development Inventory

Contributors' Statement Page

Natalia Kartushina and Julien Mayor conceptualized and designed the study, supervised data collection and data analyses, drafted the initial manuscript, reviewed and revised the manuscript.

Luis Muñoz carried out data processing and analyses, reviewed and revised the manuscript

All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

INTRODUCTION

Pacifier use during childhood has been hypothesised to interfere with language processing. Recent evidence suggests that transient use of an object in the infant's mouth (a teething toy) impairs speech sound discrimination^{1,2} and that extensive pacifier use translates into slower processing of abstract words at 7-8 years³, but to date no studies have revealed detrimental effects of prolonged pacifier use on infant vocabulary learning. The present pre-registered study tests the hypothesis that greater accumulated pacifier use is associated with smaller vocabulary sizes at 12- (in comprehension and production) and 24-months of age (in production).

METHODS

Parents of 12- and 24-month-old children were recruited in the Oslo region (Norway) via birth registries. Upon the application of inclusion criteria (monolinguals exposed to >90% Norwegian; born full-term, without reported visual, auditory or cognitive impairments), the sample consisted of n=1181 children; n=448 (228 girls) 12-month-olds and n=733 (388 girls) 24-month-olds.

Parents filled in Norwegian versions of CDIs⁴, parental reports that assess vocabulary in both comprehension and production for 12-month-old infants (CDI-WG: 393 words) and in production, only, for 24-month-old infants (CDI-WS: 731 words). CDI scores were transformed into age- and gender-based percentiles using Norwegian norms^{5,6}. Additionally, parents were asked to report their child's pacifier use in hours, during daytime, in 2-month intervals from birth to the assessment date. We indexed socio-economic status with maternal education.

The study was approved by the local ethics committee (5600837). The stimuli, anonymized data and codes for the analyses are available at <https://osf.io/bg7wv/>.

RESULTS

The first models evaluated whether total accumulated pacifier use predicted vocabulary size in comprehension and production at 12 months of age and in production at 24 months of age. We ran beta regressions on vocabulary scores (percentiles) with accumulated pacifier use (in hours) as a predictor, controlling for maternal education. The results revealed that pacifier use correlated negatively with vocabulary sizes in both comprehension and production at 12 months of age, with a borderline effect on production at 24 months of age (see Table 1).

Follow-up models evaluated whether the period of pacifier use differentially impacted vocabulary size. We first performed a linear regression, for each child, on pacifier use as a function of age, to evaluate changes in pacifier use over time (positive slopes indicate increasing pacifier use, negative slopes indicate decreasing pacifier use). We added the predictor “pacifier change” (the slopes of the above regressions) to the beta regressions run previously to reveal any differential impact of pacifier use during different periods of the infant’s life. The results revealed a negative effect of pacifier change on vocabulary size in production at 12- and 24-months of age; infants who reportedly increased their pacifier use over age had lower vocabulary sizes than those whose pacifier use reportedly declined with age (see Table 1). Overall pacifier use was significant in both production (12- and 24-months of age) and comprehension (12 months).

Follow-up beta regressions confirmed that pacifier use at older ages correlated more strongly with vocabulary size than early use (see Figure 1), at both 12- (comprehension and production) and 24-months of age (in production).

DISCUSSION

Together, the analyses suggested that reported overall accumulated pacifier use correlated negatively with vocabulary size at both 12- (comprehension and production) and 24-months

of age (production), and that later pacifier use correlated more strongly (negatively) with vocabulary size than more precocious use, e.g., in the first 6 months of age.

Building on previous contributions which have revealed detrimental impacts of the momentary use of teething toys on infant speech perception^{1,2} and accumulated pacifier use on semantic processing efficiency³, our study is the first to suggest that pacifier use impacts word comprehension and production as early as 12 months of age, and that later pacifier use is more detrimental to word learning than early use.

Limitations of the current study include the use of retrospective reports concerning pacifier use. Further studies should aim at monitoring pacifier use regularly.

While pacifier use has been encouraged by the American Academy of Pediatrics for its positive impact at reducing sudden infant death syndrome^{7,8}, the present study adds to reports of negative impacts at emotional⁹ and cognitive levels¹⁰, and suggests that pacifier use in the first couple of years of life may hinder language acquisition.

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Table 1. Model estimates associated with the beta regressions for the first models (the impact of total pacifier use on vocabulary size at 12-months (in comprehension, in production) and at 24-months of age, and for the follow-up models, including change in pacifier use.

<i>Predictors</i>	First Models				Comp @12m				Prod @12m				Prod @24m			
	<i>Estimate</i>	<i>SE</i>	<i>Z-value</i>	<i>p</i>	<i>Estimate</i>	<i>SE</i>	<i>Z-value</i>	<i>p</i>	<i>Estimate</i>	<i>SE</i>	<i>Z-value</i>	<i>p</i>	<i>Estimate</i>	<i>SE</i>	<i>Z-value</i>	<i>p</i>
Intercept	0.11	0.05	2.07	0.04	0.27	0.04	6.08	<0.01	0.22	0.04	4.93	<0.01				
Pacifier Total	-0.11	0.05	-2.13	0.03	-0.11	0.04	-2.48	0.01	-0.08	0.04	-1.85	0.06				
Mat Edu	-0.14	0.05	-2.67	<0.01	-0.08	0.04	-1.72	0.09	0.07	0.04	0.07	0.13				

Follow-up models

Intercept	0.11	0.05	2.07	0.04	0.27	0.04	6.15	<0.01	0.22	0.04	4.98	<0.01				
Pacifier Total	-0.12	0.06	-2.01	0.04	-0.19	0.05	-3.65	<0.01	-0.19	0.06	-3.38	<0.01				
Mat Edu	-0.14	0.05	-2.67	<0.01	-0.08	0.04	-1.74	0.08	0.07	0.04	1.57	0.12				
Pacifier Change	-0.02	0.06	-0.40	0.69	-0.15	0.05	-2.90	<0.01	-0.17	0.06	-3.02	<0.01				

0–6m.

Intercept	0.11	0.05	2.07	0.04	0.27	0.04	6.06	<0.01	0.21	0.04	4.91	<0.01				
Period	-0.10	0.05	-1.97	0.049	-0.08	0.04	-1.72	0.09	-0.03	0.04	-0.73	0.47				
Mat Edu	-0.14	0.05	-2.65	<0.01	-0.07	0.04	-1.64	0.10	0.07	0.04	1.58	0.11				

6–12m.

Intercept	0.11	0.05	2.08	0.04	0.27	0.04	6.11	<0.01	0.22	0.04	4.93	<0.01				
Period	-0.11	0.05	-2.15	0.03	-0.15	0.04	-3.28	<0.01	-0.08	0.04	-1.90	0.06				
Mat Edu	-0.14	0.05	-2.66	<0.01	-0.08	0.04	-1.79	0.07	0.07	0.04	1.53	0.13				

12–18m

Intercept									0.22	0.04	4.93	<0.01				
Period									-0.09	0.04	-2.04	0.04				
Mat Edu									0.07	0.04	1.53	0.13				

18–24m

Intercept									0.22	0.04	4.96	<0.01				
Period									-0.13	0.04	-2.97	<0.01				
Mat Edu									0.07	0.04	1.54	0.13				

Figure 1. Vocabulary sizes (in percentile) as a function of reported pacifier use in hours per day. Period of use (0-6 months of age, 6-12, and so on) are colour-coded.