Early communicative development and its relation with vocabulary comprehension and production in Chinese preschool children: A longitudinal study

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Abstract

Using data from a cohort study, this study investigates the influence of early communicative development on vocabulary production at 2 years old. Information about early communicative and lexical development of infants was collected from 133 typically developing infants aged between 0;8 and 1;0 (Time 1) using the Communication and Symbolic Behavior Scale (CSBS) and the Words and Gestures form of the Chinese adaption of the MacArthur-Bates Communicative Development Inventories (CDI: WG). After reaching 16 months old (Time 2), parents completed the CDI: Words and Sentences form. Three stepwise, hierarchical linear regressions with AIC for model selection were conducted to predict vocabulary production. In the model with CSBS standard scores, gender and socioeconomic status (SES) entered as the predictors on Time 2 expressive vocabulary, the final model only included gender and SES (R^2 = 20%). When Time 1 CDI:WG percentile scores were entered, receptive vocabulary was predictive of Time 2 expressive vocabulary (R^2 = 12%). The last model indicated that communicative function, communicative means-gestural, and social-affective signalling cluster of CSBS and gender were significantly related to Time 1 expressive vocabulary score (R^2 = 23%). Despite the limited long term predictive power of CSBS, the ability to use prelinguistic gestures and vocalizations to communicate for purposes, to express communicative intentions by gestures, and to share attention, intentions and affect appeared to be tied to concurrent word production. These results are consistent with previous finding of the relative importance of early use of action and gestures on word comprehension than on production.

Introduction

Vocabulary skills of young children are remarkably variable (Fenson et al., 1993). For over 30 years, developmental psychologists and linguists have measured the variability in lexical development of infants and toddlers using the MacArther-Bates Communicative Development Inventories (CDIs) and used it as the measure for assessing language and communication skills and screening children with high risks of language delays. In both version - the Words and Gestures (CDI:WG) and the Words and Sentences form (CDI:WS), parents are asked to indicate whether each word on a checklist is understood and/or produced by their child. The vocabulary production scores of CDIs can serve as an index of vocabulary size, and was found to be predictive of grammatical development and incidence of language deficits later (e.g. Bates and Goodman, 1997).

Motivated by the following research gaps, the main goal of this study was to investigate the effects of early communicative and symbolic development on subsequent vocabulary production of typically developing Chinese infants.

(1) Despite the popularity of CDIs, not too many studies have examined the trajectory of expressive language development using the two forms of CDI across time prospectively. While a moderate correlation (r =.39 - .40) between vocabulary production measured by CDI:WG and CDI:WS has been reported (Jahn-Samilo et al., 1999; Feldman et al., 2000), an argument incurred whether this reflects authentic individual differences, thereof instability of language development from 1 to 2 years of age, or measurement deficiencies of CDIs. More longitudinal data is needed to scrutinize the stability of vocabulary production development.

(2) Children start communicate way before they are able to speak. How much continuity between early prelinguistic communication skills and later emerging verbal communication is of question. Evaluation of correlations between CDI:WG and CDI:WS scores may inform the theories suggesting that social-cognitive processes inherent in earlier prelinguistic communication paves the way for later lexical development, namely gestures and object use is more related to receptive language than expressive language ability.

(3) CDIs as if other parent-report assessment are inevitably suffered from parents' response bias. In addition with its limited focus on gestures use, symbolic representational abilities and actions with objects, using a secondary standardized assessment tool which relies on a different method for data collection and can provide a child's profile of communicative, social-affective, and symbolic abilities – CSBS – to cross-validate could better discern the course of vocabulary development.

Materials

Communication and Symbolic Behavior Scales

CSBS (Wetherby & Prizant, 1993) is a standardized assessment designed to examine communicative, social-affective and symbolic skills of children whose functional communication age is between 8 and 24 months. The child is presented with communicative opportunities including toys, book sharing, play materials, and comprehension probes, whilst observation of the natural play yields a composite score and seven cluster scores of identified language predictors.

The Cantonese version of the MacArthur-Bates Communicative Development Inventories

CDIs (Tardif & Fletcher, 2008) yield information on the course of participants' language development. CDI:WG is appropriate for children aged 8 to 16 months. It provides means for quantifying the development of vocabulary comprehension and production, and actions and gestures production. CDI:WS is designed for children aged 16 to 30 months, the normative scores on vocabulary production and sentence complexity.

Methodology

Participants

The participants were recruited for an ongoing, prospective, cohort study of the neural basis of language and cognitive development from birth to five years old. The participants were recruited from a local public hospital, and/or via advertisements on social media. To be included in this analyses, each participant must have completed at least one language assessment in the two longitudinal waves. The first wave was restricted to the age between 0;8 and 1;0 (Time 1) and the second wave for between 1;4 and 2; 6 (Time 2). A final sample of 133 infants (68 girls) was resulted. All participants were typically developing healthy Chinese Cantonese-learning infants. Eleven infants (8.5%) were born before 37 weeks of gestational age. In addition, we computed Hollingshead four-factor index (Hollingshead, 2011) as proxy of participants' family socioeconomic status (SES) (Table 1).

Table 1. Summary of Participants' Demographic Information (N=133)

	N (%)	Mean	SD	Range
Sex (Female)	68 (51.5)	-	-	-
Birth Weight (kg)		3.12	0.39	2.25 - 4.01
Gestational Age (weeks)		38.9	1.24	34.0 – 41.1
Family Socioeconomic Status		46.3	11.0	9.0 – 63.0
Age completed CSBS		8.93	1.69	0;8 – 0;12
Age completed CDI:WG		10.9	1.45	0;8 – 0;12
Age completed CDI:WS		22.2	3.12	1;4 – 2;6

SD, standard deviation.

Procedures

Parents completed a questionnaire package including questions about demographic background of the family. Participants were followed up at the intervals of 8-, 12-, 18- and 24-month visits. They were assessed with the CSBS at the age of 0;8 and 1;0, and the CDI:WG at 12;0. After reaching 16 months old, parents were asked to complete the CDI:WS. Nonetheless, to maintain the sample, age-appropriate participants were allowed to receive the language assessments even they have missed the time windows of two weeks before and after the time point.

Analyses

The CDI scores were transformed into age- and gender-based percentiles using Cantonese norms, whilst the CSBS scores were normed by age only. We modelled word production against word comprehension and other early communicative and symbolic skills using generalized linear models using stepwise simplification through the evaluation of the AIC (Akaike Information Criterion) index by the MASS library.

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Results

Descriptive Statistics

Mean, standard deviation (SD) and range of CSBS and CDIs scores are shown in Table 2. Pearson correlation coefficients of scores of CSBS and CDIs in the two longitudinal waves were presented in Table 3.

Stepwise Regression

Model 1 – T2 vocabulary production by CSBS: Gender (β = 23.60, p = 0.02) and SES (β = 0.88, p = 0.05) were the only predictors in the best-fit model.

Model 2 – T2 vocabulary production by CDI:WG : Vocabulary comprehension was the only significant predictor (β = 0.31, p = 0.003).

Model 3 – T1 vocabulary production by CSBS: The use of gestures as communicative means (β = 3.05, p = 0.03), followed by communicative function (β = -3.13, p = 0.08) and social-affective signaling (β = 2.47, p = 0.08) were selected in the best-fit model.

Model 4 – T1 vocabulary comprehension by CSBS: no predictors as well as gender and SES survived in the final model.

Model 5 – T2 vocabulary production by CSBS controlling for T1 vocabulary production: The use of gestural communicative means was included, but its variance explained was not significant (β = -2.38). Time 2 vocabulary production was better explained by gender (β = 26.74, p = 0.06) and SES (β = 1.57, p = 0.07).

Conclusion

Except for Time 1 CDI:WG vocabulary comprehension, total and early gestures, and Time 2 CDI:WS vocabulary production, the intercorrelation coefficients between inventories were not significant. Yet, within CDI:WG, CDI:WS and CSBS, the subscales became significantly, moderately related. When our Time 1 measure captures the age before 1 year, the results echo Feldman's et al. finding and suggested that using vocabulary score at age 1 year or prior to predict performance at age 2 years is inappropriate. Rather, this study suggests we may consider to use the score of vocabulary comprehension.

Although CDIs have been demonstrated to be valid and reliable parental reports of vocabulary size, and with high correlations with other behavioral measures, this study failed to find concurrent validity between CSBS and CDI:WG, which theoretically both covers one's communicative abilities with gestures.

Considering the various language predictors previously identified, children who used more gestures to express communicative intentions tended to have larger vocabulary size during the second year of life. Future studies could scrutinize how this pattern of correlation impacted by different types of gestures (e.g. deictic vs. symbolic gestures).

Insufficient Sample & Method bias

Results of this study have to be interpreted with cautions on two main reasons. Since data collection is still ongoing, insufficient sample size may render some of the results unreliable. Since some parents may have applied a different and more liberal definition of the behavior in question, the lack of common variance between CSBS and CDIs could be attributed different measurement method used. Future investigation could include direct measures of vocabulary production at the later stage of development.

Table 4. Summary of stepwise regression results between vocabulary production, vocabulary comprehension and early communicative and symbolic beahviors

Model	Outcome	Covariates	Predictor(s)	R^2	Adjusted R^2	F	df
1	T2 Words Production	Gender & SES	-	0.2	0.15	4.75 *	2, 39
2	T2 Words Production	Gender & SES	T1 Words Understood	0.12	0.09	3.34 *	3, 73
3	T1 Words Production (CDI:WG)	Gender & SES	T1 Communicative function, T1 Comunicative means - Gestural and T1 Social-affective behavior (CSBS)	0.23	0.15	2.68 *	5, 45
4	T1 Words Comprehension (CDI:WG)	Gender & SES	-	0.05	0.007	1.18	2, 47
5	T2 Words Production (CDI:WS)	Gender, SES & T1 Words Production (CDI:WG)	T1 Comunicative means - Gestural	0.36	0.17	1.85	4, 13

Note. * p < .05, ** p < .01, *** p < .001

df, degree of freedom; T1, Time 1; T2, Time 2; CSBS, Communication and Symbolic Behavior Scales; CDI, MacArthur Communicative Development Inventories, WG, Words and Gestures; WS, Words and Sentences, SES, socioeconomic status.

Table 2. Mean, standard deviation (SD) and range of CSBS and CDIs scores

Variable	Mean	SD	Range
CSBS scores measured at Time 1 (N=76)			
Communicative function	10.9	2.18	6-15
Comunicative means - Gestural	9.63	3.04	4-15
Comunicative means -Vocal	10.8	3.18	6-17
Comunicative means -Verbal	9.66	0.888	8-12
Reciprocity	10.4	2.43	6-15
Social-affective behavior	11.1	2.54	3-16
Symbol	9.66	2.84	5-13
CDI:WG scores measured at Time 1 (N=108)			
Phrases Understood	38	32	5-100
Words Understood	42.3	33.7	5-100
Words Produced	47.2	27.7	10-100
Total Gestures	42	31.2	5-100
Early Gestures	48.6	32.1	5-100
Late Gestures	37.8	30.6	5-100
CDI:WS scores measured at Time 2 (N=99)			
Words Produced	58.6	32.1	5-100
Complexity	61.6	29.9	5-100

CSBS, Communication and Symbolic Behavior Scales; CDI, MacArthur Communicative Development Inventories, WG, Words and Gestures; WS, Words and Sentences, .

Table 3. Pearson correlations between CSBS, CDI:WG and CDI:WS measured language parameters of Time 1 and Time 2

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14
CSBS														
1. T1 Communicative function	—													
2. T1 Comunicative means - Gestural	0.405 ***	—												
3. T1 Comunicative means -Vocal	0.561 ***	0.283 *	—											
4. T1 Comunicative means -Verbal	0.238 *	0.121	0.269 *	—										
5. T1 Reciprocity	0.358 **	0.437 ***	0.377 ***	-0.067	—									
6. T1 Social-affective behavior	0.309 **	0.114	0.098	-0.126	0.21	—								
7. T1 Symbolic behavior	-0.087	-0.007	0.001	0.196	0.122	-0.241 *	—							
CDI:WG														
8. T1 Phrases Understood	0.039	0.154	0.009	0.054	0.178	0.084	-0.03	—						
9. T1 Words Understood	-0.009	0.033	-0.096	-0.116	0.141	0.112	-0.126	0.776 ***	—					
10. T1 Words Produced	-0.098	0.21	-0.034	-0.035	0.187	0.236	-0.027	0.309 **	0.341 ***	—				
11. T1 Total Gestures	0.064	0.111	0.007	0.123	0.257	0.103	0.036	0.492 ***	0.635 ***	0.394 ***	—			
12. T1 Early Gestures	0.12	0.108	-0.008	0.151	0.213	-0.009	0.009	0.496 ***	0.519 ***	0.392 ***	0.839 ***	—		
13. T1 Late Gestures	-0.01	0.119	0.019	0.069	0.264	0.189	0.035	0.377 ***	0.596 ***	0.32 ***	0.899 ***	0.547 ***	—	
CDI:WS														
14. T2 Words Produced	0.206	0.166	0.272	-0.054	0.045	0.176	0.064	0.234	0.322 **	0.212	0.258 *	0.266 *	0.181	—
15. T2 Complexity	0.251	0.197	0.23	0.004	0.018	0.206	-0.013	0.217	0.212	0.176	0.122	0.228	0.007	0.889 ***

Note. * p < .05, ** p < .01, *** p < .001

CSBS, Communication and Symbolic Behavior Scales; T1, Time 1 measures; T2, Time 2 measures.