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and Kristen Hollas¹

Abstract

Language style matching (LSM) offers promise as an unobtrusive measure of synchrony between members of conversational dyads, but no studies have explored key questions related to LSM in developmental context. We examined LSM in young children’s ($N = 87$, $M_{\text{age}} = 54.63$ months) interactions with caregivers versus experimenters, and evaluated links between LSM and expressive vocabulary. LSM was significantly higher among caregiver–child than experimenter–child dyads and was positively associated with children’s expressive vocabulary.

Keywords

language style matching, parent–child, preschool-aged, synchrony

Even in brief interactions, dyadic partners begin to mimic one another’s voice qualities, behaviors, and affect (Abney, Paxton, Dale, & Kello, 2014). Synchrony in adults’ behavior is common, nonconscious, and occurs across many types of behaviors, including facial expressions, posture, and speech (Chartrand & Bargh, 1999). In general, higher synchrony signals greater familiarity and higher quality relationships (Gonzales, Hancock, & Pennebaker, 2010).

Recently, researchers developed a novel method of measuring synchrony in speech called language style matching (LSM: Gonzales et al., 2010; Ireland et al., 2011). LSM is a marker of the behavioral coordination of language, a metric quantifying the

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similarity of function-word use between individuals (Gonzales et al., 2010; Pennebaker, 2011). Function words (e.g., *the*, *and*, *of*, *have*, *could*), which comprise more than half of all speech (Rochon, Saffran, Berndt, & Schwartz, 2000), are devoid of clear lexical meaning and express grammatical relationships in a sentence. Production of function words is typically independent of the content of the topic of discussion (Gonzales et al., 2010) and is an aspect of language that is difficult, if not impossible, to consciously monitor or influence in the self or others (Chung & Pennebaker, 2007). By evaluating the similarity of function-word use across members of a dyad, the LSM metric enables the examination of an aspect of linguistic behavior, and potentially of relationship quality (Borelli et al., 2019), of which participants are not aware, and that is unrelated to the topic of their speech (Ireland & Pennebaker, 2010).

Studies of school-aged children and their parents suggest that higher LSM is associated with relationship quality—higher LSM is associated with greater attachment security (Borelli et al., 2016) and lower physiological stress reactivity in children (Borelli et al., 2016; Rasmussen et al., 2017). Furthermore, higher LSM predicts lower levels of separation anxiety symptoms 2 years later among children with a specific type of genetic polymorphism that may place children at risk for anxiety (*OPRM1* polymorphism A118G; Boparai et al., 2018). Thus, early evidence suggests that higher LSM is associated with relationship quality in children aged 8 years and older.

These promising findings have led scholars to contend that LSM may tap into an interactional history that has become engrained linguistically (Borelli et al., 2016; Dragojevic, Gasiorek, & Giles, 2016; Masur & Rodemaker, 1999), perhaps representing relationship quality (e.g., degree of familiarity). If LSM is one remnant of the history of interactions between people, then it holds tremendous promise as an unobtrusive, easy-to-measure assessment tool. LSM is unlikely to be influenced by social desirability or the context of the conversation. Furthermore, LSM levels can be compared across studies and samples, as well as against benchmark scores developed for this system of scoring LSM (Pennebaker, 2011), offering a way of contextualizing the level of synchrony within a dyad. However, the current state of knowledge contains significant gaps in understanding about LSM.

Given that young children's verbal skills are developing (see, e.g., Saffran, Senghas, & Trueswell, 2001), adult-child dyads may show low levels of matching. On the other hand, children learn language in part through their caregivers (Messum & Howard, 2015; Nguyen & Delvaux, 2015), and even unfamiliar adults and children mutually adapt to each others' conversational patterns (Gilstrap & Ceci, 2005), and therefore it is possible that adult-child dyads may exhibit linguistic matching.

It is unclear whether LSM between adults and younger children is associated with familiarity in the same way it is among older people, but we predict that even young children will have greater LSM with people with whom they are more familiar. Specifically, young children have presumably already had extensive exposure to the language patterns of their primary caregivers on which to model their own language expression. Extant studies have tabulated LSM via samples of language taken from child and caregiver interactions with others (Boparai et al., 2018; Borelli et al., 2016; Rasmussen et al., 2017). However, narratives produced in the absence of the other

member of the dyad may not be as strong a measure of matching as LSM derived from caregiver–child interactions. In addition, studies of caregiver–child LSM have relied upon individually generated speech samples (rather than conversations), making it impossible to isolate the dyadic aspects of LSM from each individual’s propensity for linguistic matching. We provide the first test as to whether young children show greater LSM with their caregivers than with strangers.

Finally, no studies have explored whether LSM is associated with important potential confounds, including expressive vocabulary, or the child’s ability to produce common English vocabulary words. It is difficult to ascertain whether higher LSM is linked with relationship quality or whether a potential confound (e.g., expressive vocabulary) better accounts for their association. Furthermore, without understanding the links between LSM and other language fluency constructs, we cannot ascertain whether LSM constitutes an equally strong predictor of relationship quality among children of varying levels of expressive vocabulary. In sum, despite early promise, a number of pressing issues regarding LSM remain unanswered.

Current Investigation

We analyzed preschool-aged children’s LSM within two contexts—when speaking with a caregiver and with an unknown experimenter about the same laboratory event. We used an existing data set that facilitated testing our *a priori* hypotheses regarding LSM and familiarity in adult–child dyads—although this data set was not ideal in one key way: Caregivers were allowed to interact without constraints with their children and strangers had to follow a more constrained set of guidelines. However, this constraint allowed us to examine the extent to which children were modifying their language in synchrony with a static adult interviewer and utilize this as a baseline for children’s linguistic adaptation. The caregiver–child conversations also varied slightly in context such that caregivers were randomly assigned to talk with their children in a fact-focused or entertainment-focused way. Verbatim transcripts from these interviews were analyzed for caregiver–child and experimenter–child LSM; as a point of comparison, we also computed within-child LSM using the transcripts of children’s conversations with the caregiver and unfamiliar experimenter. This metric, which essentially served as a measure of the similarity of each child’s language across the two different conversational contexts, was a within-person measure of similarity in linguistic style, whereas the other LSM indices were between person measures. This allowed us to estimate the magnitude of children’s linguistic shifts to accommodate different adult conversational contexts.

Hypotheses

We tested three hypotheses:

Hypothesis 1: (a) Caregiver–child LSM in the present study would be significantly lower than LSM levels observed in previous research with older children and their

caregivers and (b) older child age within the present sample would be associated with higher LSM.

Hypothesis 2: LSM would be higher when familiarity was greater, and thus caregiver–child LSM would be significantly higher than experimenter–child LSM.

Hypothesis 3: Children with higher expressive vocabulary would show higher caregiver–child and experimenter–child LSM.

Method

Participants

Preschool-aged children ($N = 87$, $M_{\text{age}} = 54.63$ months, $SD = 9.14$ months; 47.1% female) and a caregiver (91.9% biological mothers, 4.7% biological fathers, 3.4% “other”) participated in this study. Caregivers identified children’s ethnic/racial background as follows: 51.3% Hispanic/Latino, 18.4% Caucasian, 18.4% African American, 5.3% Asian American, and 6.6% “Other.” Caregivers were generally well-educated (71.8% completed college), married (73.6%), spoke only English at home (84%), and lived in a household with a family income at, or above, \$60,000 per year (58.6%).

Procedure and Measures

The institutional review boards at both institutions where data collection took place (Florida International University and University of California, Irvine) approved this study’s protocol. Caregivers provided informed consent and children provided informed assent for their participation. Dyads completed a brief conversation about a shared past experience that was not included as part of the present study. They were randomly assigned to either a “silly” or a “fact” condition prior to data collection.

Play Activity. Children assigned to the silly condition were told that they would play a game with a toy elephant, those in the fact condition were told they would gather clues to find a kidnapped toy elephant. All children successfully followed a series of clues, in order, to find the toy elephant. Children received an animal sticker at the conclusion of the task.

Parent–Child Interview. During the play activity, caregivers were told that their children were participating in a task that involved finding a toy elephant. Caregivers in the silly condition were told to question their children in an entertaining way and those in the fact condition were told to get information. Dyads were given 5 minutes alone to discuss the laboratory task using the condition-specific instructions.

Experimenter–Child Interview. Next, the experimenter interviewed the child about the laboratory task. First, she elicited free recall via an open-ended prompt to tell everything that happened and used neutral prompts to encourage children’s responding

(e.g., “oh,” “what else?”). Then, the experimenter asked 12 scripted closed-ended prompts (e.g., “what color ribbon was the elephant wearing”). Both the caregiver–child and experimenter–child interviews were audio recorded for later transcription and coding.

Expressive Vocabulary. Children completed the expressive vocabulary test—second edition with the experimenter, a standard measure of a child’s ability to generate vocabulary words at different developmental levels. The task involves children looking at pictures and telling the experimenter what is depicted in each picture; the difficulty of terms queried increases across the task.

Language Style Matching. Caregiver–child and experimenter–child interviews were transcribed verbatim, edited according to the procedures outlined by Pennebaker, and analyzed using the linguistic inquiry and word count system (Pennebaker, Francis, & Booth, 2001). Linguistic Inquiry and Word Count system analyzes the text and generates percentages of words for each category used in the text (e.g., auxiliary verbs divided by total word count). This procedure produces nine function-word categories that are used in determining LSM, including auxiliary verbs (e.g., *might*), articles (e.g., *the*), common adverbs (e.g., *naturally*), personal pronouns (e.g., *you*), indefinite pronouns (e.g., *someone*), prepositions and relative pronouns (e.g., *of*, *which*), negations (e.g., *not*), conjunctions (e.g., *and*), and quantifiers (e.g., *most*; Gonzales et al., 2010).

To calculate LSM, we followed Pennebaker’s standard procedures: First, we took the absolute difference of the adult and child values for each of the nine LSM categories. Next, we divided this value by the sum of the proportions for that function-word category (Adult + Child) for that dyad. Finally, we subtracted this value from 1:

$$\text{LSM}_{\text{word category}} = 1 - \left[\frac{|(\text{Adult} - \text{Child})|}{(\text{Adult} + \text{Child})} \right].$$

Then, we averaged the nine individual LSM calculations to create an overall LSM score for each caregiver–child dyad:

$$\text{LSM}_{\text{Total}} = \frac{\text{LSM}_{\text{word category 1}} + \text{LSM}_{\text{word category 2}} + \dots + \text{LSM}_{\text{word category 9}}}{9}.$$

LSM scores range between 0 and 1; higher scores signify greater matching (Gonzales et al., 2010). Scores of .60 reflect low synchrony and .85 or higher suggest high synchrony (Pennebaker, 2011).

We calculated LSM for the caregiver–child interview and the experimenter–child interview. Resultant scores provide an index of the overall level of linguistic matching in the dyad. We also calculated within-child LSM as a measure of the similarity of each child’s linguistic style within the two different conversations.

Table 1. Means and Standard Deviations for Key Study Variables.

Measures	Total (N = 86)	Boys (n = 45)	Girls (n = 41)	Gender Diffs	Condition Diffs
	M (SD)	M (SD)	M (SD)	t Statistic	t Statistic
Age in months	54.56 (9.12)	53.8 (9.08)	55.39 (9.21)	−0.81	−0.52
Income level ^a	10.16 (2.78)	10 (3.05)	10.34 (2.48)	−0.56	−0.23
Highest education ^b	4.86 (0.79)	4.80 (0.87)	4.92 (0.70)	−0.71	−1.67
Expressive vocabulary score ^c	102.96 (14.98)	101.80 (15.16)	104.28 (14.85)	−0.75	−1.17
LSM CareCh	0.70 (0.13)	0.69 (0.14)	0.72 (0.12)	−1.13	−0.68
LSM ExpCh	0.58 (0.15)	0.56 (0.18)	0.60 (0.13)	−1.04	−1.45
LSM within-child	0.61 (0.20)	0.58 (0.21)	0.66 (0.16)	−1.69	−2.31*

Note. Diffs = Differences; LSM = language style matching; Care = caregiver; Ch = child; Exp = experimenter; EVT-2 = expressive vocabulary test—second edition.

^aA value of 10 signifies a household income of \$50,000 to \$54,999 per year. ^bA value of 4 signifies “some college.” ^cThe expressive vocabulary score was the standard score derived from the EVT-2. The population mean on the EVT-2 is a standard score of 100 with a standard deviation of 15 points.

* $p < .05$.

Results

Children in the silly interviewing condition were significantly more similar in their linguistic style across the two conversational contexts, but there were no gender differences and no other interviewing condition differences in any of the study variables (see Table 1). These variables are not considered further. LSM scores were positively intercorrelated (Table 2).

Data Analytic Plan

We used a one-sample t test to compare parent–child LSM values with the levels of LSM found in other studies of parent–child dyads composed of older children (Hypothesis 1a). We examined correlations to test age-related associations in LSM (Hypothesis 1b). We used a repeated measures analysis of covariance in which we explored the differences between LSM as a function of dyad, controlling for covariates (Hypothesis 2) and hierarchical regressions controlling for child age to test Hypothesis 3.

Hypothesis Testing

Age Differences in LSM. Caregiver–child LSM in the present study ($M = 0.70$, $SD = 0.13$) was significantly lower than what has been reported in prior studies of school-aged children (Borelli et al., 2016 [8- to 12-year-olds]: $t(153) = -11.62$, $p < .0001$, $M = 0.89$, $SD = 0.04$; Rasmussen et al., 2017 [9- to 12-year-olds]: $t(153) = -3.87$, $p < .0001$, $M = 0.80$, $SD = 0.21$). Within our sample, interviewer–child LSM: $r = .40$, $p < .001$, and within-child LSM: $r = .35$, $p = .002$, but not caregiver–child LSM: $r = .35$, $p = .09$, increased with child age.

Table 2. Zero-Order Correlations Among Key Study Variables.

Variable	<i>M (SD)</i>	2	3	4	5	6	7
1. Age	54.56 (9.12)	.15	-.00	.16	.19	.40***	.35**
2. Income	10.16 (2.78)	—	.13	.09	.12	.20	.16
3. Highest Educ	4.86 (0.79)		—	.08	-.05	.05	.01
4. EVT-2	102.96 (14.98)			—	.39**	.30**	.39**
5. LSM CareCh	0.70 (0.13)				—	.31**	.51**
6. LSM ExpCh	0.58 (0.15)					—	.87**
7. LSM within child	0.61 (0.20)						—

Note. Educ = Education; LSM = language style matching; Care = caregiver; Ch = child; Exp = experimenter; EVT-2 = expressive vocabulary test–second edition.

* $p < .05$. ** $p < .01$. *** $p < .001$.

Figure 1. LSM as a function of conversational context.

Note. LSM = language style matching. Caregiver–child LSM is significantly greater than the other types of LSM. Experimenter–child and within-child LSM do not significantly differ. While caregiver–child and experimenter–child are between-person LSM indices, the within-child LSM score is a within-person index, representing the degree of similarity each child showed across the two conversational contexts.

LSM and Familiarity. Controlling for child age, $F(1, 75) = 6.34, p = .01, \eta^2 = .08$, and expressive vocabulary, $F(1, 75) = 0.27, p = .60$, caregiver–child LSM was significantly greater than experimenter–child LSM, $F(1, 75) = 4.23, p = .04, \eta^2 = .05$ (see Figure 1).

LSM and Expressive Vocabulary. At the bivariate level, children’s expressive vocabulary was positively associated with both types of adult–child LSM (see Table 2). The results

of a linear regression revealed that caregiver–child LSM, $b = 31.58$, $p = .001$, but not interviewer–child LSM, $b = 21.63$, $p = .09$, was significantly associated with expressive vocabulary after controlling for age, $b = -0.03$, $p = .87$.

Discussion

This first examination of LSM between preschool-aged children with caregivers and unfamiliar adults enabled us to examine basic questions regarding the nature of linguistic matching among preschool-aged children within conversations conducted in a standardized setting. The findings have implications for our understanding of dyadic synchrony and provided mixed support of our hypotheses.

LSM for caregiver–child dyads was significantly lower than those that have been reported for school-aged children and their parents (Borelli et al., 2016; Rasmussen et al., 2017). Importantly, in prior studies, the parents and children were not conversing; thus, these LSM values may underestimate true levels of LSM when the dyads interact. Although the variability in designs prevents us from ruling out alternative explanations for the differences between the findings, it is likely that caregiver–child matching, as assessed by LSM, continues to develop into the school years, a possibility supported by age-related changes observed in the present study, but in need of further investigation across a broader age range.

In line with our prediction, older children showed greater matching with experimenters, but this association between child age and LSM was not significant with caregivers. We wonder whether the lack of significant association between child age and child–caregiver LSM is reflective of caregiver compensatory behavior—because caregivers were less constrained in their responding, they may have been more linguistically accommodating with younger children. Researchers could further probe this research prediction by asking parents of multiple children to speak with them, evaluating LSM as a function of child age.

Consistent with our second hypothesis, caregiver–child LSM was significantly higher than experimenter–child LSM. Thus, linguistic matching is higher as a function of familiarity in children’s interactions just a few years after the emergence of language capacities. We believe this pattern of effects suggests that it is either that LSM is driven by familiarity or that caregivers drive the synchrony observed in the caregiver–child interactions. This latter interpretation is supported by the results showing that children’s LSM was highly similar across conversational partners, suggesting minimal adaptation, and that, by design, interviewers were somewhat constrained in their conversational contributions. Future work may seek to examine whether individual differences in LSM in this age range are associated with constructs of interest, such as children’s psychosocial adjustment.

In partial support of our third set of hypotheses, children scoring higher on expressive vocabulary had higher caregiver–child and experimenter–child LSM. When interpreting this finding alongside the finding that children with greater expressive vocabulary showed higher within-child LSM, and thus, lower levels of cross-conversation variability, we tentatively suggest that perhaps children with greater expressive

vocabulary have verbal skills that are more adult-like, and thus, more similar to adult conversational partners. To the extent that LSM can be improved through conversations in which caregivers are more attuned to their children, as we tentatively suggest (and, see Borelli et al., 2016), and in line with sociocultural development theory (Fivush & Nelson, 2004; Nelson & Fivush, 2004) one would expect children's language skills to both facilitate, and be facilitated by, LSM with caregivers. However, since we cannot rule out the possibility that greater expressive vocabulary promotes relationship quality, future studies involving LSM as a measure of relationship quality should statistically control for children's expressive vocabulary. Scholars conducting longitudinal studies of the development of LSM and children's expressive vocabulary will be positioned to explore whether and to what degree each capacity develops.

Children with higher expressive vocabulary had higher LSM with their caregivers whereas children with lower expressive vocabulary had equally low LSM with their caregivers and with the experimenter. This finding suggests that cross-situation LSM stability is not attributable to expressive vocabulary to the same degree across children of all levels of vocabulary. In our minds, this suggests that this individual difference factor does not explain cross-situation stability.

Several aspects of the research design limit the conclusions we can draw. First, the two conversations were not equivalent because experimenters were following guidelines regarding what to discuss whereas caregivers were given more minimal and open-ended instruction for the postevent conversation; this should be addressed in subsequent studies of LSM. Second, we standardized the general topic of conversation in order to be able to compare across conversational partners, but this standardization could limit the generalizability of the findings to the types of conversations that occur naturalistically among adults and children. Third, we assessed a small range of child and caregiver characteristics and had limited variability in these constructs in our sample; future work must more thoroughly examine the association between these factors and LSM.

Conclusion

Consistent with predictions, preschoolers' degree of matching with caregivers is lower than what has been shown in prior studies of school-aged children and their parents and older preschoolers show greater matching with strangers than younger preschoolers. Furthermore, preschoolers exhibit greater language matching with caregivers than with unknown adults, suggesting the utility of this measure as a marker of familiarity even among young children. Finally, the extent of language matching, as well as the similarity of the child's matching across conversational partners, varies as a function of expressive vocabulary.

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