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Early word-object associations and later language development

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ABSTRACT
Early language skills vary considerably across children, especially before the age of about two years. Thus, it can be difficult to distinguish between ‘late bloomers’ and children who show a language delay or impairment. Here we present the results of a longitudinal study wherein toddlers' performance on a looking-time-based ‘Switch’ task of word-object association (Stager & Werker, 1997) was related to the children's later language skills. Word-object association performance at 17 or 20 months was significantly related to scores on some standardized tests of language comprehension and production up to two and a half years later. The implications of these results for further early identification research are discussed.

KEYWORDS
Early word learning; language development; late talkers; MacArthur-Bates CDI; switch task

Language comprehension and production skills in children under the age of two years vary widely across individuals (Fenson et al., 1994). While some toddlers are combining a range of words into phrases, others are still producing only a few single words. This variability in rate of language acquisition makes early identification of language delay or impairment challenging (Rescorla, 1989). Early identification is important if
children are to receive early language intervention, thus maximizing their potential for active and successful lives (e.g., Aram & Hall, 1989; Bernhardt & Major, 2005; Magnusson & Naucier, 1998). The primary method for assessing children's language abilities before the age of 2 years is to ask parents to report on their child's language abilities, a method with variable specificity and sensitivity, as discussed below. To increase specificity and sensitivity, more precise measurement techniques are required. The current study is an exploratory investigation into the relations between toddlers' performance on a word-object association task and their later language skills. This represents the first step in determining whether such a task may be able to contribute to language screening in toddlers, so that possible language delay or impairment may be identified earlier.

As noted above, parent reports are a commonly used tool for assessing language development in toddlers. Such reports can provide a more comprehensive and representative picture of children's early language skills than is possible in a brief, often formal encounter with a clinician or an experimenter (Feldman et al., 2000). Perhaps the most widely used parent report – both in English-speaking countries and elsewhere – is the MacArthur-Bates Communicative Inventory, or CDI (Fenson et al., 1994; Hemmer & Ratner, 1994; Jackson-Maldonado, Thal, Marchman, Bates & Gutierrez-Clellen, 1993). The validity and reliability of parental report depends crucially on parents' ability to observe their children's comprehension and production of vocabulary and sentences. The vocabulary production section appears to be the most reliable measure in the CDI. Several researchers have found that parents appear highly capable of evaluating their children's production of words (Dale, Price & Bishop, 2003; Feldman et al., 2000; Ring & Fenson, 2000), even when their children show language delay (Thal, O’Hanlon, Cleemmons & Fralin, 1999). Furthermore, parental reports of vocabulary production seem to be unaffected by differences in maternal education, approximate income and race (Feldman et al., 2000). On the other hand, comprehension scores are reported to be less reliable. Although some researchers have found significant correspondence between parent report and actual child comprehension (Ring & Fenson, 2000), others have shown parental estimates of child comprehension to correlate negatively with years of maternal education (Fenson et al., 1993; Thal et al., 1999; Tomasello & Mervis, 1994) and with health insurance status, taken as a measure of income (Feldman et al., 2000). Parents with lower education and SES levels tended to overestimate their children's language comprehension skills in those studies.

Moreover, the CDI is designed as a measure of young children's language development at the time of testing, not as a tool for prediction of later language skills. Some studies have shown positive correlations in CDI scores at earlier and later ages, but others have not. In studies of English-speaking (Fenson et al., 1994) and Dutch-speaking children (Bornstein, Putnick & De Houwer, 2006), individual differences in the language comprehension and production skills of toddlers remained relatively stable between the ages of 13 and 20 months. However, in a larger-scale study of 2156 children, Feldman et al. (2000) found that correlations between performance on the Infant version of the CDI and on the Toddler version, one year later, ranged from 0.18 (mostly on comprehension sections) to 0.39 (on vocabulary production sections).
sections). These statistically significant but only moderately sized effects led the authors to caution against using either version of the CDI as a tool for identifying children at risk for later language impairment or delay. At age 1, there were too many floor effects for reliable identification of impairment, and at age 2 the standard deviation equalled the mean of three of the measures, showing high variability and, again, low reliability for identifying impairment. Dale et al. (2003) measured the vocabulary production scores of 8386 British twin children at the age of 2 years, from the 100-item short form of the CDI (Fenson et al., 2000). They found statistically significant relations between this early vocabulary measure and later proficiency in vocabulary, grammar and abstract language at the ages of 3 and 4 years. However, effect sizes were small, and accuracy of prediction was too poor to be of practical use in discriminating persistent and transient difficulties with language. Sixty per cent of the children who scored at or below the 10th percentile at Time 1 performed within normal limits on language tests at age 4. More recently, Tsao, Liu & Kuhl (2004) found significant correlations between CDI scores at ages 13 and 16 months, but not between scores at each of these earlier ages and those at 24 months. Thus, despite the CDI's usefulness as an estimator of current language ability in toddlers, other measures are clearly needed for the prediction of later language skills.

A different way of assessing young children's abilities is to measure their behaviour directly, rather than via parent report. Increasingly, researchers are beginning to assess different aspects of language skills, and to examine their predictive validity for subsequent language development. For example, it has recently been shown that accuracy of speech perception at 9 months (Tsao et al., 2004), skill at word segmentation at 7–9 months (Newman, Bernstein Ratner, Jusczyk, Jusczyk & Dow, 2006) and speed of word recognition at 15 months (Fernald, Perfors & Marchman, 2006) all correlate significantly with later vocabulary size. Further, newborn infants' auditory event-related potentials in response to consonant-vowel syllables have predicted verbal abilities at the age of 3 years (Molfese & Molfese, 1985) and 5 years (Molfese & Molfese, 1997) and reading level at 8 years (Molfese, 2000). These studies suggest that a fundamental step in assembling a vocabulary is to use the native speech sound categories established in the first year of life to direct word learning. Hence, a task that taps into this skill set might be particularly sensitive for identifying infants who might experience difficulties in language acquisition. One such measure is the 'Switch' task, a word-object association task developed by Cohen, Werker and colleagues (e.g., Cohen, 1998; Stager & Werker, 1997). In this task, infants are presented with two pairs of stimuli, each consisting of a novel word presented auditorily through speakers, and a novel, moving object presented visually on a TV screen. These word-object pairs are alternated until there is a criterial decline in the child's looking time to the screen (usually to 50% of initial looking time). Two test trials ensue: a 'Same' trial (one of the two original word-object combinations) and a 'Switch' trial (original word and object in novel combination). An increased looking time to the switched pairing is taken to indicate that infants have noticed the change in the original pairings, and that they therefore have learnt the original word-object associations.

Studies of 14-month-olds have shown that infants of that age look longer to Switch than to Same trials when phonetically dissimilar words are used, e.g., *lif* and *neem*
However, when presented with phonetically similar labels *bih* and *dih*, 14-month-olds look equally to Switch and Same trials, showing no evidence of having learned the *bih* and *dih* labels (Stager & Werker, 1997). This difficulty in learning phonetically similar words is temporary. At 17 and 20 months, the majority of infants notice the switched pairings with the phonetically similar words (Werker, Fennell, Corcoran & Stager, 2002). More intriguing is the finding that, although infants of 14 months failed to notice the switch between the phonetically similar words *bih* and *dih*, in a simplified, single-object version of this task, infants of 8 months succeeded (Werker et al., 1998). The authors suggested that the 8-month-olds succeeded because they were treating the task as a simple phonetic discrimination task (between *bih* and *dih*). Older infants, who are learning to link words with objects, appear to treat the task as a word learning task, which is more difficult. Taken together, the above results suggest that even young infants can discriminate similar-sounding words if they process them merely as acoustic forms. However, when infants attempt to link the words with objects (as in the Switch task), the cognitive demands of the task are greater. Werker et al. (1998, 2002) suggest that at the earlier stages of word learning (around the age of 14 months), the identification of word-object links is the focus of attention; thus, children temporarily ignore fine phonetic detail, even though they are able to discriminate it. As infants’ proficiency in word-object association improves (by age 17–20 months), more cognitive resources become available, allowing infants to pay attention to fine phonetic detail, and hence pass the Switch task even when the words sound very similar (*bih* and *dih*); see Werker & Fennell (2004). Further support for this notion comes the finding that infants of 14 months succeed when the test words are highly familiar (*doll* and *ball*); Fennell & Werker, 2003.

The Switch word learning task using minimal pairs (such as *bih*-*dih*) thus shows a developmental change across the second year of life, with variable performance across infants. A task that discriminates across age and across individuals has the potential to act as a useful diagnostic predictor. Children who notice the ‘switch’ have noticed something unexpected (novel), and therefore look longer at the switched stimuli pairing than at the familiar pairing from the habituation trials.

Success on the explicitly language-based Switch task requires attention to phonetic detail (in the similar-sounding nonsense words presented), and the ability to learn the association between a pictured object and a label (a skill that constitutes an essential step toward learning about word meaning). The aim of the present study was to explore whether performance on this Switch task by toddlers at age 17 or 20 months (reported in Werker et al., 2002) would be related to their later language skills, as measured on standardized tests of language comprehension and production.

**METHOD**

**Participants**

The participants for the current study had taken part in the Switch procedure study described in Werker et al. (2002) at the age of 17 or 20 months. All were of at least
37 weeks’ gestation, had had uneventful births and were apparently in good health, both at the initial test and at the time of the follow-up tests (described below). The children were all exposed to English at least 70% of the time and were from relatively high SES families. The parents of 16 of these infants had completed the Toddler version of the CDI (Words and Sentences) for their child at the time of the Switch task. The 32 children who had participated in the Switch task study in the year prior to the current study (Werker et al., 2002) were invited to participate in two follow-up trials. The parents of 26 of these participants agreed, and for the first follow-up they completed the Toddler version of the CDI for their children. Time between initial test and first follow-up ranged from 5 to 17 months, with a mean delay of 11.46 months ($SD$ 3.63, median 11). Fourteen months later, the parents of 15 of these participants agreed to have their children participate in a second follow-up study, which used a battery of standardized speech and language assessment tasks (described below). The participants’ ages at the two follow-up points are reported in Table 1.

**Procedure**

**Follow-up 1**

The parents of the 26 children who agreed to participate in the first follow-up were given standard instructions on how to complete the vocabulary production section of the Toddler version of the CDI. This section asks parents to indicate the words that their child produced, from a list of 680 words divided into 22 semantic categories. The parents completed the form and returned it by mail. This Toddler version of the CDI provides norms for children aged 16–30 months, but some of the participants were older than 30 months.

**Follow-up 2**

Of the same 26 children, 15 participated in a second follow-up study, which comprised a series of speech and language tests commonly used by speech and language therapists in North America to assess preschoolers. Children were seen in

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Mean ages and age ranges (in months) for infants in Follow-ups 1 and 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Follow-up</td>
<td>Original age group</td>
</tr>
<tr>
<td>1</td>
<td>17 months</td>
</tr>
<tr>
<td></td>
<td>20 months</td>
</tr>
<tr>
<td>2</td>
<td>17 months</td>
</tr>
<tr>
<td></td>
<td>20 months</td>
</tr>
</tbody>
</table>

*m = male, f = female.
their homes or in a playroom at the university by a speech-language therapist, and were given the following tasks:

(1) The Preschool Language Scale – 3 (PLS-3; Zimmerman, Steiner & Pond, 1992). The PLS-3 has two subscales, Auditory Comprehension and Expressive Communication. The Auditory Comprehension (AC) subscale tests children’s ability to understand verbal instructions through pointing to the appropriate object or picture, or carrying out actions with toys and objects. The Expressive Communication (EC) subscale tests children’s ability to communicate by initiating games, pointing, producing sounds and words, and answering questions.

(2) The Peabody Picture Vocabulary Test – Revised (PPVT-R; Dunn & Dunn, 1981), a multiple-choice vocabulary comprehension test in which the child points to one of four pictures, the one he or she thinks best illustrates the word the experimenter says.

(3) The Photo Articulation Test – 3 (PAT-3; Lippke, Dickey, Selmar & Soder, 1997), a photograph-based naming task, designed to elicit all the phonemes of English in single words.

RESULTS

The children’s Switch task performance and concurrent CDI scores at 17 or 20 months are reported first below. Their scores on the CDI at Follow-up 1 and a standard speech-language battery at Follow-up 2 are then reported and compared with the original test scores.

Scores at original testing time

The time that each infant had looked at the Same and Switch trials (each shown for 20 seconds) in the original Switch task (Werker et al., 2002) was recorded. To assay individual differences in performance, the difference between each infant’s looking times to the Switch and Same trials was calculated (as in Werker et al., 2002) and used as the predictive variable for scores on later tasks.

Table 2 shows that, on average, infants in both the 17- and the 20-month age group looked longer at the Switch than Same trials. A repeated-measures analysis of variance confirmed that the longer mean looking time for Switch than Same was significant ($F(1, 24) = 4.63$, $p = 0.04$, effect size (partial $\eta^2$) = 0.16), and that there was no main effect of, or interaction with, age group. This confirms that the group of children who participated in this follow-up study indeed had succeeded in learning the task’s word-object association, like the larger group reported in Werker et al. (2002). As shown in Table 2, both groups had very similar difference scores for Switch-Same disparity. A one-way ANOVA confirmed that the two age groups’ Switch-Same difference scores on the Switch task did not differ significantly, $F(1, 25) = 0.029$, $p = 0.87$. However, the relatively large standard deviations in Table 2 show that there was much individual variation in looking time; in fact, difference scores ranged from $-10.8$ to $+14.8$ seconds.
For the infants for whom CDI scores were available, the 20-month-olds appeared to have larger production vocabularies in terms of raw scores than the 17-month-olds. However, a one-way ANOVA showed that this difference failed to reach significance, $F(1, 14) = 2.05, p = 0.18$. The lack of significance can probably be attributed to the largely overlapping ranges of raw CDI scores: from 15 to 249 for 17-month-olds, and from 31 to 264 for 20-month-olds. As can be seen from the CDI percentile ranks shown in Table 3, both groups had productive vocabularies about average for their age; they did not differ significantly on this measure, $F(1, 14) = 0.01, p = 0.92$.

Switch-Same looking time differences and later language performance

Follow-up 1

At the first follow-up, 12 of the 26 children were older than 30 months of age, which is the upper age limit in the CDI norming sample. Thus, because CDI percentile ranks could not be determined for these participants, raw scores are also reported in Table 3.

Pearson correlations were calculated for the infants’ Switch-Same looking time difference at age 17 or 20 months, and parent-reported production vocabulary size (on the CDI) at the first follow-up, 5 to 17 months later. The correlation between Switch-Same difference and CDI raw scores showed a trend towards significance, $r = 0.367, p = 0.065$. The correlation coefficient for CDI percentiles was larger ($r = 0.452$), but did not reach significance ($p = 0.105$).

Follow-up 2

Fifteen of the 26 children from Follow-up 1 continued to participate at Follow-up 2. To ensure that the smaller sample of children who went on to the second follow-up...
did not represent a special population of those originally tested, control analyses
were run, comparing earlier scores of those infants who continued at Follow-up 2
with those who did not. There were no significant differences between those two
groups in terms of their Switch-Same difference scores or their CDI scores (either raw
or percentile ranks) initially or at Follow-up 1; thus, Follow-up 2 analyses were per-
formed for the smaller group. Standardized scores on the PLS-3 (including Total
Language Score, TLS, which combines EC and AC scores), PPVT-R and PAT-3 are
shown in Table 3. (Three children chose not to complete the PPVT-R and/or the PAT-3,
which resulted in a lower \( N \) for these tasks.)

At Follow-up 2, significant Pearson correlation coefficients were found between
the children’s Switch-Same looking-time differences and several of the language
scores. The PLS-3 Total Language score showed \( r = 0.791, p < 0.001 \) (with signifi-
cant positive correlations for both the subscales contributing to this score: EC
\( r = 0.718, p = 0.003 \); AC \( r = 0.709, p = 0.003 \)). The PPVT-R and Switch task also
showed significant positive correlations: \( r = 0.542, p = 0.056 \). PAT-3 scores were not
significantly correlated with the Switch scores: \( r = -0.036, p = 0.904 \).

Thus, early word-object association abilities, as measured by the Switch task,
were significantly related to language skills one to two years later, in both language
comprehension and production. Switch task performance was not significantly cor-
related with scores on the PAT-3, but many participants performed close to ceiling
on this task. Six of the 14 children showed 3 or fewer phoneme mismatches on the
PAT-3 with the adult targets, another five between 5 and 8 mismatches, and only
two children showed large numbers of mismatches (14 and 29).

Correlation coefficients based on small samples must necessarily be interpreted
with caution; thus, a second set of analyses was run to evaluate the results further.

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**Table 3** Mean scores for the CDI at Follow-up 1, and Standard Scores for the PLS-3,
PPVT-R and PAT-3 at Follow-up 2 (SD in brackets)

<table>
<thead>
<tr>
<th>Age group (months)</th>
<th>CDI raw score</th>
<th>CDI % ile ranks</th>
<th>PLS-3 EC</th>
<th>PLS-3 AC</th>
<th>PLS-3 TLS</th>
<th>PPVT-R</th>
<th>PAT-3</th>
</tr>
</thead>
<tbody>
<tr>
<td>17</td>
<td>428.73</td>
<td>58.77</td>
<td>111.90</td>
<td>114.20</td>
<td>114.70</td>
<td>110.67</td>
<td>111.3</td>
</tr>
<tr>
<td></td>
<td>(212.76)</td>
<td>(33.26)</td>
<td>(16.67)</td>
<td>(10.35)</td>
<td>(13.34)</td>
<td>(12.56)</td>
<td>(10.59)</td>
</tr>
<tr>
<td>N</td>
<td>15</td>
<td>13</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>609.36</td>
<td>99.00</td>
<td>113.00</td>
<td>114.80</td>
<td>115.60</td>
<td>120.25</td>
<td>112.8</td>
</tr>
<tr>
<td></td>
<td>(70.41)</td>
<td>(--)</td>
<td>(10.34)</td>
<td>(17.15)</td>
<td>(14.98)</td>
<td>(13.96)</td>
<td>(7.12)</td>
</tr>
<tr>
<td>N</td>
<td>11</td>
<td>1</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Overall</td>
<td>505.15</td>
<td>61.64</td>
<td>112.27</td>
<td>114.40</td>
<td>115.00</td>
<td>113.62</td>
<td>111.86</td>
</tr>
<tr>
<td></td>
<td>(188.72)</td>
<td>(33.72)</td>
<td>(14.47)</td>
<td>(12.37)</td>
<td>(13.37)</td>
<td>(13.23)</td>
<td>(9.23)</td>
</tr>
<tr>
<td>N</td>
<td>26</td>
<td>14</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>13</td>
<td></td>
</tr>
</tbody>
</table>

Note. CDI, PAT-3, PLS-3, EC, AC, TLS and PPVT-R are explained in the text (p. 320).
For the second analysis, participants were divided into two groups on the basis of their relative performance on the Switch task at the original testing time. The division point for the two groups was the median Switch-Same looking time difference of 2.3 seconds. This time difference was very close to the participants’ mean Switch-Same looking-time difference of 2.58 seconds, and nearly identical to the common difference seen when significant results are obtained in the Switch task with a sample size of 16 (as in, e.g., Werker et al., 2002). The two groups were compared in terms of later language performance in a series of one-way analyses of variance, some of which revealed significant differences. At Follow-up 1, those in the ‘$>2.3$ seconds’ group had significantly higher CDI percentile ranks ($M = 76.44$, $SD = 19.55$) than those in the ‘$<2.3$ seconds’ group ($M = 35.00$, $SD = 39.37$); $F(1, 13) = 7.17$, $p = 0.020$, effect size (partial $\eta^2$) = 0.37. At Follow-up 2, the two groups showed significant differences in their PLS-3 Total Language scores. Those in the ‘$>2.3$ seconds’ group scored significantly higher ($M = 121.33$, $SD = 10.71$) than those in the ‘$<2.3$ seconds’ group ($M = 105.50$, $SD = 11.33$); $F(1, 13) = 7.34$, $p = 0.010$, effect size (partial $\eta^2$) = 0.36. It seems that this effect was attributable more to differences in language comprehension than in language production skills. Examining the PLS-3 subscales separately revealed a significant difference between the means for the Auditory Comprehension scores (‘$>2.3$ seconds’ $M = 121.11$, $SD = 7.64$, ‘$<2.3$ seconds’ $M = 104.33$, $SD = 11.50$, $F(1, 13) = 11.68$, $p = 0.005$, effect size (partial $\eta^2$) = 0.47). There was also a significant difference between the groups on PPVT-R scores, with the ‘$>2.3$ seconds’ group scoring higher ($M = 119.88$, $SD = 13.14$) than those in the ‘$<2.3$ seconds’ group ($M = 103.60$, $SD = 4.39$); $F(1, 11) = 6.97$, $p = 0.023$, effect size (partial $\eta^2$) = 0.39. The two groups’ scores did not differ, however, on the Expressive Communication subscale of the PLS-3, or on the PAT-3.

**CDI scores and later language performance**

Although the CDI was designed to assess concurrent abilities, rather than to predict later language development, several studies have examined relationships between CDI scores and later language development. Thus, the current study also examined the relationships between children’s CDI scores at initial test and language skills at Follow-up 1 (for the subset of children for whom these scores were available). Some significant correlations were found. Initial CDI raw scores correlated significantly with CDI raw scores at Follow-up 1 ($N = 16$): $r = 0.533$, $p = 0.034$ (there were no significant correlations for percentile scores, $N = 8$). Initial CDI raw scores correlated significantly with PPVT-R scores at Follow-up 2 ($N = 9$): $r = 0.737$, $p = 0.024$. Although initial CDI raw scores did not correlate significantly with the Total Language scores from the PLS-3, there was a trend towards a significant correlation with performance on the AC Subscale, $r = 0.608$, $p = 0.062$ ($N = 10$). Follow-up 1 CDI raw scores showed no significant correlations with later tasks, but Follow-up 1 CDI percentile scores (available for only 9 children) again correlated significantly with the comprehension-based tests: both the PPVT-R at Follow-up 2, $r = 0.741$, $p = 0.022$, and the PLS-3 AC subscale, $r = 0.712$, $p = 0.021$. These significant correlations are interesting, because concurrent CDI scores did not correlate significantly with Switch-Same
looking-time difference, and yet both correlated significantly with the later comprehension test scores.

**DISCUSSION**

The present study investigated potential relationships between children’s performance on the Switch task of minimal-pair word-object association at age 17 or 20 months, and later language skills. Correlations between the magnitude of infants’ preference for a novel versus a familiar word-object pairing on the Switch task, and MacArthur-Bates CDI production vocabulary at the first follow-up (5–17 months later) did not reach conventional levels of significance. However, there were significant correlations between strength of early preference for switched word-object pairings, and scores on standardized tests of language comprehension and production in the second follow-up (PLS-3, PPVT-R), up to two and a half years later. Although the relatively small number of participants necessitates caution in interpreting these correlations, the confirmation of the same pattern using a median split suggests a certain amount of robustness and consistency in this relation. As such, these results provide preliminary evidence that the ability to use phonological distinctions to guide early word-object association is related to later language comprehension and production.

In contrast, throughout the correlational and comparative analyses conducted, there were no significant relationships between early performance on the Switch task and later performance on the Photo Articulation Test-3 (Lippke et al., 1997). However, most children performed near ceiling on that test. A more challenging test of phonology (with a greater set of multisyllabic words) may have been more discriminatory.

The MacArthur-Bates Communicative Developmental Inventory (CDI; Fenson et al., 1993), used in this study and many others, is designed to provide a measure of children’s current vocabulary size. As described in the introduction, the CDI was not designed to be used as a predictive tool, and studies of its predictive value have indicated only limited success, particularly with lower SES groups. In the current study of a relatively high SES group, CDI scores (for the subset of participants for whom these were available) did show significant positive correlations with several later scores. Initial CDI raw scores, although not percentile ranks, correlated significantly with CDI raw scores in Follow-up 1, although with slightly larger r-values than those found by other authors (e.g., Dale et al., 2003; Feldman et al., 2000). Both initial CDI raw scores (although not percentile scores), and Follow-up 1 CDI percentile scores (although not raw scores) correlated significantly with scores on tests of comprehension (the Auditory Comprehension subscale of the PLS-3 and the PPVT-R) at Follow-up 2. As mentioned earlier, Switch-Same looking-time difference also correlated significantly with comprehension, but not with CDI scores. These results thus showed some relationship between early parental reports of vocabulary production and later language comprehension measures, although only Switch task performance was significantly related to both comprehension and production measures.

The results of the present study converge with those of Fernald et al. (2006). In the latter study, vocabulary size at 25 months (as measured by the PPVT) was related
to concurrent speed of processing in word recognition tasks, and to almost all measures of language tested from as early as 12 months of age. Furthermore, word recognition at 25 months continued to predict growth in production of vocabulary across the second year of life. In the current study, the relationship between the CDI and the minimal pair Switch task would suggest that the ability to use phonological categories to learn words supports vocabulary acquisition (as indexed by the CDI) and later advancement in lexical performance. Success on the Switch task requires an ability to cope with the cognitive demands of linking a new word with a new object (e.g., Dollaghan, 1985) while simultaneously accessing fine phonetic detail (Stager & Werker, 1997; Werker et al., 2002). The present results would suggest that infants who succeed at this task at the age of 17–20 months also employ these abilities to associate words and objects quickly in the real world. This may account for their faster gains in language development.

An alternative interpretation is that the link between performance in the Switch task and later language is mediated, not through harnessing phonological categories to direct word learning, but instead via individual differences in the ability to learn. A series of studies has shown that rapid habituation and/or strong preference for novelty in infancy (generally interpreted as indicators of more efficient styles of information processing) may be related to higher cognitive skills in childhood (e.g., Bornstein & Sigman, 1986; Colombo, 1997; McCall & Carriger, 1993; Slater, 1995). Although such research has typically employed non-linguistic stimuli, recent studies have shown a more specific and possibly privileged relationship between early performance in habituation tasks and subsequent linguistic skills. Indeed, meta-analyses have shown that the decrement and recovery of attention in infancy can account for 18% of the variance in childhood intelligence tests (Bornstein & Sigman, 1986), and that normalized correlations between habituation/recognition memory and later IQ were at 0.36 (McCall & Carriger, 1993). Thus, although a large proportion of the variance remains unaccounted for, early information processing is helpful in predicting later childhood cognitive performance. Further, a special link may exist between attention in infancy and language proficiency in childhood: the outcome measures most often reported in studies of the decrement or recovery of attention in infants are later verbal ability and psychometric intelligence (itself strongly related to verbal skills) (Bornstein & Sigman, 1986; Colombo, Shaddy, Richman, Maikranz & Blaga, 2004). A related finding in several studies is that young infants who are better able to establish and maintain joint attention with a parent have larger vocabularies later on (e.g., Saxon, 1997; Tomasello & Farrar, 1986; Tomasello & Todd, 1983). The Switch task is a non-social task, but may engage processing mechanisms similar to those in social interaction in terms of joint attention. Further research is needed to tease apart the relative contribution of a specific relation between minimal pair word learning tasks and subsequent language development, versus a relationship that is mediated by more general cognitive and/or social skills. To address this question, and test other alternative interpretations, the authors and colleagues are conducting a larger study that includes not only purportedly normally developing children, but also children with familial risk for a language delay.

In summary, the present study showed that performance on the Switch task in infancy is significantly related to later preschool performance on measures of language
comprehension and production. The strength of the relationships observed, even in a small sample of typically developing children, is promising. The current study points to the need for a more comprehensive investigation to explore the possibility that the minimal pair Switch task might be useful for early identification of language delay.

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