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Associations among Household Chaos, the Home Literacy Environment, Maternal Reading Ability, and Children's Early Reading

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The current study examines whether associations exist between household chaos and children's early reading skills, after controlling for a comprehensive battery of home literacy environment characteristics. Our sample included 455 kindergarten and first-grade children who are enrolled in the Western Reserve Reading Project. We go on to test whether these associations are moderated by maternal reading ability. Results suggest that the degree of household order is significantly and positively associated with the expressive vocabulary, Woodcock Reading Mastery, and phonological awareness skills of children whose mothers are above-average readers. By contrast, the number of books a child owns or brings home and how often a child amuses self alone with books are significantly associated with the expressive vocabulary, Woodcock Reading Mastery, and phonological awareness skills of children whose mothers are average-ability readers. These results suggest the potential for new approaches to encouraging literacy development in the home beyond those that depend solely on parental literacy.

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The home environment is a primary context for children's early learning and socioemotional development (Bradley, Caldwell, & Rock, 1988; Bradley et al., 1989; Morrison & Cooney, 2001). In particular, scholars have employed the term "home literacy environment" (HLE) to refer to the subset of environmental factors thought to be most germane for literacy growth (Foy & Mann, 2003; Leseman & de Jong, 1998; Burgess, Hecht, & Lonigan, 2002). Two early attempts to operationalize the HLE yielded multifaceted inventories of home and family characteristics, including frequency with which a parent reads to child (also known as shared or joint reading), age when reading with child began, number of minutes spent reading to child yesterday, number of books child owns, frequency with which child asks to be read to, frequency with which child looks at books by self, frequency of trips to library with child, frequency with which mother reads to self, frequency with which father reads to self, amount caregiver enjoys reading to self, child's hours of television viewing per day, and the number of household newspaper, magazine, and child magazine subscriptions (Griffin & Morrison, 1997; Payne, Whitehurst, & Angell, 1994). Numerous studies have since substantiated an association between the HLE and children's early literacy skills (e.g., Burgess et al., 2002; Frijters, Barron, & Brunello, 2000; Molfese, Modglin, & Molfese, 2003; Rashid, Morris, & Sevcik, 2005; Roberts, Jurgens, & Burchinal, 2005; Senechal, LeFevre, Thomas, & Daley, 1998; Senechal & LeFevre, 2002; Taylor, Clayton, & Rowley, 2004).

The dimensions of the HLE presented by Payne et al. (1994) and Griffin and Morrison (1997) are often treated by researchers as exhaustive. However, neither index explains more than a modest amount of variance in children's early reading skills. After controlling for primary caregiver IQ and education, an index combining nine HLE characteristics explained only 12% of the variance in a sample of 4-year-old children's expressive and receptive vocabulary (Payne et al., 1994). When Griffin and Morrison (1997) controlled for both child general cognitive ability and maternal education, their seven-item HLE index explained only 3% of the variance in kindergarten children's receptive vocabulary. We believe that the explained variance is small because there are aspects of the broader home environment not captured in traditional HLE studies. The present study considers other literacy-related behaviors as well as inputs not directly related to reading, shedding new light on the concept of the HLE.

Researchers looking for other aspects of the HLE that may explain additional variability in early reading development have found that children's interest in, or enjoyment of, reading is predictive of early reading skills (Burgess, 2005; Frijters et al., 2000; Scher, Baker, & Mackler, 1997;

Scarborough, Dobrich, & Hager, 1991). These findings are important because they suggest a broader definition of the HLE than that conceived of by both Payne et al. (1994) and Griffin and Morrison (1997), which consisted almost exclusively of those facets of the home environment directly under parental control. Studies have also found that reading behaviors initiated by the child rather than the parent, such as the number of books child brings home from school and the frequency with which child initiates self-reading, are associated with early reading skill (Petrill, Deater-Deckard, Schatschneider, & Davis, 2005). It is likely that to some degree child behaviors are the result of parent behaviors such as encouragement and modeling; however, both sets of behaviors contribute to early reading development.

In addition to expanding the scope of the HLE to include child-directed measures, it is also important to examine other aspects of the home that, although not directly related to literacy instruction, may set the conditions for learning. In particular, there is reason to suspect that household chaos, which has demonstrated negative associations with a range of child cognitive outcomes, may also be associated with children's literacy growth. Chaotic environments have been defined as being very noisy, with a high degree of crowding and foot traffic (i.e., many people coming and going), and a lack of routine, predictability, and organization (Wachs, 1989, 2000).

The plurality of research on the association between household chaos and child and parent well-being has focused on the impact of household crowding and noise or foot traffic on children's outcomes and parental competencies (Bronzaft & McCarthy, 1975; Bronzaft, 1981; Cohen, Krantz, Evans, Stokols, & Kelly, 1981; Cohen, Glass, & Singer, 1973; Evans, Wells, & Moch, 2003; Evans, Hygge, & Bullinger, 1995; Haines, Stansfeld, Job, Berglund, & Head, 2001; Maxwell & Evans, 2000; Maxwell, 1996). Specifically, a small but growing body of literature has illuminated associations between environmental noise, crowding, and disorganization and the communication development of infants (Wachs & Chan, 1986), the general cognitive and language development of primary-grade children (Cohen et al., 1973; Gottfried & Gottfried, 1984), and the social and emotional development of preschool and school-aged children (Coldwell, Pike, & Dunn, 2006; Dumas, Nissley, Nordstrom, Phillips Smith, Prinz & Levine, 2005) and young adolescents (Evans, Gonnella, Marcynyszyn, Gentile, & Salpekar, 2005). Research has also linked lower levels of household chaos in childhood to the later accumulation of human capital (measured by years of completed schooling and average hourly earnings) when children are grown (Dunifon, Duncan, & Brooks-Gunn, 2001). However, no studies have tested for explicit associations between elements of household chaos

and early reading skills in young school-aged children. The present study explores associations between two distinct aspects of household chaos—quiet and order—and early reading development.

There are several reasons to hypothesize that household chaos may be linked to literacy development. First, there is evidence that environmental noise generated outside of the home or school is connected to literacy development. Several studies have found associations between school-based chaos and language or reading ability among preschool and school-aged children (Bronzaft & McCarthy, 1975; Bronzaft, 1981; Cohen et al., 1981; Evans & Maxwell, 1997; Haines et al., 2001; Maxwell & Evans, 2000).

Second, studies have found associations between household chaos and measures closely related to reading skill. Specifically, household chaos has been linked to general cognitive ability in elementary school-aged children (Hart, Petrill, Deater Deckard, & Thompson, 2007) and verbal and nonverbal skills in 3- and 4-year-old children (Petrill, Pike, Price, & Plomin, 2004), which suggests that chaos in the home may be linked to early reading as well.

A third reason that the degree of household chaos may be important for early reading development comes from evidence suggesting covariance between chaotic homes and negative parenting. For example, compared to parents in less chaotic households, the parents of young children in chaotic homes are less likely to be responsive and vocally stimulating with their child (Corapci & Wachs, 2002; Evans, Maxwell, & Hart, 1999; Wachs & Camli, 1991) and more likely to exhibit high levels of parenting stress and to report symptoms related to depression (Corapci & Wachs, 2002; Wachs & Camli, 1991). Because parenting quality (for reviews, see Collins, Maccoby, Steinberg, Hetherington, & Bornstein, 2000; Maccoby, 2000) and parent mental health (e.g., NICHD Network, 1999; Sameroff, Seifer, Baldwin, & Baldwin, 1993) are associated with children's early cognitive development, the degree to which they are related to household chaos suggests a likely association between household chaos and early reading skills.

It is possible that household chaos is associated with young children's reading skills but that some children are more vulnerable to its effects than others. Similarly, associations between the HLE and early reading may vary across subgroups of children. In particular, we propose that high maternal reading ability may serve as a buffer against deficits in the HLE and broader home environment. Maternal cognitive and reading ability is strongly associated with children's early reading (Hess, Holloway, Dickson, & Price, 1984; Luster & Dubow, 1992; Payne et al., 1994) as well as with the quality of the home environment in general and the HLE in particular (Baharudin & Luster, 1998; Bradley et al., 1993; Burgess, 2005). Con-

sequently, studies seeking to assess the influence of the HLE on early reading have typically controlled for maternal reading ability (e.g., Evans, Shaw, & Bell, 2000; Griffin & Morrison, 1997). No studies to date have considered the possibility that maternal reading ability is a moderator, rather than a confounder, of the HLE.

It is reasonable to hypothesize that maternal reading ability moderates the association between the HLE and early reading because it may compromise the effectiveness of literacy activities such as shared book reading. Even if mothers who are not themselves strong readers engage in shared book reading with the same frequency as other mothers, the quality of their shared reading may be lower. Furthermore, mothers who find reading to be taxing or who simply do not enjoy reading may model reading behaviors and make reading materials available in the home in ways that make reading appear less attractive to the child. In fact, a study on the language development of children of adolescent mothers found that the impact of a lower-quality home linguistic environment was only negatively associated with child language outcomes when mothers had low verbal abilities, suggesting that maternal reading-related abilities may very well moderate the influence of various home characteristics, including the HLE, on early reading skills (Oxford & Spieker, 2006).

It might also be that maternal reading ability moderates the association between chaos and early reading because mothers who are strong readers may serve as buffers against the effect of chaos in their home. Sameroff's model of cumulative risk (Sameroff, Seifer, Barocas, Zax, & Greenspan, 1987), which posits that children's intellectual performance is a function of the number of risk factors they encounter (e.g., maternal education, parental mental health, etc.), suggests that the children of poorer readers may be more susceptible to the deleterious effects of chaos in the home. Otherwise stated, having a mother who is a strong reader may shield children against the risk posed by household chaos. Similarly, high maternal reading ability may serve as a buffer in households scoring low on measures of the HLE.

Thus, a great deal remains unknown about the associations among household chaos, the HLE, and early reading and about how these associations may vary with maternal reading ability. Specifying the nature of these links is critical to our understanding of how literacy is and can be promoted in the home. The purpose of the current study is twofold: first, we examine whether household chaos (operationalized as the degree of quiet and the degree of order) is associated with three indicators of early reading skill in the presence of a comprehensive set of HLE characteristics and maternal reading ability. Second, we explore whether the observed linkages among

household chaos, the HLE, and early reading skills differ according to maternal reading ability. All analyses control for family socioeconomic status (SES), measured as maternal education level following past studies of early reading (e.g., Hart et al., 2007). By controlling for maternal education in our models, we conduct a first and highly rigorous test of the association among household chaos, the HLE, and early reading and go on to examine whether those associations are moderated by maternal reading ability.

Method

Participants

The current study draws on the kindergarten/first-grade cohort from the Western Reserve Reading Project (WRRP), a nine-year longitudinal cohort sequential study designed to examine gene-environment processes involved in the development of reading and other cognitive and behavioral skills. The study includes monozygotic and same-sex dizygotic twin pairs from the greater Cleveland, Columbus, and Cincinnati metropolitan areas with a small minority coming from other areas of Ohio and western Pennsylvania. Recruitment, which is ongoing, is largely conducted through school nominations; additional recruiting is conducted via Ohio birth records, mothers of twins clubs, and media advertisements. Schools and other recruiting sources are asked to forward a letter and brochure describing the study, along with a stamped return postcard indicating interest in participation, to parents with twins who have begun kindergarten but not yet completed the first grade. Once a return postcard is received, parents are contacted by telephone; those who express interest in continuing are sent a short demographic questionnaire. This questionnaire asks for information about all children and adults living in the home and parents' education level, occupation, and ethnicity. Parents who return the first questionnaire are officially enrolled in the study and give written informed consent for their children's participation. General information about home life and parenting style as well as specific information about each twin is gathered through a second questionnaire, which is mailed to the home. There are then seven home visits conducted over a six-year period. During each three-hour visit, children and their mothers complete a battery of cognitive and behavioral assessments.

At the time of the current analyses, 670 children, or 335 families, had enrolled in the study. Of these 670 children, 216 had not yet completed the second questionnaire or been visited at home. These cases were excluded from the study sample, leaving an eligible sample of 456. After dropping 1 child with incomplete data, the final study sample consisted of 455 children who were assessed in their home and whose parents completed both the

Table 1. Sample Demographics

	Mean (SD)/Percent
Child age	6.10 (SD = .70 years)
Child female	44%
Mother race	
White	92%
Non-White	8%
Mother education	
Less than a bachelor's degree	33%
Bachelor's degree	33%
More than a bachelor's degree	28%
Parents married	90%
Partner race	
White	88%
Non-White	6%
Partner education	
Less than a bachelor's degree	36%
Bachelor's degree	40%
More than a bachelor's degree	24%

Note. N = 455.

first and second questionnaires. The demographic characteristics of the sample are presented in Table 1. Most households had two parents (89.91% of mothers were married), and almost all mothers were White (92%). Approximately one-third (33%) of mothers in the sample had completed high school only, one-third (33%) had obtained a bachelor's degree only, and slightly less than one-third (28%) had attended or completed a graduate program. All children in the current study were in kindergarten or first grade, with a mean age at enrollment of 6.10 years ($SD = .70$), and approximately half (44%) were female. Note that because the sample consists of twins, there are 455 children but only 228 mothers.

Measures

As stated previously, the purpose of the study was, first, to test for associations between household chaos and three early reading skills even in the presence of a battery of HLE characteristics and, second, to examine whether maternal reading ability moderates the associations between chaos

and the HLE and early reading. All analyses control for family SES. Thus, study variables include two aspects of household chaos, a range of HLE characteristics, maternal reading ability, maternal education (as a measure of family SES), and three child reading outcomes.

Of the 455 children in the analytic sample, 50 (11%) were missing values on one or more measures of household chaos or the HLE due to parent nonresponse. T-tests revealed that these children did not significantly differ from others in their early reading skill and that their mothers were not significantly different in race, education, or reading ability from those with complete data. As a result, values for missing variables were imputed using mean substitution. We determined multiple imputation to be unnecessary, as there were never more than 13 missing values for any single variable. Because some children were unable to complete all reading tests, the N varies across the three reading skills, as denoted in the tables.

Household chaos. Chaos in the home was measured via the second questionnaire using the Chaos, Hubbub, and Order Scale (Matheny et al., 1995). Mothers were asked to endorse six items describing the level of chaos in their home using a five-point scale (1 = definitely untrue, 5 = definitely true). To determine the most appropriate grouping of these items, we conducted a factor analysis with varimax rotation. Two factors emerged. One factor appeared to represent the quietness of the household and consisted of the following items: “You can’t hear yourself think in our home” (reverse coded, so that higher values are indicative of a quieter home), “It’s a real zoo in our home” (reverse coded), and “The atmosphere in our house is calm.” The second factor appeared to tap household order and routine and consisted of the following items: “The children have a regular bedtime routine,” “We are usually able to stay on top of things,” and “There is usually a television turned on somewhere in our home” (reverse coded). Responses across items were summed within each factor such that higher scores indicate greater quiet and order. Descriptive statistics for these scales, named “Degree of household quiet” and “Degree of household order,” appear in Table 2.

HLE characteristics. Items in the second questionnaire about the HLE were taken from two lists generally thought to capture the defining features of the HLE (Griffin & Morrison, 1997; Payne et al., 1994). For conceptual and methodological clarity, we distinguish between family-level characteristics of the HLE (those that pertain to parental behavior that is the same for all children within the family) and child-level characteristics of the HLE (which may differ across children in the same family). Family-level characteristics of the HLE include whether family uses library card more than once a year, how often mother reads to self, and number of household mag-

Table 2. Descriptive Statistics

Variable	Minimum	Maximum	Mean	SD
Household chaos				
Degree of household quiet	3.00	15.00	10.41	2.74
Degree of household order	6.00	15.00	11.46	1.98
Home literacy environment				
How often child read to	1.00	3.00	2.37	.60
Child owns more than 30 books	0.00	1.00	.87	.34
How often child amuses self with books	1.00	5.00	3.58	.96
Number of books child brings home	0.00	60.00	7.90	6.38
Child watches more than 15 hours of TV per week	0.00	1.00	.05	.22
Family uses library card more than once a year	0.00	1.00	.62	.49
How often mother reads to self	0.00	2.00	1.56	.68
Number of household magazine and newspaper subscriptions	0.00	17.00	4.45	3.31
Maternal characteristics				
Maternal reading ability	81.00	130.00	103.85	7.90
Maternal education level	1.00	3.00	1.94	.80
Reading skills				
Expressive vocabulary	-2.64	2.72	.05	.87
Woodcock Reading Mastery	-1.57	2.30	.02	.83
Phonological awareness	-2.12	1.85	.02	.69

azine and newspaper subscriptions (the sum of three items capturing the quantity of household newspaper, magazine, and child magazine subscriptions). For child-level HLE characteristics, mothers were asked the same questions separately about each of their twins. Mothers reported how often child is read to, whether child owns more than 30 books, how often child amuses self with books, number of books child brings home (from school per month), and whether child watches more than 15 hours of television per week. Descriptive statistics for all HLE characteristics appear in Table 2.

Maternal reading ability. During the home visit, mothers' reading ability was assessed using the Woodcock-Johnson III Tests of Achievement Passage Comprehension subtest (Woodcock, McGraw, & Mather, 2001). In a national norming sample, the mean score is 100 (SD = 15); the mean in the present sample was 103.85 (SD = 7.90), indicating slightly higher than average reading ability and restricted variance.

Maternal education. Past studies of the HLE and early reading have controlled for family SES because it is associated with both the quality of the home environment (Bradley et al., 1989; van Steensel, 2006) and with children's early literacy skills (Christian, Morrison, & Bryant, 1998). Family SES is typically captured in studies of early reading by maternal education (Evans et al., 2000; Roberts et al., 2005). Mothers in our sample reported their educational attainment on the first questionnaire by selecting from eight categories (1 = sixth grade or less, 8 = completed graduate or professional school). Because the lower education categories were sparsely populated (for example, no mothers reported having a sixth-grade education or less, and only 10% reported that they had not completed high school), we created a new three-level variable signifying whether the mother had less than a bachelor's degree (= 1), only a Bachelor's degree (= 2), or any schooling beyond a bachelor's degree (= 3).

In the present analysis, in which all models of early reading account for maternal reading ability either as a control or as a moderator, it may be redundant to control for maternal education, given the strong association between maternal education level and reading ability (U.S. Department of Education, 1992). We include both to provide a conservative test of the associations among chaos, the HLE, and early reading. As a second measure of SES we included maternal employment status. However, its inclusion did not substantively change our results, and thus it was dropped from the final models.

Child reading outcomes. During the home visit, separate testers assessed the children in different rooms on a 90-minute battery of cognitive and reading tests. In all, the battery yielded 13 measures of early reading skill that together capture a wide range of abilities that serve as precursors to reading. The Boston Naming Test (Goodglass, Kaplan, & Barresi, 2001)

and the vocabulary subtest from a short form of the Stanford-Binet Intelligence Scale (Thorndike, Hagen, & Sattler, 1986) assessed expressive vocabulary. The Phonological Awareness Test (Robertson & Salter, 1997) yielded scores on deletion of compounds and syllables, deletion of phonemes, rhyming discrimination, rhyming production, isolation, and segmentation. The Woodcock Reading Mastery Test (1987) yielded scale scores on word identification, letter identification, and word attack, all of which are standardized by gender and age against a national norming sample. To obtain similarly standardized scores for the other measures of reading skill, we regressed all remaining scale scores on gender, age, and (because studies suggest a nonlinear drop-off in early cognitive skills) an age-squared term and then normalized the residualized score.

Based on principal components factor analysis with varimax rotation, the 13 measures of reading were condensed into 3 composite measures of early reading skill. The first, Expressive Vocabulary, combines scores from the Boston Naming Test and the vocabulary subtest from the Stanford-Binet Intelligence Scale ($\alpha = .68$). The second measure of early reading skill, the Woodcock, comprises word identification, letter identification, and word attack from the Woodcock Reading Mastery Test ($\alpha = .79$). The third measure, Phonological Awareness, is a composite of the six subtests from the Phonological Awareness Test ($\alpha = .79$).

Results

Household Chaos and Early Reading

Our first aim was to test for associations between household chaos and three early reading skills even in the presence of a battery of HLE characteristics. As a first step, we examined bivariate correlations among the HLE characteristics, the two aspects of household chaos, maternal reading ability, maternal education, and the three child reading skills. As shown in Table 3, both household quiet and household order were significantly correlated with selected aspects of the HLE. Although there were significant correlations among some HLE variables, correlations were small to moderate in size, suggesting that these factors are unlikely to tap the same aspects of the HLE. This is consistent with findings from prior studies (e.g., Petrill, Deater-Deckard, Schatschneider, & Davis, 2007; Petrill et al., 2005). Similarly, household quiet and household order were moderately correlated with each other ($r = .33$), implying that they tap distinct constructs.

Both household quiet and household order as well as maternal reading ability and maternal education level were bivariate associated with the

Table 3. Pearson Correlations among Home Environment Characteristics and Early Reading Skills

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.
<i>Household chaos</i>														
1. Household quiet	1													
2. Household order	.33*	1												
<i>Home literacy environment</i>														
3. Child is read to	.25**	.09	1											
4. Child owns more than 30 books	.02	-.01	.07	1										
5. Child amuses self with books	.05	.09	.12*	.02	1									
6. Number of books child brings home	.18**	.15**	.21**	.01	.11*	1								
7. Child watches more than 15 hours of TV per week	-.21**	-.00	-.16	-.07	.03	-.05	1							
8. Family uses library card more than once a year	.18**	.15**	.18**	-.09	.08	.30**	-.16**	1						
9. Mother reads to self	.20**	.02	.14**	-.01	.15**	.13**	-.08	.18**	1					
10. Number of household subscriptions	.19**	.14*	-.02	.12	-.01	.02	-.09	-.05	.15**	1				
<i>Maternal characteristics</i>														
11. Maternal reading ability	.17**	.20**	-.07	.24**	-.02	.03	.22**	.23**	.00	.24**	1			
12. Maternal education	.18**	.21**	-.05	.10*	-.09	.14*	.15**	.30**	.20**	.20**	.41**	1		
<i>Early reading skills</i>														
13. Expressive vocabulary	.13**	.23**	.08	.21**	-.04	.11*	.04	.17**	.16**	.32**	.34**	.21**	1	
14. Woodcock	-.02	.12**	.14**	.15**	-.11*	.06	-.04	.12*	.15**	.21**	.15**	.10*	.41**	1
15. Phonological awareness	.08	.17**	.07	.13**	-.10*	.02	.02	.12*	.13**	.30**	.36**	.21**	.55**	.65**

Note. * $p < .05$, ** $p < .01$, $N = 455$.

three reading skills, and each HLE characteristic was related to one or more early reading skills, with the exception of how often mother reads to self. Additionally, all three early reading skills were strongly related to each other ($r = .41$ to $r = .65$, $p < .01$). The finding that maternal reading ability was associated with one measure of chaos and several facets of the HLE as well as with all three early reading skills suggests that our plan to test whether it moderated the associations between chaos and the HLE and early reading was appropriate.

Next, a regression model was run for each of the three early reading skills. This model included the two measures of chaos assessing quiet and order as well as the HLE characteristics and maternal reading ability. Maternal education level was controlled to enable a rigorous test of the association between chaos and early reading.

Given that the sample contained children nested within families, we employed a multilevel modeling approach via the PROC MIXED procedure in Statistical Analysis System, which adjusts the standard errors to account for the nonindependence of observations. Both measures of chaos, all characteristics of the HLE, maternal reading ability, and maternal education were standardized, as were the three early reading skills. Thus, the regression coefficients for any given reading skill should be interpreted as the average change in standard deviations for that skill associated with an increase of one standard deviation in the variable of interest.

Table 4 shows that the degree of household order was significantly and consistently related to all three early reading skills ($b = .20$, $p < .01$ for expressive vocabulary; $b = .13$, $p < .05$ for Woodcock; $b = .15$, $p < .01$ for phonological awareness), while the degree of household quiet was not associated with any early reading skill.

Whether child owns more than 30 books was significantly associated with expressive vocabulary ($b = .15$, $p < .01$). How often child amuses self with books was significantly linked to all three early reading skills ($b = .11$, $p < .01$ for expressive vocabulary; $b = .14$, $p < .01$ for Woodcock; $b = .09$, $p < .01$ for phonological awareness). How often mother reads to self was also significantly associated with all three early reading abilities ($b = -.09$, $p < .05$ for expressive vocabulary; $b = -.11$, $p < .05$ for Woodcock; $b = -.08$, $p < .05$ for phonological awareness), but notably these associations were all negative.

Maternal reading ability was associated with expressive vocabulary ($b = .21$, $p < .01$) and phonological awareness ($b = .20$, $p < .01$). Maternal education level was not associated with any early reading skills. In exploratory analyses (not shown), maternal reading ability was removed from the model to test whether it had suppressed the association between maternal education and early reading, but such an association did not emerge.

Table 4. Regression of Early Reading Skills on Aspects of Household Chaos and the HLE

	Expressive Vocabulary	Woodcock Reading Mastery	Phonological Awareness
<i>Household chaos</i>			
Degree of household quiet	.03	.04	.03
Degree of household order	.20**	.13*	.15**
<i>Home literacy environment</i>			
How often child read to	0.00	-.06	-.01
Child owns more than 30 books	.15**	.07	.06
How often child amuses self with books	.11**	.14**	.09**
Number of books child brings home	.10*	.08	.01
Child watches more than 15 hours of TV per week	.07	-.02	-.00
Family uses library card more than once a year	.06	.03	-.02
How often mother reads to self	-.09*	-.11*	-.08*
Number of household magazine and newspaper subscriptions	.05	.05	-.00
<i>Maternal characteristics</i>			
Maternal reading ability	.21**	.10	.20**
Mother has less than a bachelor's degree	-.04	-.02	-.03
Mother has more than a bachelor's degree	-.02	-.02	.01
N	447	432	441

Note. * $p < .05$, ** $p < .01$. Table presents standardized regression coefficients.

Moderation by Maternal Reading Ability

The second study goal was to examine whether the association between household chaos and the HLE, on the one hand, and early reading skills, on the other, varied with maternal reading ability. To test for moderation, we conducted subgroup analyses by repeating the regression model used earlier (exempting maternal reading ability) with two subgroups of mothers who were classified into two groups according to their reading ability utilizing a median split (median = 102). The below-median group, which had a mean of 97 (SD = 3.2, range = 81–101), is termed the “average” ability group because its mean so closely resembles that of the norming sample ($M = 100$). The above-median group, which had a mean score of 109 (SD = 6.3, range = 102–130), was termed “above-average.” For each reading skill, we repeated the regression model used earlier (exempting maternal reading ability) with the two subgroups of mothers. A visual comparison of the coefficients for chaos and the HLE between average ability and above-average ability mothers indicates whether maternal reading ability serves as a moderator. To formally test for the presence of interactions when maternal reading ability was treated as a continuous variable, we ran regression models with the full sample of mothers that included interaction terms (maternal reading ability interacted with the chaos characteristics, maternal reading ability interacted with HLE characteristics). The findings did not lead to substantively different conclusions from those based on subgroup analyses, but the ease of interpretability was compromised. Therefore, only the results from the subgroup analyses are presented here.

As shown in Table 5, the degree of household order was significantly related to all reading outcomes but only among children of above-average readers ($b = .34, p < .01$ for expressive vocabulary; $b = .23, p < .01$ for Woodcock; $b = .25, p < .01$ for phonological awareness). Only two HLE characteristics were significantly associated with early reading among the children of above-average readers and, at that, with only one of the reading skills. How often child amuses self with books ($b = .16, p < .05$) and the number of household subscriptions ($b = .16, p < .05$) were associated with Woodcock scores in this group.

Characteristics of the HLE were more consistently associated with early reading skills among children whose mothers were of average reading ability. Specifically, whether child owns more than 30 books was associated with expressive vocabulary ($b = .22, p < .01$), Woodcock ($b = .12, p < .05$), and phonological awareness ($b = .13, p < .01$) scores. The number of books child brings home was associated with expressive vocabulary only ($b = .23, p < .05$). How often child amuses self with books was related to expressive vocabulary ($b = .11, p < .05$), Woodcock ($b = .10, p < .05$), and phonological

Table 5. Differences in Associations between Household Chaos, HLE Components, and Children's Early Reading Skills according to Mother's Reading Ability

	Expressive Vocabulary		Woodcock Reading Mastery		Phonological Awareness	
	Average	Above Average	Average	Above Average	Average	Above Average
<i>Household chaos</i>						
Degree of household quiet	-.03	.10	.07	.03	.03	-.01
Degree of household order	.11	.34**	.02	.23**	.08	.25**
<i>Home literacy environment</i>						
How often child read to	-0.00	.04	-.02	-.10	-.02	.06
Child owns more than 30 books	.22**	.07	.12*	-.03	.13**	-.04
How often child amuses self with books	.11*	.05	.10*	.16**	.08*	.07
Number of books child brings home	.23*	.10	.16	.09	.12	.02
Child watches more than 15 hours of TV per week	.06	.11	-.01	-.02	.01	-0.00
Family uses library card more than once a year	.05	.05	-0.00	.09	-.03	-.03
How often mother reads to self	-.12*	-.04	-.11	-.05	-.09	-.03
Number of household magazine and newspaper subscriptions	.14	.03	-.02	.16*	.05	-0.00
<i>Maternal characteristics</i>						
Mother has less than a bachelor's degree	-.06	-.02	-.07	.03	-.06	-.02
Mother has more than a bachelor's degree	0.00	-0.00	-.11	.03	-.03	.06
N	242	206	233	200	243	199

Note. * $p < .05$, ** $p < .01$. Table presents standardized regression coefficients.

awareness ($b = .08, p < .05$). How often mother reads to self was negatively associated with expressive vocabulary ($b = -.12, p < .05$).

Following Gelman and Stern (2006), postestimation comparisons between subgroups based on maternal reading ability were conducted to test whether apparent differences in their b coefficients achieved statistical significance at the $p < .05$ level (not shown). Statistically significant differences in the size of the b coefficient for household order were found for all three early reading skills. That is, the presence of a positive association between household order and early reading in the above-average ability subgroup and the absence of this association in the average ability subgroup could not be attributed to chance.

Approximately half of the coefficients for HLE characteristics were significantly different for the children of average versus above-average-ability readers. Whether child owns more than 30 books was differentially associated by subgroup with expressive vocabulary and phonological awareness but not with Woodcock. Number of household subscriptions and how often child amuses self with books were differentially associated with the Woodcock. Coefficients for the remaining HLE characteristics that appeared to be associated with early reading only among the average-ability subgroup were not significantly different from the coefficients obtained in the above-average-ability subgroup.

Discussion

The goals of the current study were, first, to examine whether household chaos was associated with children's early reading skills even in the presence of a full complement of previously recognized HLE characteristics and, second, to test whether any observed associations among chaos and the HLE and children's early reading differed by maternal reading ability. In sum, we found that the degree of household order was strongly and positively associated with all three early reading skills, over and above the HLE, but only among children whose mothers' reading ability was above-average. By contrast, the HLE was associated with all three early reading skills only among children whose mothers were of average reading ability.

The present study finds that household order but not household quiet is associated with children's expressive vocabulary, Woodcock Reading Mastery, and phonological awareness skills. Previous studies finding significant associations between household chaos and cognitive skills in children ages 3 to 7 have posited that growing up in an organized home may stimulate cognitive growth by allowing children to maximize learning opportunities in the home (Hart et al., 2007; Petrill et al., 2004). It may be that orderly households allow for more focused practice of reading skills; however, it is unclear why

household quiet would not perform a similar function, given that prior research has found connections between environmental noise and children's reading comprehension and school achievement (e.g., Bronzaft, 1981; Cohen et al., 1973, 1981). In our sample, it may be that children are better able to withstand household noise than they are household disorder. Perhaps because all children in the current study have a twin and thus have always been exposed to a certain level of background noise, they are more habituated to household noise and are therefore less vulnerable to its effects.

It could also be that household order taps a more fundamental characteristic of parents or households, such as maternal industriousness, planning ability, or conscientiousness, that gives rise to both orderliness and better reading skills in children. Household quiet, on the other hand, may be tapping a different aspect of parental personality or noncognitive skill that is not relevant for early reading growth. Perhaps household quiet reflects factors that may not contribute to the development of early reading, such as the number of people in the home or the number of rooms in the house. Future studies should include these elements of household chaos in a more diverse sample.

These observations point to the possibility that household order and quiet are, at least in part, a function of family SES. For example, families who can afford a larger dwelling or obtain professional help with child care or house cleaning may have less chaotic homes. In the present sample, maternal education level, our measure of SES was indeed correlated with both aspects of household chaos. However, maternal education level was not associated with children's early reading. Therefore, at least in this sample, the association between household order and early reading cannot be explained by SES. This finding is consistent with prior research demonstrating that the impact of household chaos on children's cognitive outcomes is not fully accounted for by SES (Davis-Kean, 2005; Hart et al., 2007; Petrill et al., 2004). Nevertheless, as the absence of poor families in the present sample may have limited covariation between our two aspects of household chaos and SES, further exploration is needed in samples with greater variation in SES.

Turning to the HLE, in contrast to household order that mattered only for the early reading of children of above-average readers, the HLE characteristics that were important for early reading mattered primarily for children whose mothers were of average reading ability. Although differences with children whose mothers were above-average readers were not uniformly statistically significant across reading skills, there was a consistent pattern of findings. Specifically, HLE characteristics that were child- rather than parent-driven were important for children of average readers.

For children of average readers, whether child owns more than 30 books and how often child amuses self with books were significantly related to all three early reading skills. The number of books child brings home was also significantly associated with expressive vocabulary. Although children of average readers were not consistently significantly different from children of above-average-ability readers, the pattern of findings across measures suggests that the results are not due to chance. Our findings comport with a prior study demonstrating associations between child interest in or enjoyment of reading and letter-name and letter-sound knowledge among middle-class kindergartners (Frijters et al., 2000) and are suggestive of new and nontraditional pathways for reading promotion strategies that focus on the child rather than the parent.

The negative association between how often mother reads to self and expressive vocabulary among the children of average readers may be due to social desirability. Perhaps respondents who read to themselves the least actually report that they read the most or that mothers who read to themselves often are taking time away from literacy-related interactions with their children; however, as shown in Table 3, there was a positive association between mother reads to self and amount child is read to. Thus, the negative association between how often mother reads to self and child reading skills in a multivariate context remains unexplained and requires replication in future analyses.

How often child amuses self with books was the only HLE characteristic associated with early reading among all children, regardless of maternal reading ability. However, this was true only for the Woodcock. Self-amusement with books explained variance in expressive vocabulary and phonological awareness only among the children of average ability mothers. The Woodcock taps more advanced early reading skills (such as whole-word reading) than do the expressive vocabulary and phonological awareness measures. It may be that maternal reading ability matters less as children become increasingly capable of independent reading activities. Nonetheless, it is not immediately apparent why Woodcock scores were more strongly associated with self-amusement among the children of above-average-ability readers than among the children of average-ability readers.

Interestingly, while the single most touted aspect of the HLE in prior research has been shared book reading (Britto & Brooks-Gunn, 2001; Frosch, Cox, & Goldman, 2001; Senechal & Cornell, 1993; Senechal, 1997; Reese & Cox, 1999; for reviews, see Bus, van Ijzendoorn, & Pellegrini, 1995; Scarborough & Dobrich, 1994), the current study found no association between how often child is read to and early reading skill. Since the majority of previous studies were done with preschoolers, perhaps that

shared reading impacts the reading skills of preschool-aged children, which may then contribute to later interest in reading (Scher et al., 1997; Morrow, 1983; Neuman, 1986). In this sample of kindergarten and first-grade children, it may be that any effects of shared reading would have emerged earlier and therefore were not detected in the present study. The significant associations with early reading obtained by child amuses self with books and number of books child brings home could be the result of the frequency of earlier shared reading experiences, such that the children who amuse themselves often with books are those who were read to more frequently by their parents when they were younger.

In sum, the present study finds that the HLE is primarily associated with early reading skills among children whose mothers are of average reading ability, while household order is associated with early reading skills among children whose mothers are of above-average reading ability. It is not immediately apparent why the HLE does not predict reading skills among the children of more advanced readers. One possibility is that measures of the HLE are more sensitive to variability among lower-quality than higher quality environments (Leventhal, Selner-O'Hagan, Brooks-Gunn, Bingenheimer, & Earls, 2004). If so, the children of better readers may indeed profit from the quality of their HLE, but we are unable to detect it. It could also be true that, in general, the children of better readers have higher mean HLE scores than the children of average-ability readers, but variability in their HLE scores does not explain individual within-group differences in child reading scores.

Another possibility suggests the novel idea that the home environment may fulfill a hierarchy of needs with respect to conditions for learning. By this logic, HLE characteristics such as a child amusing herself or himself with books and the number of books owned may be considered basic lower-order aspects of the home environment that promote early reading skills. Household order may be a higher order element of the home environment that is not relevant for reading development unless the learning conditions for the more basic home environment characteristics are met. If above-average maternal reading ability fulfills one of those basic lower-order learning conditions, then children with above-average mothers would be able to benefit from an orderly household, while children of average-ability mothers would not.

A more parsimonious explanation is that household order and above-average reading ability are both associated with a third variable that is unmeasured. One possible candidate is executive functioning, which is linked to planning and problem-solving abilities (Miyake et al., 2000). Such skills would be manifested in household orderliness and would also likely predict child reading ability. Dunifon et al. (2001) found that adults' education and

income were predicted by the cleanliness of their parents' home assessed 25 years earlier, even accounting for parents' schooling, income, and cognitive skills. The authors hypothesized that their clean-house measure tapped a desire and ability to impose order in the household, which may reflect organization in other aspects of life such as work and parenting.

From a reading-promotion perspective, these findings are encouraging in that a range of approaches for enhancing early reading development may be made available for mothers with varying levels of reading ability. Although the generally advantaged families in our study are not those in greatest need of intervention, they may be the families most likely to actually adopt recommended strategies. It is thus important to offer a range of approaches to literacy promotion to mothers of all reading levels and financial means.

Limitations

While suggestive of promising new directions for research, the present findings should be interpreted cautiously in light of several study limitations. First, the generalizability of the sample is limited both geographically and socioeconomically; these families all reside in Ohio or western Pennsylvania and are mostly white, and a majority of mothers were college-educated (at least) and married. Furthermore, families with twins differ from families with singletons. Moreover, our mothers, for the most part, had average or above-average reading ability; links with below-average reading ability need to be examined.

An additional limitation is that all questions pertaining to household chaos as well as to parent and child reading behaviors were reported by the parent. Compared to observational measures, self-report measures, particularly those that respondents may consider indicative of good parenting, are vulnerable to social desirability bias.

Another shortcoming not unique to the present study but intrinsic to the investigation of the HLE and children's reading development is the possibility of reverse causality. Although the HLE may influence literacy growth, it is also plausible that reading ability influences the HLE. For example, children who amuse themselves often with books may enhance their reading development, but it may also be that children with more advanced early reading skills are more likely to play with books. Nonetheless, it may still be useful to promote children's self-initiated reading activities if it improves reading skill and engages a bidirectional cycle of self-reading and reading growth similar to what has been termed the "snowball effect" of early reading by Raikes and colleagues (2006).

Finally, we recognize the possibility of Type I error due to the sizable number of comparisons conducted with a relatively small sample. By setting an alpha level of less than .05, it is possible to reduce the size of allowable Type I error. In our study, if an alpha of .01 is set, the findings in the full sample analyses (see Table 4) for household order, the child-driven HLE characteristics, and maternal reading ability remain largely unchanged. In the subgroup analyses (see Table 5), if we set an alpha level of .01, household order continues to matter only for the reading skills of children with above-average-ability mothers. However, approximately half of the HLE characteristics that were associated with the early reading skills of children of average-ability mothers lose their significance.

Implications

Despite its limitations, the current study is the first to test the association between household chaos and early reading development. Moreover, this study is the first to examine whether maternal reading ability moderates the association between early reading and either household chaos or the HLE. The results support the inclusion of both household order and child-initiated facets of the HLE in future studies examining the association between the HLE and early literacy.

Our results highlight the potential promise of approaches for enhancing early literacy growth in the home beyond shared reading, which until now has been favored to the exclusion of other possible strategies. Making books available in the home and encouraging children to engage with reading materials may be as yet neglected but potentially effective approaches to improving early reading. Indeed, in the present sample it was the children of mothers with average reading abilities, the very mothers for whom shared reading may be less appealing or effective, who benefited from child-initiated literacy activities. Therefore, if mothers who are not particularly skilled readers prefer to pursue strategies that do not depend on their reading ability, they should be encouraged to enable child-driven activities. For mothers who are above-average readers but may not have the time or inclination to read aloud, there may be a new strategy that has been overlooked until now: keeping an orderly home. If these results are replicated, parent education materials can be revised to incorporate the importance of household order.

Our findings may thus provide to parents who are weaker readers, who do not enjoy reading, or who lack the time for shared reading a set of alternatives for improving the reading outcomes of their young children. Because these data are cross-sectional, we cannot argue that increasing the

amount of time a child amuses self alone with books will result in improved reading scores; however, by identifying previously neglected aspects of the home environment that are linked to early reading and by distinguishing those HLE characteristics that are child-driven from those that are parent-driven, reading research can shift toward a model of literacy promotion in which parents with different reading abilities and preferences may choose from among strategies the ones that best fit their family's needs.

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