

## CLINICAL RESEARCH ARTICLE



# Shared reading with infants: SharePR a novel measure of shared reading quality

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**BACKGROUND:** The AAP recommends “shared” reading from early infancy for healthy development. However, many families are uncertain how to read most enjoyably and effectively with infants, especially from underserved backgrounds. Shared reading quality (interactivity) moderates benefits yet is challenging to measure. SHARE/STEP is a new model of shared reading quality at this age incorporating evidence-based behaviors.

**OBJECTIVE:** To test the SharePR parent-report measure of caregiver–infant reading quality.

**METHODS:** This study involved mother–infant dyads in two unrelated trials in an obstetric (0–2 months old) and pediatric (6–9 months old) clinic. SharePR is a 10-item measure based on the SHARE/STEP model. Analyses involved descriptive statistics, measures of psychometric integrity, and correlations with home literacy environment (HLE).

**RESULTS:** There were 99 dyads in the younger (1.2 + 0.5 months) and 108 dyads in the older groups (6.6 + 1.1 months). A majority were of non-white race (73%, 96%) and low-socioeconomic status (56%, 44% in-poverty). SharePR administration time was under 2 min and scores were normally distributed at each age. Psychometric properties were strong in terms of internal consistency and reliability. Scores were positively correlated with HLE for the older group ( $p < 0.05$ ).

**CONCLUSIONS:** SharePR may be an efficient tool to quantify shared reading quality with infants, warranting further investigation.

**CLINICAL TRIALS:** Data for these analyses were collected via two unrelated trials led by the lead author (J.S.H.). For the younger cohort, this is registered on the ClinicalTrials.gov website, ID# NCT04031235. For the older cohort, this is registered on the ClinicalTrials.gov website, ID# 2017-6856.

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## IMPACT:

- The AAP recommends caregiver–child (“shared”) reading beginning in infancy, yet many families are uncertain how to do so.
- Verbal and social-emotional interactivity during shared reading (“quality”) moderates benefits and is often low in families from disadvantaged backgrounds, yet is challenging to measure.
- SharePR is a 10-item parent-report measure of shared reading quality based on a novel conceptual model incorporating evidence-based behaviors (SHARE/STEP).
- SharePR exhibited promising psychometric properties in two separate samples of mothers of younger and older infants.
- SharePR is a potentially useful measure of shared reading quality at this formative age, for research and to frame early reading guidance.

## INTRODUCTION

The first year of life is a dynamic span of brain development<sup>1</sup> where foundations of literacy begin to emerge, including oral language,<sup>2</sup> concepts of print and attitudes toward books, reading and learning.<sup>3</sup> This is also a critical time where bonds between infants and parents and other caregivers are dependent on nurturing experiences (“relational health”).<sup>4</sup> A child’s home literacy environment (HLE) can substantially influence outcomes in these areas,<sup>4–11</sup> and involves access to books, consistency of reading routines, and quality of verbal and social-emotional interactivity during caregiver–child (“shared”) reading.<sup>12,13</sup> The term “shared

reading” (or “joint” reading<sup>6</sup>) was originally used to describe classroom-based reading instruction,<sup>14</sup> yet has evolved into other contexts including HLE<sup>15,16</sup> and various book types (e.g., wordless).<sup>17,18</sup> Its unifying theme has been summarized as, “reading aloud...in an interactive manner that fosters the development of language and listening comprehension as well as print-based skills”.<sup>5</sup> Importantly, it has been applied for preverbal infants, whose capacity to “share” evolves with language, motor, and social-emotional development.<sup>19–21</sup>

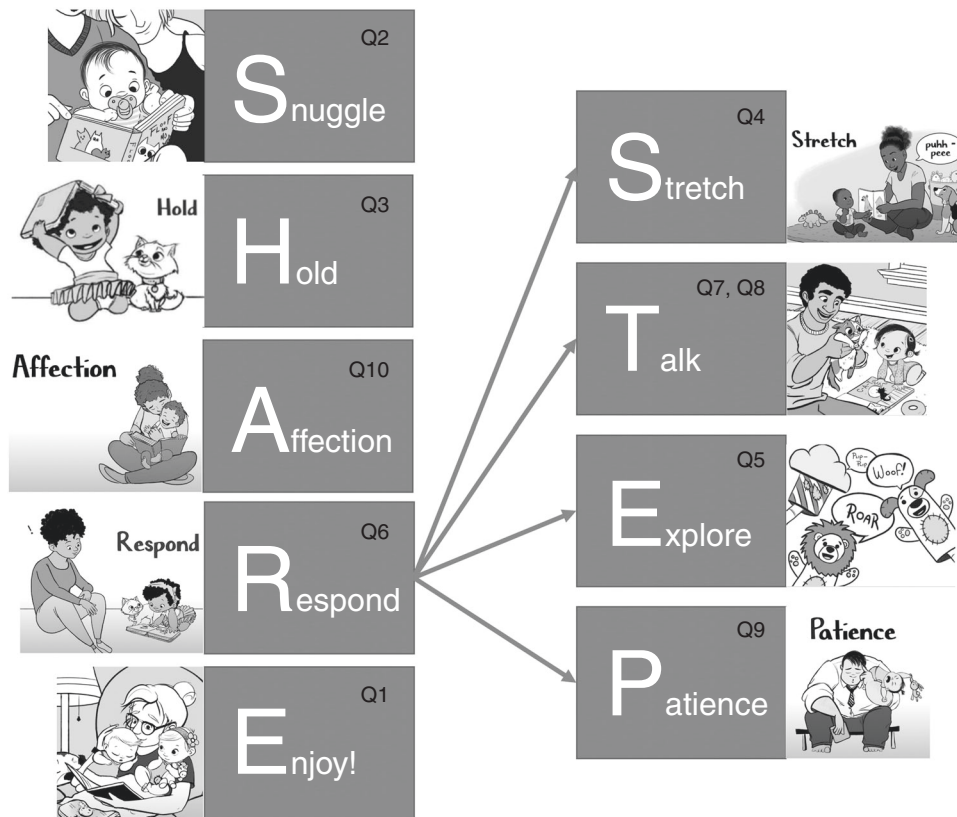
While less studied than for older children, there is evidence that HLE during infancy (generally defined as under 12 months old)

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**Fig. 1** SHARE/STEP conceptual model for the SharePR measure. SHARE/STEP is an acronym for behaviors likely to enhance verbal and social-emotional interactivity during shared reading with infants. SHARE represents nurturing and encouragement while STEP represents ways to Respond to what the child says or does. SharePR items Q1–Q10 map to these behaviors, as shown. Images excerpted with permission from ref. <sup>50</sup>

may be formative, benefits of shared reading accruing in a dose-response manner.<sup>21–25</sup> This is why the American Academy of Pediatrics (AAP) recommends literacy promotion during clinic visits beginning as soon as possible after birth,<sup>26</sup> and programs such as Dolly Parton’s Imagination Library (DPIIL) and Reach Out and Read (ROR) commence in the newborn period.<sup>20,27</sup> Shared reading quality is a critical aspect of HLE that moderates overall benefits,<sup>28,29</sup> yet can be challenging to measure, particularly during infancy. This reflects a major gap and opportunity to tailor guidance for families, particularly from underserved and minority backgrounds, who tend to have more barriers, misconceptions, apprehension, and/or differing cultural perspectives on the importance of reading at this age.<sup>21,30–41</sup>

The SharePR is a 10-item parent-report measure developed to address this gap and opportunity. Its items are based on a novel conceptual model called SHARE/STEP (Fig. 1) that integrates behaviors reflecting nurturing, interactivity, and enjoyment, akin to “dialogic” reading with older children.<sup>12,29,42–47</sup> While evidence regarding specific reading behaviors during infancy is scant, SHARE/STEP is rooted in evidence-based themes known to confer cognitive, relational, and neurobiological benefits: affection and nurturing;<sup>48–50</sup> multi-sensorial exploration;<sup>51–53</sup> responsiveness,<sup>22,25,26,54</sup> and joint attention;<sup>55,56</sup> “serve-and-return” vocalization<sup>57</sup> and child-directed speech,<sup>2,3,58–61</sup> and building parent–child interest.<sup>21,23,62</sup> Accordingly, the acronym SHARE stands for: (1) Snuggle on the parent/caregiver’s lap; (2) let the baby Hold and explore the book; (3) show Affection; (4) Respond to what the baby does or says; and (5) Enjoy the process, rather than worry about reading the “right” way. The acronym STEP reflects ways to Respond to the baby: (1) Stretch word sounds (i.e., child-directed Speech); (2) Talk about pictures in the book; (3) Explore word

sounds in fun ways; and (4) be Patient, as reading at this age is often messy. SharePR items map onto these behaviors, as shown in Fig. 1.

To our knowledge, no similar measurement approach or model of shared reading quality during infancy has been developed or tested in clinic settings. The StimQ-Infant is established for ages 5–12 months old and has a READ subscale,<sup>63</sup> yet this involves mostly quantitative and content items and is not anchored to a cohesive conceptual framework. Most research at this age has used individual items regarding reading frequency or attitudes.<sup>20,22,24,64</sup> The purpose of this study was to examine the psychometric properties of the SharePR using data from two unrelated trials involving mothers of younger ( $n = 99$ ) and older infants ( $n = 108$ ). Psychometric analyses included classical and modern theory (Rasch) modeling and correlations with other aspects of HLE. The overarching goal is to provide an efficient, reliable, conceptually sound measurement tool for research and possibly clinical use, the latter to help frame reading guidance (e.g., via SHARE/STEP) for families from underserved backgrounds who face inequities in HLE,<sup>34–37</sup> reading readiness,<sup>65,66</sup> and outcomes.<sup>67</sup>

## METHODS

### Settings and samples

The current study is a secondary analysis of data obtained via two unrelated longitudinal trials of home parenting practices conducted between 2018 and 2020. Each of these involved healthy mother–infant dyads recruited during normally scheduled clinic visits. The first study involved testing specially designed children’s books for safe sleep (intervention) and shared reading (control) promotion during prenatal care, and was based in an urban, academic women’s health center in the

Midwest.<sup>68</sup> Baseline assessment was at a third-trimester prenatal visit and follow-up at a visit 2–6 weeks postpartum (standard obstetric practice) or else by phone up to 10 weeks. Eligibility criteria were: (1) viable pregnancy with no known neurodevelopmental anomalies and estimated gestational age (EGA) of  $\geq 36$  weeks at baseline, (2) maternal age  $\geq 18$  years old, and (3) fluent in English without the need of an interpreter.

The second study involved using a mobile app to encourage shared reading compared to the usual ROR and was based at an urban, academic pediatric primary care clinic in the Northeast.<sup>69</sup> The ROR program is established at this clinic beginning at the newborn visit. Baseline assessment was at a regularly scheduled well-visit between 6 and 9 months old and follow-up at a regularly scheduled well-visit approximately 6 months later. Eligibility criteria were: (1) gestation at least 34 weeks, (2) age at baseline visit at 5.75–9.75 months, (3) no history of a medical condition likely to confer language delay, (4) fluent in English without the need of an interpreter, and (5) no acute infectious illness during the visit.

Sample sizes for the respective studies were determined via power analyses in the context of their primary aims, which included HLE as an outcome of interest. For both studies, families were compensated with gift cards for time and travel, and each study was approved by the Cincinnati Children's Hospital Institutional Review Board.

### Relevant measures

Parents in both groups received demographic and family reading history surveys administered by a clinical research coordinator (CRC) at the baseline visit (prenatal and 6–9 months, respectively). Due to the use of slightly different forms, some items were not captured for both groups (child sex for the younger group, maternal age for the older group). The approach to reading history also differed between studies. Pregnant women in the obstetric (OB) study were administered a four-item adaptation of the Adult Reading History Questionnaire (ARHQ), with a summary score  $\leq 60\%$  ( $\leq 9.6/16$ ) suggesting the risk of reading difficulties.<sup>70</sup> These items were on an ordinal scale (0–4 points) and involved difficulty learning to read in school and completing schoolwork, current attitude toward reading, and estimated number of books read for pleasure each year. The custodial parent in the pediatric study was asked whether there was a history of reading difficulties or dyslexia in the child's parent or sibling (Yes, No, Unsure).

In the OB-based study, the SharePR was administered by a CRC at the postpartum visit prior to surveys related to intervention or control materials. In the pediatric-based study, SharePR was administered by a CRC at the baseline (6–9 months) visit prior to exposure to intervention or control materials. Parents did not receive instruction in SHARE/STEP or any other approach designed to enhance shared reading quality in either study.

### SharePR measure

The SharePR is a parent-report measure with 10 items, scripted at an estimated 5th-grade reading level. It is based on the SHARE/STEP conceptual model described above, with 8 items reflecting all SHARE/STEP behaviors, one item reflecting sharing the book with the infant to build excitement and before reading, and one reflecting cuddling with the infant after reading to capture its "afterglow." Item development involved experts in pediatrics, speech-language pathology, emergent literacy, and measure development at Cincinnati Children's Hospital and a pediatrician-collaborator from the Children's Hospital of Philadelphia. Each item has a Likert-based, ordinal scoring system, with response options ranging from 0 to 3 points (items 1, 2, and 10: Rarely/never, Sometimes, Usually, Always; other items: Rarely/never, A few times, Fairly often, A lot). Higher scores reflect greater verbal and/or social-emotional interactivity ("quality") with a maximum score of 30 points. Preliminary items were pilot tested for clarity among colleagues and parents of infants attending a hospital-based primary care clinic and revised accordingly prior to use.

As this stage in development, the SharePR is intended to be administered by a trained research or clinical staff. Administration begins by asking the parent if they have begun reading with their child. If not, reasons are noted (e.g., too busy, child won't understand yet) and no more items are asked. If so, the first two items involve lap-sitting and showing the book to the child before reading to build interest (Snuggle, Enjoy), framed with: "When deciding your answer, try to think about how you have read children's books with [CHILD'S FIRST NAME] over the past month." The next seven items involve the frequency of other SHARE/STEP

behaviors, framed with: "Please think of a children's book that you have read with [CHILD'S FIRST NAME] recently. When you are reading a book like [BOOK NAME] together, *how often do you do the following things?*" Items are: encouraging the child to hold the book, stretching words (child-directed speech), using sound effects (e.g., animal noises), saying words back when the child tries, pointing at pictures and talking about them, relating pictures to the child's world (e.g., cat in book/pet cat), and patiently trying ways to restore interest if the child gets upset. The final item involves spending time together (e.g., rocking) after reading before moving on to another activity.

Research coordinators practiced SharePR administration with the lead author prior to each study launch and were instructed to adhere to instrument wording verbatim during actual use to maximize fidelity. Only mothers who reported that they had begun reading with their babies were included in these analyses. As with all measures, item and total scores were directly entered by a CRC into a REDCap database.<sup>71</sup>

### Other HLE measures

In both studies, at the same visit where SharePR was administered, mothers were also asked three, HLE-related questions, estimating: (1) number of books at home that they could read with the baby, (2) minutes per day of shared reading, and (3) days per week of shared reading. In addition, parents were asked an open-ended question to name three favorite things that they liked to do with their baby at home, and the coordinator noted whether "reading" was mentioned (adapted from ref.<sup>72</sup>) Mothers in the OB-based study were also asked to what degree the baby seemed to enjoy being read to at her/his age (Likert scale).

### Statistical analyses

Data analysis proceeded in four steps, similar to a comparable measure for older children based on dialogic reading criteria developed by the study team (DialogPR).<sup>73</sup> First, demographic characteristics were computed for each age group. Second, descriptive statistics were computed for SharePR scores and other variables in each age group. All 10 SharePR items were then evaluated for smoothness, modality, difficulty, polarity, and response density across levels for each age group. Modern theory Rasch rating scale methods were used due to the identical, ordered categorical nature of response options across all items.<sup>74,75</sup> Model fit was tested for each item to identify any that were markedly or unnecessarily influencing scale-level distributions. Third, preliminary estimates of reliability were computed for each age, using Cronbach's coefficient alpha ( $\alpha_C$ ) as the measure of reliability.

As there is currently no criterion-related ("gold") standard parent-report measure of shared reading quality with infants and observation exceeded the scope of either study, the final step (concurrent validity) was exploratory in nature. This involved Spearman-rho ( $r_s$ ) correlation coefficients between SharePR total score and HLE items (number of children's books at home, reading minutes/day and days/week, naming of reading as favorite activity). The criterion for statistical significance was set at the unadjusted  $\alpha = 0.05$  level due to the preliminary nature of the study. All analyses were conducted using SAS v9.4 and Winsteps v4.7 software.

## RESULTS

### Demographic, family reading, and HLE characteristics

Mean maternal age at the SharePR assessment visit was  $27 \pm 6$  years (18–41) for the younger group, and was not captured for the older group. Mean child age at this visit was  $1.2 \pm 0.5$  months for the younger group and  $6.6 \pm 1.1$  for the older group. Both sample populations were largely of a minority race (73% non-white in younger, 96% in older group), with median maternal education high school graduate/GED, and 56% in the younger and 44% in the older group meeting US poverty criteria.<sup>76</sup> A total of 11% of mothers in the older group reported a family history of reading difficulties or dyslexia, and 24% in the younger group screened at-risk for reading difficulties (below ARHQ cutoff). All mothers in both groups reported that they had begun reading with their infants. Measures of HLE were similar between groups, though shared reading was named as a favorite activity more often in the younger group (58% vs. 44%). These data are summarized in Table 1.

**Table 1.** Demographic, family reading, and home literacy environment characteristics.

Variable	Younger group N = 99 f (%)	Older group N = 108 f (%)
Child gender		
Female	NM	54 (50)
Male	NM	54 (50)
Child race		
Black or African American	60 (61)	25 (23)
Hispanic	4 (4)	72 (67)
White	27 (27)	4 (4)
Other (Asian, Biracial)	8 (8)	7 (6)
Annual household income level		
\$0–\$15,000	52 (53)	32 (30)
\$15,001–\$30,000	17 (17)	27 (25)
\$30,001–\$50,000	8 (8)	28 (26)
\$50,001–\$75,000	6 (6)	11 (10)
Over \$75,000	15 (15)	6 (5)
Missing	1 (1)	4 (4)
Mother education level		
Less than high school	16 (16)	13 (12)
High school diploma/GED	38 (38)	43 (40)
Some college <sup>a</sup>	28 (28)	34 (31)
College graduate and above	17 (17)	18 (17)
Income to needs		
At/under poverty <sup>b</sup> threshold	55 (56)	48 (44)
Above poverty threshold	43 (43)	57 (53)
Missing	1 (1)	3 (3)
Family history of reading difficulties or dyslexia		
No	NM	96 (89)
Yes	NM	12 (11)
At-risk for reading difficulties (ARHQ derived <sup>c</sup> )		
No	75 (76)	NM
Yes	24 (24)	NM
Children's books in the home		
3 or fewer	25 (25)	20 (18)
4–9	23 (23)	45 (42)
10–19	14 (14)	23 (22)
20 or more	37 (38)	20 (18)
Shared reading days per week		
None (0)	0 (0)	0 (0)
1–3	34 (34)	44 (41)
4–6	22 (22)	22 (20)
Every day	43 (44)	42 (39)
Shared reading minutes per day		
Under 5 min	3 (3)	2 (2)
5–14.9 min	46 (47)	65 (60)
15–29.9 min	35 (35)	27 (25)
30 min or more	15 (15)	14 (13)
Shared reading named as a favorite activity		
Yes	57 (58)	47 (44)
No	42 (42)	61 (56)

NM not measured in the respective study/sample.

<sup>a</sup>Includes associate degree.

<sup>b</sup>Derived using the 2020 US Department of Health and Human Services Poverty Table.

<sup>c</sup>Score under 9.6/16 (<60%) suggests at-risk for reading difficulties.

## Descriptive statistics for the SharePR

Mean SharePR score for the younger sample was  $17 \pm 6$  (median 18, range 3–28), and for the older sample was  $18 \pm 6$  (median 18, range 3–30). Histograms of score distributions, which were normally distributed at each age (Shapiro–Wilk test), are in Fig. 2. SharePR scores were not significantly correlated with child age, poverty status or maternal education level. Research coordinators estimated SharePR administration time of <2 min in both studies, with no reports of maternal concern with item wording or clarity.

## Item analysis

Item-level information for the SharePR for each sample (age) is provided in Table 2. Item response density was acceptable (at least 10% per option) with few exceptions. Rasch estimates of item difficulty ranged from  $-1.37$  (Q10) and  $-0.69$  (Q7) (less difficult) to  $1.79$  (Q6) and  $0.77$  (Q8) (more difficult), respectively, within the desirable range of  $\pm 2\sigma$  and centered around zero. Point-measure correlations ranged from  $0.26$  (Q10) and  $0.25$  (Q3) to  $0.65$  (Q3, Q7) and  $0.59$  (Q8), respectively, suggesting a low to moderate, positive relationship between each of the SharePR items and the entire scale at each age. Item fit statistics using empirically-derived  $z$ -values were all below the traditional  $\pm 2\sigma$  at each age, suggesting no outliers likely to influence distributions.<sup>77</sup> Inter-item correlations were low to moderate in magnitude, shown in Table 3. The most highly correlated items for the younger group were Q5–Q7 and Q7–Q8 (both  $r_p = 0.44$ ), and for the older group Q1–Q7 ( $r_p = 0.39$ ) and Q1–Q9 ( $r_p = 0.37$ ).

## Reliability and validity

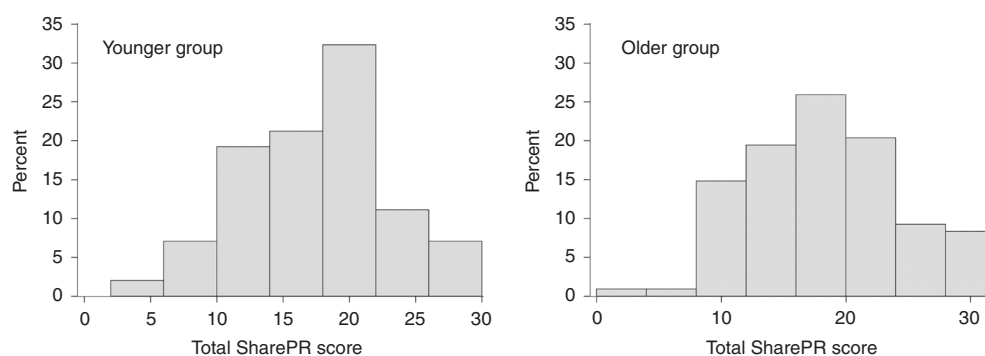
Internal consistency was acceptable to good, at  $r_{Co-\alpha} = 0.70$  for the younger group and  $r_{Co-\alpha} = 0.64$  for the older group.

In the older group, there were significant positive correlations between higher SharePR total scores and HLE items children's books in the home ( $p = 0.01$ ), shared reading minutes/day ( $p < 0.001$ ), days/week ( $p = 0.07$ ) and shared reading named as a favorite activity ( $p = 0.04$ ). SharePR total scores were not significantly correlated with any of these HLE items for the younger group. HLE items were all significantly or near-significantly inter-correlated in the older group, while only favorite activity and reading days/week were significant in the younger group ( $p = 0.002$ ). Maternal impression of the baby's enjoyment of reading was significantly, positively correlated with favorite activity ( $p = 0.04$ ), books in the home ( $p = 0.04$ ), and days/week ( $p < 0.001$ ).

## DISCUSSION

Parents are considered to be a child's "first and most important teachers".<sup>78</sup> Beginning at birth and likely sooner,<sup>79</sup> nurturing stimulation in the home, exemplified by shared reading,<sup>6–8</sup> greatly influences cognitive, relational, academic, and health outcomes.<sup>4–11,19,23</sup> This is the rationale for AAP Literacy Promotion recommendations,<sup>26</sup> programs such as DPIL and ROR that commence at Newborn age,<sup>20,27</sup> and for reading promotion during home visiting that often begins prenatally.<sup>80</sup> Each shares a goal of enhancing HLE as early as possible, which involves quantitative and qualitative factors.<sup>81,82</sup> This is particularly vital for families from underserved and minority backgrounds, who tend to face barriers including household stressors, literacy challenges, fewer resources, negative experiences with reading or school, differing cultural perspectives on the value of shared reading relative to other activities, and uncertainties about the "right way" to read aloud.<sup>31,33–35,40,41</sup>

Quantitative factors such as children's books in the home and frequency of shared reading are most straightforward to estimate and address within existing programs.<sup>13,27</sup> By contrast, qualitative factors such as verbal and social-emotional interactivity during shared reading are more challenging, with no parent-report



**Fig. 2 Distributions of SharePR total scores for each age group.** Histograms for SharePR total scores ( $N_1 = 99$  younger/left,  $N_2 = 108$  older/right). Shapiro–Wilk tests revealed normality of score distributions for both age groups.

measurement tool previously studied in clinic settings at this age. This reflects a major gap and opportunity, as qualitative reading behaviors can be highly impactful during infancy, given their potential to fuel attachment<sup>83–86</sup> and social<sup>2,57</sup> and multi-sensorial<sup>51–53</sup> contexts in which learning occurs at this age. Shared reading quality also tends to be low in families from underserved backgrounds,<sup>37,42,43</sup> who stand to benefit from improved measurement and guidance across developmental stages. The purpose of this study was to test a novel, efficient measurement tool grounded in an evidence-based conceptual model of behaviors likely to enhance shared reading quality during infancy (SHARE/STEP) that is flexible across family, literacy, and cultural contexts.

The SharePR performed well in both age groups, including administration time, normality of score distributions, and psychometric properties. Score distributions (including median and range) were remarkably similar, despite differences in reported reading behaviors (items) at respective ages. This suggests durability of the SharePR across infancy, where the nature of “interactivity” during shared reading evolves rapidly with the child’s emergent literacy skills. This is an essential feature of the SHARE/STEP approach, which was developed to frame the process in a structured yet flexible way, managing parental expectations (Patience) while emphasizing nurturing (Snuggle/Affection), empowerment (Hold), responsiveness (Respond/STEP) and fun (Enjoy). Developmental changes are suggested by differences in difficulty estimates (i.e., how often endorsed) for items/behaviors of younger and older ages. While most shifted slightly, these differences were most substantial for Q3 (encouraging the child to hold the book) and Q10 (cuddling after reading), likely reflecting emerging fine motor skills and decreasing emphasis on bonding versus language. More broadly, variability in item response density at each age suggests that parents could identify their own shared reading behavior in the options provided. Future versions of the SharePR may remind parents that age-dependent differences in behaviors are normal, such as a “Not yet” response option or age-tiered wording for items clearly dependent on the developmental stage (e.g., holding the book, saying words back when the child tries).

SharePR performance was strong for the younger age group. Item response density was good, yet relatively skewed for Q6 (say words back when the child tries; Respond), where affirmative responses clustered between 4 and 8% and Q10 (cuddle after reading) where only 1% responded Rarely/never. For Q6, this is to be expected given that this sample involved preverbal infants. By contrast, Q10 reflects the cuddly “afterglow” of shared reading, which may be highly relatable at this age where bonding is paramount. Indeed, the least “difficult” (easiest to endorse) item here was Q10, and the most difficult Q6. Item–measure correlations were all positive and small to moderate in magnitude, which is optimal. Inter-item correlations were also small to

moderate and highest between items reflecting similar types of behaviors: Q5–Q7 (Explore word sounds, Talk about pictures) and Q7–Q8 (Talk about pictures, Talk about how the story relates to the child’s life). Interestingly, the items with the highest number of significant inter-correlations were encouraging the child to Hold the book (Q3), which seems an intuitive bridge between snuggling and verbal engagement, and Talking during the story (Q7, Q8) which seems most likely to occur alongside other verbal behaviors. The weakest performing item at this age was Q10, which in addition to sub-optimal response density, was not significantly correlated with any other items and had the lowest item–measure correlation. While Q10 performed better for the older group, this may warrant consideration of removal, especially as it most closely captures nurturing after reading rather than a shared reading behavior.

SharePR also performed well with the older age group. Item response density was good overall, though responses for Q1, Q3, and Q7 skewed toward affirmative, perhaps more “natural” behaviors at this age. Strikingly, response distributions for Q9 (try new ways to build interest; Patience) and Q10 (cuddle after the story) were almost equally bimodal favoring Always and Never, possibly reflecting more or less hurried maternal style and/or child temperament. The easiest item at this age was Q7 (Talk-pictures) and the hardest Q8 (Talk-life), which seems reasonable given the appeal of pictures to guide story sharing (scaffolding<sup>87</sup>) and sustain joint attention,<sup>88</sup> relative to more abstract, real-world content. The range of item difficulty was narrower (–0.7 to 0.8) than for the younger group, though balanced between easier and harder items, possibly reflecting that the measured behaviors seemed achievable for most parents surveyed at this age. Inter-item correlation was again highest for potential “gatekeeper” items, here reflecting enjoyment during reading (Q1 and Q7), which seems likely to inspire other behaviors. Item–measure correlations were again small to moderate, suggesting that each contributed uniquely but not exceedingly to the overall score. The weakest performing item was Q6, which had the lowest point-measure correlation and only two significant inter-item correlations. While speculative, this may reflect variability in how infants hold books at this age (e.g., chewing, patting, turning pages), which though basic overall, may reflect a range of more or less sophisticated shared reading behaviors. However, as it is a core shared reading behavior, removal of this item seems imprudent at this stage in SharePR development.

This study also provides insights into shared reading attitudes and behaviors during infancy, where relatively few studies have been conducted. SharePR scores were significantly correlated with HLE items in the older group yet, surprisingly, not in the younger group. While not all were significant, there was substantial intercorrelation among all HLE items in the older group, while in the younger group these largely involved reading as a favorite activity and impression of the baby’s enjoyment of reading. This is

**Table 2.** Item analysis (Rasch) and summary statistics for SharePR for each group.

	Item	<i>M</i> ( <i>SD</i> )	Difficulty	Standard error	Infit <i>z</i>	Outfit <i>z</i>	Point-measure correlation
<i>Younger group (n = 99; age range 0–2.5 months)</i>							
	Q6 (Respond)	2.0 (1.2)	1.79	0.16	1.84	1.61	0.39
	Q3 (Hold book)	2.4 (0.9)	0.86	0.11	−0.33	−0.60	0.65
	Q8 (Talk-life)	1.6 (1.2)	0.62	0.11	−0.82	−1.30	0.63
	Q4 (Stretch)	2.0 (1.1)	0.08	0.10	−0.25	0.05	0.55
	Q9 (Patience)	0.4 (0.9)	−0.04	0.10	−1.31	−1.17	0.58
	Q5 (Try sounds)	0.9 (1.2)	−0.27	0.11	0.22	0.43	0.49
	Q1 (Show book)	2.1 (1.1)	−0.28	0.11	0.9	0.56	0.51
	Q7 (Point-talk)	1.1 (1.1)	−0.49	0.11	−1.53	−1.22	0.65
	Q2 (Snuggle-lap)	1.7 (1.1)	−0.91	0.13	0.88	0.76	0.37
	Q10 (Cuddle-after)	2.7 (0.7)	−1.37	0.16	0.25	1.19	0.26
<i>Older group (n = 108; age range 5.8–9 months)</i>							
	Q8 (Talk-life)	0.9 (1.2)	0.77	0.10	−1.22	−0.57	0.59
	Q4 (Stretch)	1.3 (1.3)	0.46	0.09	1.55	1.62	0.47
	Q6 (Respond)	1.6 (1.2)	0.43	0.09	1.20	0.86	0.49
	Q9 (Patience)	1.3 (1.4)	0.29	0.09	0.18	−0.14	0.54
	Q10 (Cuddle-after)	1.5 (1.3)	0.25	0.09	0.09	−0.06	0.50
	Q5 (Try sounds)	2.0 (1.2)	−0.16	0.09	−1.31	0.10	0.45
	Q2 (Snuggle-lap)	2.1 (1.1)	−0.21	0.09	−0.21	0.93	0.34
	Q1 (Show book)	2.4 (1.1)	−0.54	0.10	−0.68	−0.81	0.44
	Q3 (Hold book)	2.5 (1.0)	−0.58	0.11	0.97	2.13	0.25
	Q7 (Point-talk)	2.5 (0.0)	−0.69	0.11	−1.18	−0.71	0.42

Rasch and item-level summary statistics for SharePR scores for each group ( $n_1 = 99$  younger,  $n_2 = 108$  older), including mean (*M*), standard deviation (*SD*), difficulty, standard error, internal fit, external fit, and point-measure (item-total score) correlation. Terms presented for each item Q1–Q10 briefly summarize the behavior it intends to assess. Items are presented in order of difficulty (positive: harder; negative: easier).

consistent with maternal reliance on infant cues to determine “likes” and establish routines during early infancy, where those involving reading may be relatively difficult to interpret, especially in mothers with less experience and in cultural contexts where reading may be less customary.<sup>33</sup> Prior studies underscore the importance of framing parental expectations regarding early shared reading in an empowering, flexible, enjoyable, culturally inclusive way,<sup>20,30,33,35,38</sup> which is intended in the SHARE/STEP model.

Interestingly, shared reading was named as a favorite activity in the younger group more often than in the older group (58% vs. 44%), perhaps reflecting a wider range of activities with older children (e.g., toys) and/or cultural differences. Reading frequency was also higher for the younger group with more books reported at home, consistent with lower rates of shared reading during infancy described in Hispanic families (older group was 67% Hispanic) relative to singing, storytelling, and other behaviors.<sup>33</sup> Despite these differences and while not “gold standard” concurrent validation criteria, emergence of strong correlations between SharePR scores and HLE items suggests coherence within an HLE framework that evolves across infancy. Future longitudinal studies ideally involving observation (e.g., during home visiting) in more diverse cultural contexts would be useful to more accurately characterize these relationships.

This study has limitations that should be noted. It involves data collected during two unrelated studies where its use was exploratory in nature. One was conducted in an OB clinic,<sup>68</sup> the other in a pediatric clinic,<sup>69</sup> which may not be comparable in terms of capturing maternal knowledge, priorities, and attitudes. Both samples largely involved mothers of minority race, lower education, and economic disadvantage, limiting generalizability. The concentrated nature of these samples limited statistical power

to detect differences related to these important demographic covariates. While not involving SHARE/STEP, the design for the younger group featured prenatal shared reading guidance, while the older group received care in a pediatric clinic where ROR is administered, each a potential confounder fueling higher scores. As with all parent-report tools, SharePR is subject to social desirability and other biases.<sup>89</sup> While the observation of shared reading is the ideal standard with which to establish concurrent validity, this was not feasible during either study. Cross-sectional design does not allow insights into predictive validity, which remains to be determined.

This study also has important strengths. The SharePR was developed referencing a novel conceptual model (SHARE/STEP) grounded in evidence-based themes of parent–child nurturing and reading during infancy, which guided item content and organization. It exhibited strong psychometric properties in two unrelated samples of substantial size using advanced analytic modeling techniques. These samples involved very young and older infants, reflecting a dynamic span of cognitive and social-emotional development. Scores were normally distributed at both ages, suggesting measuring durability across infancy. Each sample involved families from underserved backgrounds, vital populations to address given persistent inequities in HLE and reading outcomes.<sup>34–36,66</sup> While further testing is needed (ideally involving direct observation), SHARE/STEP is an intuitive, evocative acronym with potential as a framework for coaching families in flexible, enjoyable evidence-based principles likely to enhance shared reading quality during infancy, reinforcing AAP guidelines<sup>26</sup> and complementing programs such as home visiting,<sup>80</sup> DPIL,<sup>27,64</sup> and ROR.<sup>13</sup> Thus, while the primary purpose of the current study was to begin to validate the SharePR, its potential as an efficient (<2 min), non-intrusive way to measure the impact of early

**Table 3.** Intercorrelation table for SharePR items and total score for each age group.

Item		Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Total score
<i>Younger group (n = 99; age range 0–2.5 months)</i>											
Q1	(Show book)	−0.05	0.27**	0.15	0.06	0.15	0.27**	0.29**	0.30**	0.16	0.51**
Q2	(Snuggle-lap)		0.32**	0.22*	0.08	0.01	0.13	0.12	0.08	0.04	0.35**
Q3	(Hold book)			0.34**	0.15	0.23*	0.35**	0.30**	0.17	0.05	0.64**
Q4	(Stretch)				0.15	−0.03	0.28**	0.33**	0.26**	0.04	0.56**
Q5	(Try sounds)					0.13	0.44**	0.22*	0.30**	0.14	0.48**
Q6	(Respond)						0.16	0.20	0.11	0.09	0.35**
Q7	(Point-talk)							0.44**	0.34**	0.04	0.69**
Q8	(Talk-life)								0.21*	0.02	0.61**
Q9	(Patience)									0.18	0.56**
Q10	(Cuddle-after)										0.26**
<i>Older group (n = 108; age range 5.8–9 months)</i>											
Q1	(Show book)	0.12	0.31**	−0.12	0.13	0.13	0.39**	0.07	0.37**	0.25**	0.52**
Q2	(Snuggle-lap)		−0.03	0.06	0.24*	0.12	0.03	0.04	0.02	0.28**	0.40**
Q3	(Hold book)			−0.09	−0.03	0.08	0.24*	0.02	0.11	−0.04	0.25**
Q4	(Stretch)				0.21*	0.18	0.14	0.29**	0.14	0.21*	0.43**
Q5	(Try sounds)					0.14	0.26**	0.19*	0.16	0.13	0.51**
Q6	(Respond)						0.22*	0.19*	0.15	0.18	0.51**
Q7	(Point-talk)							0.16	0.24*	0.03	0.51**
Q8	(Talk-life)								0.27*	0.17	0.48**
Q9	(Patience)									0.24*	0.59**
Q10	(Cuddle-after)										0.52**

Spearman-rho intercorrelation coefficients between SharePR items Q1 through Q10 and total score.

All significance tests were evaluated at the nominal alpha = 0.05 and alpha = 0.01 levels, without adjustments for multiplicity.

\**p* value < 0.05, \*\**p* value < 0.01.

interventions for at-risk families based on SHARE/STEP is appealing (e.g., ROR, home visiting, demonstration videos, community coaching sessions). Overall, at this preliminary stage, the SharePR offers a conceptually and psychometrically sound step toward improved insight into shared reading quality with infants, an important catalyst for cognitive and social-emotional development. Future directions ideally involve expanded validation referenced to shared reading observations and longitudinal assessments in a more diverse sample, development of a self-report version, and use to explore the efficacy of SHARE/STEP as a bridge to dialogic reading guidance as verbal skills emerge.<sup>73</sup>

## CONCLUSION

In this study involving mothers of younger and older infants, the novel, 10-item SharePR measure of shared reading quality exhibited promising psychometric properties on item and scale levels at each age. The SharePR is founded on a conceptual model of behaviors likely to enhance verbal and social-emotional interactivity during infancy (SHARE/STEP), in turn, fueling cognitive and relational development. While preliminary, these findings begin to address an important gap and opportunity to efficiently assess shared reading quality at this formative age and complement early interventions for at-risk families, consistent with AAP recommendations.

## DATA AVAILABILITY

All data for this study were newly acquired via the methods described. These data will be made available to the scientific community in a deidentified manner upon notice of publication via written request to the corresponding author. Requests must include a description of the project (e.g., project outline) and also an

acknowledgment of the data source in any grant submissions, presentations, or publications. The rationale for the written request is that no repository currently exists and creation would exceed the scope and current funding resources of the study team. Any costs associated with data transfer will be the responsibility of the requesting parties.

## REFERENCES

- Gilmore, J. H., Knickmeyer, R. C. & Gao, W. Imaging structural and functional brain development in early childhood. *Nat. Rev. Neurosci.* **19**, 123–137 (2018).
- Kuhl, P. K., Ramirez, R. R., Bosseler, A., Lin, J. F. & Imada, T. Infants' brain responses to speech suggest analysis by synthesis. *Proc. Natl. Acad. Sci. USA* **111**, 11238–11245 (2014).
- Kuhl, P. K. Is speech learning 'gated' by the social brain? *Dev. Sci.* **10**, 110–120 (2007).
- Mendelsohn, A. L. et al. Reading aloud, play, and social-emotional development. *Pediatrics* **141**, e20173393 (2018).
- National Early Literacy Panel. *Developing Early Literacy: Report of the National Early Literacy Panel* (Washington, DC, National Institute for Literacy, 2008).
- Bus, A., Ijzendoorn van, M. & Pellegrini, A. Joint book reading makes for success in learning to read: a meta-analysis on intergenerational transmission of literacy. *Rev. Educ. Res.* **1995**, 65 (1995).
- Swanson, E. et al. A synthesis of read-aloud interventions on early reading outcomes among preschool through third graders at risk for reading difficulties. *J. Learn. disabilities.* **44**, 258–275 (2011).
- Anderson, R. C. et al. *Becoming a Nation of Readers: The Report of the Commission on Reading* (Washington, DC, National Institute of Education, 1985).
- Puglisi, M. L., Hulme, C., Hamilton, L. G. & Snowling, M. J. The home literacy environment is a correlate, but perhaps not a cause, of variations in children's language and literacy development. *Sci. Stud. Read.* **21**, 498–514 (2017).
- Hutton, J. S. et al. Shared reading and television across the perinatal period in low-SES households. *Clin. Pediatr. (Phila)*. **57**, 904–912 (2018).
- Ece Demir-Lira, Ö., Applebaum, L. R., Goldin-Meadow, S. & Levine, S. C. Parents' early book reading to children: Relation to children's later language and literacy

- outcomes controlling for other parent language input. *Dev. Sci.* **22**, e12764 (2019).
12. U.S. Department of Education. *Dialogic Reading* (Washington, DC, Institute of Education Sciences, 2007).
  13. Klass, P., Dreyer, B. P. & Mendelsohn, A. L. Reach out and read: literacy promotion in pediatric primary care. *Adv. Pediatr.* **56**, 11–27 (2009).
  14. Holdaway, D. *The Foundations of Literacy* (Portsmouth, NH, Heinemann, 1979).
  15. Roberts, J., Jurgens, J. & Burchinal, M. The role of home literacy practices in preschool children's language and emergent literacy skills. *J. Speech, Lang., Hearing Res.* **48**, 345–359 (2005).
  16. Lonigan, C. & Whitehurst, G. J. Relative efficacy of parent and teacher involvement in a shared-reading intervention for preschool children from low-income backgrounds. *Early Child. Res. Q.* **13**, 263–290 (1998).
  17. Hammett-Price, L., van Kleeck, A. & Huberty, C. J. Talk during book sharing between parents and preschool children: a comparison between storybook and expository book conditions. *Read. Res. Q.* **44**, 171–194 (2009).
  18. Chaparro-Moreno, L. J., Reali, F. & Maldonado-Carreno, C. Wordless picture books boost preschoolers' language production during shared reading. *Early Child. Res. Q.* **40**, 52–62 (2017).
  19. Muhinyi, A. & Rowe, M. L. Shared reading with preverbal infants and later language development. *J. App. Dev. Psychol.* **64**, 101053 (2019).
  20. Sinclair, E. M., McCleery, E. J., Koepsell, L., Zuckerman, K. E. & Stevenson, E. B. Shared reading practices and early literacy promotion in the first year of life. *J. Dev. Behav. Pediatr.* **40**, 538–546 (2019).
  21. Karrass, J. & Braungart-Rieker, J. Effects of shared parent–infant book reading on early language acquisition. *J. Appl. Dev. Psychol.* **26**, 133–148 (2005).
  22. Dunst, C. J., Simkus, A. & Hamby, D. W. Effects of reading to infants and toddlers on their early language. *Dev. Cent. Early Lit. Learn. Rev.* **5**, 1–7 (2012).
  23. Debaryshe, B. D. Joint picture-book reading correlates of early oral language skill. *J. Child Lang.* **20**, 455–461 (1993).
  24. Mol, S. E. & Bus, A. G. To read or not to read: a meta-analysis of print exposure from infancy to early adulthood. *Psychol. Bull.* **137**, 267–296 (2011).
  25. Dunst, C. J., Simkus, A. & Hamby, D. W. Relationship between age of onset and frequency of reading and infants' and toddlers' early language and literacy development. *CELLreviews* **5** (2012).
  26. AAP Council on Early Childhood. Literacy promotion: an essential component of primary care pediatric practice. *Pediatrics* **134**, 404–409 (2014).
  27. Szumlas, G. A. et al. A combined reach out and read and imagination library program on kindergarten readiness. *Pediatrics*. **147**, e2020027581 (2021).
  28. Flack, Z. M., Field, A. P. & Horst, J. S. The effects of shared storybook reading on word learning: a meta-analysis. *Dev. Psychol.* **54**, 1334–1346 (2018).
  29. Mol, S., Bus, A., de Jong, M. & D. S. Added value of dialogic parent–child book readings: a meta-analysis. *Early Educ. Dev.* **19**, 7–26 (2008).
  30. Levy, R., Hall, M. & Preece, J. Examining the links between parents' relationships with reading and shared reading with their pre-school children. *Int. J. Educ. Psychol.* **7**, 123–150 (2018).
  31. Levy, R., Hall, M. & Preece, J. Examining the links between parents' relationships with reading and shared reading with their pre-school children. *Int. J. Educ. Psychol.* **7**, 123 (2018).
  32. Gregory, E., Long, S. & Volk, D. *Many Pathways to Literacy: Young Children Learning with Siblings, Grandparents, Peers, and Communities* (New York, Routledge Falmer, 2004).
  33. Jimenez, M. E. et al. Perspectives on shared reading among a sample of Latino parents. *Child.: Care Health Dev.* **45**, 292–299 (2019).
  34. Curenton, S. M. & Justice, L. M. Children's preliteracy skills: influence of maternal education and mothers' beliefs about shared reading interactions. *Early Educ. Dev.* **19**, 261–283 (2008).
  35. Berkule, S. B., Dreyer, B. P., Huberman, H. S., Fierman, A. H. & Mendelsohn, A. L. Attitudes about shared reading among at-risk mothers of newborn babies. *Ambul. Pediatr.* **7**, 45–50 (2007).
  36. Dexter, C. & Stacks, A. A preliminary investigation of the relationship between parenting, parent-child shared reading practices, and child development in low-income families. *J. Res. Child. Educ.* **28**, 394–410 (2014).
  37. Hutton, J. S. et al. Shared reading quality and brain activation during story listening in preschool-age children. *J. Pediatr.* **191**, e201 (2017).
  38. Berkule, S. B. et al. Mothers' expectations for shared reading after delivery: implications for reading activities at 6 months. *Ambul. Pediatr.* **8**, 169–174 (2008).
  39. Karrass, J., VanDeventer, M. C. & Braungart-Rieker, J. M. Predicting shared parent-child book reading in infancy. *J. Fam. Psychol.* **17**, 134–146 (2003).
  40. Bingham, G. E. Maternal literacy beliefs and the quality of mother-child book-reading interactions: associations with children's early literacy development. *Early Educ. Dev.* **18**, 23–49 (2007).
  41. McDaniel, B. T. & Radesky, J. S. Technofence: parent distraction with technology and associations with child behavior problems. *Child Dev.* **89**, 100–109 (2018).
  42. Whitehurst, G. J. et al. Outcomes of an emergent literacy intervention in Head Start. *J. Educ. Psychol.* **86**, 542–555 (1994).
  43. Whitehurst, G. et al. A picture book reading intervention in day care and home for children from low-income families. *Dev. Psychol.* **30**, 679–689 (1994).
  44. Whitehurst, G. et al. Accelerating language development through picture book reading. *Dev. Psychol.* **24**, 552–559 (1988).
  45. Lonigan, C., Anthony, J., Bloomfield, B., Dyer, S. & Samwel, C. Effects of two shared-reading interventions on emergent literacy skills of at-risk preschoolers. *J. Early Intervention* **22**, 306–322 (1999).
  46. Doyle, B. G. & Bramwell, W. Promoting emergent literacy and social-emotional learning through dialogic reading. *Read. Teach.* **59**, 554–564 (2006).
  47. Crain-Thoreson, C. & Dale, P. Enhancing linguistic performance: parents and teachers as book reading partners for children with language delays. *Top. Early Child. Spec. Educ.* **19**, 28–39 (1999).
  48. Scatliffe, N., Casavant, S., Vittner, D. & Cong, X. Oxytocin and early parent-infant interactions: a systematic review. *Int. J. Nurs. Sci.* **6**, 445–453 (2019).
  49. Bergin, C. The parent-child relationship during beginning reading. *J. Lit. Res.* **33**, 681–706 (2001).
  50. Canfield, C. F. et al. Beyond language: impacts of shared reading on parenting stress and early parent-child relational health. *Dev. Psychol.* **56**, 1305–1315 (2020).
  51. DeBruin-Parecki, A. *Let's Read Together: Improving Literacy Outcomes with the Adult-Child Interactive Reading Inventory (ACIRI)* (Brookes Publishing, Baltimore, MD, 2007).
  52. Edelman, G. M. Neural Darwinism: selection and reentrant signaling in higher brain function. *Neuron* **10**, 115–125 (1993).
  53. Mason, G. M., Goldstein, M. H. & Schwade, J. A. The role of multisensory development in early language learning. *J. Exp. Child Psychol.* **183**, 48–64 (2019).
  54. Zeece, P. D. & Churchill, S. L. First stories: emergent literacy in infants and toddlers. *Early Child. Educ. J.* **29**, 101–104 (2001).
  55. Tomasello, M. & Farrar, J. Joint attention and early language. *Child Dev.* **57**, 1454–1463 (1986).
  56. Rossmanith, N., Costall, A., Reichelt, A. F., López, B. & Reddy, V. Jointly structuring triadic spaces of meaning and action: book sharing from 3 months on. *Front. Psychol.* **5**, 1390 (2014).
  57. National Research Council and Institute of Medicine Committee on Integrating the Science of Early Childhood Development. *From Neurons to Neighborhoods: The Science of Early Childhood Development* (Washington, DC, National Academy Press, 2000).
  58. Kuhl, P. K. Early language learning and literacy: neuroscience implications for education. *Mind, Brain Educ.* **5**, 128–142 (2011).
  59. Ferjan Ramirez, N., Lytle, S. R., Fish, M. & Kuhl, P. K. Parent coaching at 6 and 10 months improves language outcomes at 14 months: a randomized controlled trial. *Dev. Sci.* **22**, e12762 (2018).
  60. Rowe, M. L. Child-directed speech: relation to socioeconomic status, knowledge of child development and child vocabulary skill. *J. Child Lang.* **35**, 185–205 (2008).
  61. Newman, R. S., Rowe, M. L. & Bernstein Ratner, N. Input and uptake at 7 months predicts toddler vocabulary: the role of child-directed speech and infant processing skills in language development. *J. Child Lang.* **43**, 1158–1173 (2016).
  62. Dunst, C. J., Jones, T., Johnson, M., Raab, M. & Hamby, D. W. Role of children's interests in early literacy and language development. *CELLreview.* **4** (2011).
  63. Dreyer, B. P., Mendelsohn, A. L. & Tamis-LeMonda, C. S. Assessing the child's cognitive home environment through parental report: reliability and validity. *Early Dev. Parent.* **5**, 271–287 (1996).
  64. Funge, S. P., Sullivan, D. J. & Tarter, K. Promoting positive family interactions: evaluating a free early childhood book distribution program. *Early Child. Educ. J.* **45**, 603–611 (2017).
  65. National Center for Education Statistics. *Early Childhood Longitudinal Program Birth Cohort (ECLS-B)* (Washington, DC, US Department of Education, 2011).
  66. Center on Children and Families at Brookings. *Starting School at a Disadvantage: The School Readiness of Poor Children* (Washington, DC, Brookings Institution, 2012).
  67. National Center for Education Statistics. National Assessment of Educational Progress at Grades 4 and 8: Reading. In: *Institute for Education Sciences* (Washington, DC, National Center for Education Statistics, 2019).
  68. Hutton, J. S., Perazzo, D., Boldt, M., Leonard, A. C. & Kelly, E. Safe sleep and reading guidance during prenatal care? findings from a pilot trial using specially designed children's books. *J. Perinatol.* **42**, 510–512 (2022).
  69. Hutton, J., Huang, G., Wiley, C., DeWitt, T. & Ittenbach, R. F. Randomized trial of a mobile app introduced during well-visits to enhance guidance for reading with young children. *Acad. Pediatr.* **21**, 977–987 (2021).
  70. Lefly, D. L. & Pennington, B. F. Reliability and validity of the Adult Reading History Questionnaire. *J. Learn. Disabilities.* **33**, 286–296 (2000).
  71. Harris, P. et al. Research electronic data capture (REDCap) – a metadata-driven methodology and workflow process for providing translational research informatics support. *J. Biomed. Inform.* **42**, 377–381 (2009).



72. Needlman, R., Toker, K. H., Dreyer, B. P., Klass, P. & Mendelsohn, A. L. Effectiveness of a primary care intervention to support reading aloud: a multicenter evaluation. *Ambul. Pediatrics*. **5**, 209–215 (2005).
73. Hutton, J. S., Huang, G., Phelan, K. J., DeWitt, T. & Ittenbach, R. F. Shared reading quality assessment by parental report: preliminary validation of the DialogPR. *BMC Pediatr*. **18**, 330 (2018).
74. Smith, E. V. & Smith, R. M. *Rasch Measurement: Advanced and Specialized Applications* (Maple Grove, MN, JAM Press, 2007).
75. Rasch, G. On general laws and the meaning of measurement in psychology. In *Proceedings of the Fourth Berkeley Symposium on Mathematical Statistics and Probability* (Berkeley, CA, 1961).
76. US Department of Health and Human Services. *2020 Poverty Guidelines for the 48 Contiguous States and the District of Columbia*. Accessed July, 2020. <https://aspe.hhs.gov/2020-poverty-guidelines> (2020).
77. Smith, R. M. Detecting item bias with the Rasch model. *J. Appl. Meas.* **5**, 430–449 (2004).
78. Ramey, C. T. & Ramey, S. L. Early intervention and early experience. *Am. Psychologist* **53**, 109–120 (1998).
79. Lang, A., Del Giudice, R. & Schabus, M. Sleep, little baby: the calming effects of prenatal speech exposure on newborns' sleep and heartrate. *Brain Sci.* **10**, 511 (2020).
80. US Department of Health and Human Services. *Home Visiting Evidence of Effectiveness: Effectiveness Research*. <https://homvee.acf.hhs.gov/Models.aspx> (2018).
81. Tambyraja, S. R., Schmitt, M. B., Farquharson, K. & Justice, L. M. Home literacy environment profiles of children with language impairment: associations with caregiver- and child-specific factors. *Int. J. Lang. Commun. Disord. / R. Coll. Speech Lang. Therapists* **52**, 238–249 (2017).
82. High, P. C. & Klass, P. Literacy promotion: an essential component of primary care pediatric practice. *Pediatrics* **134**, 404–409 (2014).
83. Bus, A. G., & van Ijzendoorn, M. H. Affective dimension of mother-infant picturebook reading. *J. Sch. Psychol.* **35**, 47–60 (1997).
84. Bus, A. G., Belsky, J., van Ijzendoorn, M. H. & Crnic, K. Attachment and book-reading patterns: a study of mothers, fathers, and their toddlers. *Early Child. Res. Q.* **12**, 81–98 (1997).
85. Bus, A. G., & van Ijzendoorn, M. H. Attachment and early reading: a longitudinal study. *J. Genet. Psychol.* **149**, 199–210 (1988).
86. Bus, A. G. & van Ijzendoorn, M. H. Mother-child interactions, attachment, and emergent literacy: a cross-sectional study. *Child Dev.* **59**, 1262–1272 (1988).
87. Mermelstine, R. Parent-child learning interactions: a review of the literature on scaffolding. *Br. J. Educ. Psychol.* **87**, 241–254 (2017).
88. Farrant, B. M. Joint attention and parent-child book reading: keys to help close gaps in early language development, school readiness and academic achievement. *Fam. Matters* **91**, 38–46 (2012).
89. Hofferth, S. L. Response bias in a popular indicator of reading to children. *Workshop on the National Children's Study* (Crystal City, VA, 2004).
90. Hutton, J. S. & Brown, C. Illustrator. *SHARE This Book* (Cincinnati, OH, Blue Manatee Press, 2018).

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## AUTHOR CONTRIBUTIONS

J.S.H. researched and developed the SHARE/STEP conceptual model, drafted the SharePR screening measure and refinements, was the principal investigator in both studies from which data were collected, collaborated in data analysis, created Fig. 1, and drafted the initial manuscript and subsequent revisions. G.H. performed all data analysis for this study including rendering all tables and Fig. 2, and reviewed and revised the manuscript under the supervision of R.F.I. C.C. collaborated in the analysis of each dataset, participated in manuscript preparation, and reviewed and revised the manuscript. T.D. provided guidance on each study protocol design, analysis, and measure refinement, and reviewed and revised the manuscript. R.F.I. guided SharePR measure development and refinement, oversaw all data analyses in collaboration with GH, and reviewed and revised the manuscript. All authors read and approved the final manuscript as submitted.

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## COMPETING INTERESTS

J.S.H. is the author of children's books used in both studies and the founder of blue manatee press, their publisher. All books were donated, and J.S.H. receives no salary or other compensation for this work. T.D. serves on the Board of Directors of Reach Out and Read but receives no compensation for this. The remaining authors have no conflicts of interest relevant to this article to disclose.

## CONSENT TO PARTICIPATE

For both trials from which data were accessed, full written informed consent was obtained from all participants, consistent with human subjects' protections.

## ADDITIONAL INFORMATION

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