

## **A Typology for Observing Children's Engagement with eBooks at Preschool**

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### **Abstract**

This research reports a two-phase descriptive study of young children's engagement with ebooks conducted in Head Start classrooms. Phase 1 focused on the development of a typology as an analytic framework for observing engagement with ebooks in different formats (shared book; independent book browsing) and across devices (stationary touch screen; handhelds). Converging extant research categories with videotaped observations of ebook reading from classroom samples (n=12 children), a typology was derived using qualitative analytic procedures. It consisted of three categories (control, multisensory behaviors, communication) and 11 salient behaviors of children's engagement with ebooks. Phase 2 applied the typology to a comparable classroom sample (n=24 children) to obtain descriptive observations of children's engagement with ebooks in teacher-led ebook reading at the touch screen and child-led ebook browsing/reading with handheld devices (iPad; iPod). Potential influences of behavioral regulation levels on children's engagement with ebooks were also explored. Results supported the typology as a fairly reliable and manageable framework for analytic purposes of description and enumeration, yielding descriptive evidence of children's engagement with ebooks in the sample. In brief, control varied with format, which in turn influenced the distribution of multisensory behaviors and types of communication. Level of behavioral regulation influenced control.

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Increasingly, the ebook is an appealing choice for storybook reading with young children, although its impact on early literacy development and its role in early literacy instruction remains open to question. Are ebooks with their audio and film-like qualities more appealing to young children than traditional storybooks? Are they more engaging, drawing children's attention to story lines and words? Do they support or deter children's capacities to comprehend stories and learn about printed words? In short, do ebooks support learning to read and reading for the rigors of school or are they merely edutainment?

In pursuit of these larger questions, this study describes children's engagement with ebooks in two formats commonly used for storybook reading/browsing in the preschool setting:

shared reading with the teacher and independent book browsing/reading, usually in a comfortable spot or library corner. Most studies of young children's engagement with books have focused on traditional storybooks, describing where children look and what they say and do, but fewer have examined young children's engagement with *screens* that constitute the pages of an ebook for shared viewing/reading or independent viewing/reading. In a changing world, where ebooks may soon rival hard-bound storybooks, how children engage with them is important not only for understanding how ebooks might supplement the early literacy experience, but also how they might improve the learn-to-read process.

### Indicators of Engagement With Storybooks

In early literacy research, the concept of engagement involves a combination of attention, interest and enjoyment where children look, see, and listen with apparent pleasure to storybooks read aloud to them. The concept is grounded in broader, multi-disciplinary professional literature (e.g. learning theory) that distinguishes engagement from motivation, with the former more reliant on self-agency, or the power to take control and see results of one's own decisions (Murray, 1997), and the latter on external agency where others exhort activity. In brief, individuals choose to be engaged; they are not told or assigned to do so. They engage when activities are interesting, socially useful or personally enjoyable to them, and within their zone of proximal development (Marcum, 2000; Vygotsky, 1978). When engaged, individuals actively participate, often with their whole bodies, not merely observe. They persist at activity, especially if it has an element of challenge (Csikszentmihaly, 1996; Smith, 2010). Engagement, in sum, involves self-direction, interaction, emotion, choice and a sense of competence.

Along these lines, several global behavioral indicators of young children's engagement during adult-child book reading have been identified. DeBruin-Parecki (1999), for example, synthesized observations of young children's engagement with books from extant research into three categories: attention to print, (e.g., maintaining physical proximity with the book); interactive reading (e.g., responding to questions); and strategies (e.g., spontaneously offering ideas about a story). In their study of preschoolers' engagement with ebooks and traditional books, Moody, Justice, and Cabell (2010) described engagement as persistence, enthusiasm, and compliance, adapting these scales from the Minnesota Teaching Task instrument (Egeland, et al., 1995). Persistence involved behaviors such as pointing, page turning, commenting, and answering questions; enthusiasm included similar indicators plus smiling and laughing; compliance behaviors were demonstrated by timely responding, staying seated, and following directions. Children's level of reading engagement varied, they found, between adult-led traditional and ebook storybook reading formats with higher levels of persistence in adult-led ebook reading, but more communications in adult-led traditional book reading. Based on read aloud discussions in kindergarten classrooms, Sipe (2002) developed a typology of expressive engagement that included dramatizing, talking back, critiquing/controlling, inserting, and taking over. All are forms of verbal response, also reflected in the DeBruin-Parecki (1999) framework (interactive category) and the adapted scales from the Minnesota Teaching Task (e.g., positively commenting on a book as an indicator of persistence and enthusiasm).

Another line of early literacy research has pursued more fine-grained physiological behaviors indicative of engagement. Visual eye tracking studies, for example, have measured focal visual attention to picture and print, observing the salient features of a book page that capture young children's attention (Evans & Saint-Aubin, 2010). Young children, it appears, tend to prefer picture features to print features, even at the onset of reading on their own.

Moreover this tendency appears to amplify in interactive ebooks where visuals and animations are powerful attractors. Nielsen's eye-tracking study of adult screen reading behaviors, for example, indicated an F-shaped pattern of eye movement: two horizontal stripes followed by a vertical stripe—a pattern that promotes faster, but apparently shallower reading (Nielsen & Pernice, 2009). Skin conductance registers have been used to measure arousal levels as indicators of engagement with texts showing that multimedia features and interactivity benefit story comprehension (Verhallen, Bus, & de Jong, 2006). Some studies of haptic perception (tactile; kinesthetic senses) suggest that the sensory-motor affordances of digital reading enhance haptic interactions (touch; bodily movement), and thereby engagement, although perhaps in ways that increase scanning and browsing over a more focused and contemplative reading experience (e.g., Mangen, 2008)—an observation corroborated by Nielsen and colleagues. More recently, child error registrations (clicks) in an Intelligent Tutoring System, *Living Letters* ([www.bereslim.nl](http://www.bereslim.nl)), were used to assess level of engagement, indicating more or less commitment to letter-learning tasks over playful interactions (Van der Kooy-Hofland, Bus, & Roskos, 2012). Child-control of the computer device (e.g., the mouse), however, appears to be a critical feature of engagement, facilitating young children's interest in and attention to screen content (Calvert, Strong & Gallagher, 2005). When adult control outweighs child control, children's visual attention increasingly dropped off with time, and they seem to get bored.

Summarizing much of this research, descriptors of young children's engagement with books involve two large behavioral categories: (1) verbal behaviors that include responses such as commenting, answering questions, offering ideas, laughing, making noises and (2) nonverbal behaviors such as control of the object, eye gaze, touching, bodily movement, facial expressions (e.g. smiling, frowning), page turning and gestures. In various combinations these behaviors provide evidence of engagement with books that may involve self-agency, multi-sensory participation, sense of competence, persistence and enjoyment.

While existing research provides some descriptive evidence of young children's engagement behaviors with traditional storybooks that informs early literacy pedagogy (e.g., the design of quality early literacy materials), the body of research on children's engagement with ebooks is rather thin. Addressing this gap, our study provides descriptive observations of young children's engagement with ebooks in familiar book reading formats in preschool: shared reading and independent book browsing/reading. Both formats include literacy goals for developing what Don Holdaway (1979) famously described as a literacy set: high expectations of print, familiarity with book language, essential strategies for handling written language, and knowledge of print conventions. The study was guided by the following questions:

1. What does children's engagement with ebooks look like? What are primary categories and features of children's engagement with ebooks?
2. How does the format (organization and arrangement) of ebook reading influence children's engagement? Are there differences between a teacher-led or child-led format of ebook reading?
3. Does children's level of behavioral regulation influence their engagement with ebooks?

## Method

### Background of the Study

A descriptive research approach was used to observe children's engagement with ebooks in different formats for reading in the preschool classroom. The study was organized into two phases. In phase one we developed a typology for observing young children's engagement with ebooks, drawing on existing categories from research and emergent categories from videotaped observations. In phase two we applied the typology as an analytic framework to videotaped observations of ebook reading in the preschool classroom--teacher-led ebook reading at the touch screen and child-led ebook browsing/reading with handheld devices (iPad; iPod)--comparing and contrasting evidence of engagement. We also explored the potential influences of behavioral regulation levels on children's engagement with ebooks.

Both phases of the study were conducted in Early Reading First (2001) classrooms where the emphasis is on evidence-based early literacy instruction geared to three and four-year old children with school readiness needs. A total of 40 children and 8 teachers participated in the two phases of the study. Teachers from phase 1 also participated in phase 2. Descriptive information of the sample in each phase is summarized in Table 1. The child sample was diverse (18% Hispanic; 29% White; 49% African American); included a majority of boys (boys = 24; girls = 16) and involved children in the average range of the PPVT-IV, with the exception of 9 children with special needs. The teacher sample was also diverse and included four teachers with AA degrees and four with BS or higher degrees; the group averaged 13 years of preschool teaching. (Note: All had participated in substantial professional development in evidence-based early literacy instruction as a part of the Early Reading First program (96 hours est. per year) that included an orientation to ebook devices (stationary touchscreens; iPads; iPods), ebook collections, and classroom applications.

Table 1

#### *Participant Demographics*

##### **Phase 1**

Classroom Site	Teacher		Child Sample n=3 per classroom	
	Education	Years of Experience	Mean Age in Months	Mean PPVT-4* standard score
Midwest 1	AA ECE	16	54	97
Midwest 2	AA ECE	14	50	96
Southwest 3	BAE-Elementary	14	57	84
Southwest 4	BAE-SPED	03	44	69

##### **Phase 2**

Midwest 1	AA ECE	16	52	83
Midwest 2	AA ECE	26	50	97
Midwest 3	AA ECE	10	57	110
Midwest 4	AA ECE	14	56	103
Southwest 5	BA-Elementary	14	54	75
Southwest 6	M.ED-SPED	25	58	84
Southwest 7	BAE-SPED	02	53	87
Southwest 8	BAE-SPED	03	55	82

\*PPVT-4: Peabody Picture Vocabulary Test 4<sup>th</sup> Edition (Dunn & Dunn, 2007).

## Phase 1

**Participants.** Our research objective in phase 1 was to describe children's engagement with ebooks using verbal and nonverbal categories of behaviors found in prior early literacy research as a guide and to observe emergent categories from field observations.

A total of 12 children from four different Early Reading First (ERF) classrooms and their teachers participated in this phase (see phase 1 participant demographics in Table 1).

**Procedures.** Prior to an 8-week observation cycle, teachers participated in a 90-minute training session conducted by the research team that introduced them to ebooks as a reading resource, provided operational basics of ebook viewing at a touchscreen, and outlined an instructional procedure for shared reading of ebooks with the children (see Figure 1). As a part of the ERF project, all of the teachers had received substantial training and coaching in the shared book reading routine (est. 30 hours), and were skilled in implementing basic before-during-after shared reading instructional steps, referred to as BDA. A total of 8 ebooks from the Tumblebook (Tumblebooks.com, n.d.) and Mobi Story collections (<http://www.stillmotionmedia.com/>) were selected for shared reading (see Appendix A). Over the 8-week time frame, teachers were asked to view/read each ebook 2x during a one-week period (usually T/TH), to highlight any new vocabulary words, and to allow the children to browse/reread the ebook on a mobile device (iPod or iPad) after the second reading (usually TH or F).

**Data collection.** Video observations of ebook shared reading at the touchscreen were collected from two angles: FLIP camera on teacher and web cam on children consisting of 53 video recordings, totaling 15 hours. Video observations of ebook reading with iPads or iPods were not collected at this time for three reasons: (1) logistical difficulties of video capture (e.g., tracking individual children), (2) the novelty of the devices in the environment, and (3) incomplete procedures for prepping children for individual ebook browsing (e.g., safety, use of headphones, locations). From the ebook shared reading corpus, video samples ( $n = 32$  [8 per teacher]), each averaging 16 minutes and counter-balanced for session (read 1; read 2), were selected for analysis, totaling 8.5 hours.

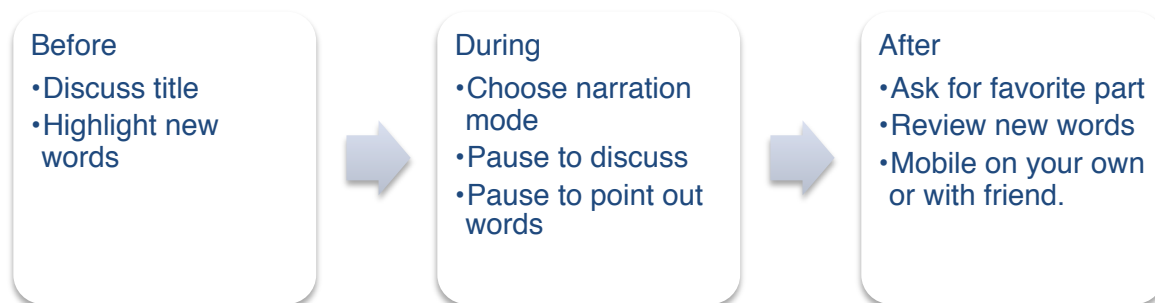


Figure 1. Shared Ebook Reading Guide

**Data Analysis.** The video samples were entered into NVivo 8 (QSR International, 2007) as classroom cases consisting of teacher and child codes (T1, T2, T3, T4; C1, C2, C3...C12). At this point, the child became the focus of analysis. Adapting Carney's "ladder of abstraction" approach (Carney, 1990), a series of progressive qualitative analyses were conducted of child

behaviors. Using an analytic induction procedure (Goetz & LeCompte, 1984) cases were initially scanned at 1-minute intervals for evidence of behaviors in existing verbal and nonverbal categories (research-based) as well as any emergent categories of behaviors. This analysis yielded a working typology that consisted of three behavioral categories: (a) control as indicated by positioning and operation at the touchscreen (operating the control buttons); (b) multi-sensory behaviors, such as touching; and (c) communication involving verbal and nonverbal behaviors, such as talking or smiling. An enumerative strategy was then used to identify salient behaviors in each of these categories, based on frequency counts. Behaviors in the upper quartile of total frequency were designated as salient based on results of an earlier study (Roskos, Burstein, You, Brueck, & O'Brien, 2011). This analysis served to clarify the categories and emergent behaviors of a 'working' typology. The categories appeared sufficiently broad-based (capturing many behaviors) for operational definition yet narrow enough for purposes of reliability (McWilliam & Ware, 1994).

The typology was then used to code a 120-minute sample drawn from the 8.5 hours of video observations. Our analytic goal was to further define categories and behaviors and operationalize the typology for use in subsequent analyses. Initially, a 3-member team each coded 30 minutes of video observation from the 120-minute sample at 1-minute intervals to establish more precise definitions for categories and behaviors and establish coding rules. At each minute interval coders stopped the videotape sample and coded the salient behaviors present in each category at that interval. These data were compared and discussed to achieve consensus and to further establish coding decision rules (see Appendix B). The team then each coded the remaining 90 minutes of video observations from the sample, achieving inter-coder agreement of 86%. This analysis yielded a typology for use as an analytic tool to observe children's engagement with ebooks under different conditions (format; devices) (see Table 2).

Table 2

*Typology of Engagement with Ebooks*

Category	Salient Behaviors
Control	Operating the device
Multi-sensory Behaviors	Looking Touching Listening Moving Gesturing
Communication	Making facial expressions Making noises Using language Commenting Answering questions Asking questions

## Phase 2

In phase 2 of the study we applied the typology as an analytic framework to (1) describe children's engagement with ebooks under two conditions: teacher-led shared reading at the stationary touch screen and child-led ebook browsing/reading with a handheld device (iPad; iPod) and (2) observe the influence of children's behavioral regulation on their engagement with ebooks under these conditions. Our overarching research objective was to describe emergent patterns of behavior that characterized young children's engagement with ebooks, i.e., the distribution of their behaviors across analytic categories and behaviors, evidence of format effects, and self-regulatory influences on engagement. Results from these analyses could then be used to assess the extent to which the observational data meshed with existing theoretical frameworks of young children's engagement with storybooks, elaborate on these frameworks and link with other relevant research pertaining to the influences of engagement on early literacy experience and the learn-to-read process.

**Participants.** Phase 2 included a total of 24 children and 8 teachers from ERF classrooms in the same two regions of the country (see Table 1). In general, the participants had similar characteristics to those in phase 1. The children's mean age and vocabulary scores on PPVT-4 were slightly higher than those of phase 1 participants (phase 1 MA = 51 months; phase 2 = 54 months; phase 1 mean PPVT = 87; phase 2 = 90). Teachers participating in phase 2 were also more experienced (phase 1 mean years of experience = 12; phase 2 = 14).

**Procedures.** Phase 2 occurred over a 4-week period following the same procedures as those in phase 1 (2 shared readings per week using the BDA protocol). Teachers were oriented to ebooks and how to use them in the preschool classroom using an online training tutorial developed from the 90-minute professional development session used in phase 1. The tutorial explained the types of ebooks available for early childhood classrooms; showed how to operate ebooks at the touch screen and on hand-held devices; demonstrated shared reading with ebooks at the touch screen using a BDA approach and made the facilitation of children's ebook reading with hand-held devices more explicit; and provided opportunities for practice using simple simulation exercises. Teachers repeated the tutorial two times to develop fluency and comfort with ebook reading in the preschool classroom and also received in-class assistance from literacy coaches.

Four ebooks were selected from Tumblebooks for shared reading at the touchscreen and children's independent browsing/reading on iPods or iPads (see Appendix A). External webcams and USB microphones (Eyeball USB Webcam Microphone [Blue Microphones]) were used for video captures of shared and independent ebook viewing/browsing/reading.

**Measures.** Two measures were introduced in phase 2 to assess children's behavioral regulation as a mediating factor of control in engagement. Using *attending to screen* or eye gaze as an indicator, time to onset at screen and duration were calculated for individual children in the two instructional formats (shared reading at the touch screen; independent reading with mobile devices). Onset was defined as how long it takes to establish attention to the screen and duration

as how long the child maintains eye contact at screen before looking away the first time. The rules were strictly maintained for purposes of this study, which sought to describe behavioral regulation influences in a preliminary way. Returns-to-screen after an initial ‘look away’ were not measured, nor were cumulative effects of onset and duration with iterative ‘look-aways’ and returns’ to screen when ebook reading.

Children’s behavioral regulation was assessed using the Head-Toes-Knees-Shoulders (HTKS) task (McClelland et al., 2007). This task is a direct assessment of behavioral regulation, recruiting three skills: inhibitory control, attention, and working memory. Its primary focus is on inhibitory control. Children are asked to play the game and instructed to do the opposite of what is asked. For example, when asked to touch their head, they need to touch their toes. A total of 20 items are rated on a 0-2 scale with the higher number indicative of higher levels of behavioral regulation. Overall, the measure meets generally established levels of validity and reliability (McClelland et al., 2007).

**Data Analysis.** A total of 547 minutes of video observation were entered into NVivo 8 using the same procedures as in phase 1, organizing each classroom as a case example with each child the unit of analysis in each classroom case. Observational data were coded at 1-minute intervals by the 3-member research team using the categories and salient behaviors defined in the typology. Each minute interval served as a sample of engagement, allowing the coding of each salient behavior present by child in that instance. Effort was made to capture the simultaneity of engagement with the ebook at the screen, coding each salient behavior present in the interval according to the coding rules. Inter-coder agreement was 91%. This analysis yielded frequency counts of salient behaviors by category by child in the temporal sample. These data were then aggregated and the total time of each salient behavior was calculated to determine the percent of time each salient behavior within a category occurred under different conditions (format; device) and by levels of behavioral regulation.

Time to onset and duration of attention to the screen by each child was also calculated in seconds using the minute interval as a tracker. These data were aggregated by level of behavioral regulation and entered into SPSS for statistical analyses.

## Results

### A Typology of Engagement

In phase 1 we queried the data to develop a big picture view of children’s engagement with ebooks and derived a typology of engagement as an analytic tool. The typology included three categories – control, multisensory behaviors, and communication – and 11 salient behaviors, three of which specified Using Language as a behavior, namely commenting, asking questions, and answering questions (see Table 2). In general, the typology proved to be a fairly reliable and manageable framework for collecting and laying out the data to see “what’s there” for analytic purposes of description and enumeration. Inter-rater reliability was strong and the categories + behaviors were sufficiently specified for purposes of enumeration. We then applied the typology to a second sample of videotaped observations, totaling 547 minutes. Our analytic goal was twofold: (i) to describe children’s engagement with ebooks in different formats and (ii) to examine the influence of their behavioral regulation on their engagement with ebooks.

### Descriptive Evidence of Engagement in Different Formats

**Control.** Reflecting the commonplaces of book reading in the preschool setting, the majority of ebook reading was teacher-led at the touch screen (79% of time; 432 minutes) and



the remaining child-led using handheld devices – iPad or iPod (21% of time; 115 minutes). Teachers, therefore, had a higher incidence of control over ebook reading than children as illustrated in Figure 2.

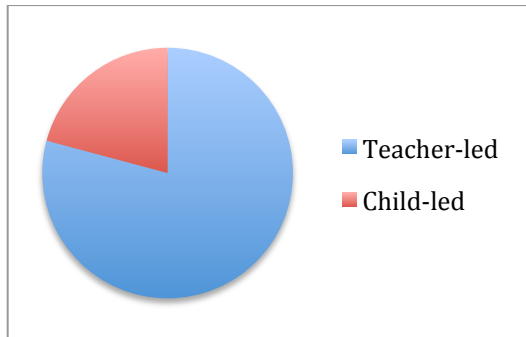


Figure 2. Incidence of Control

**Multisensory Behaviors.** Figure 3 shows the distribution of multisensory behaviors by device in the two formats: adult-led at the touch screen and child-led at the iPad or iPod. Several interesting tendencies emerge from these data. One, children’s looking, touching and listening behaviors tend to increase with greater control of the device with the iPod showing the highest incidence of these behaviors. That children used headphones with the iPod, thus shielding them from extraneous noises, coupled with its smaller size, demanding more motor control, may account for the greater concentration of looking, touching and listening behaviors with the ebook on this device. The iPod device, in short, may have supported a “cocoon-like” reading environment that both captured and sustained these multisensory behaviors of engagement.

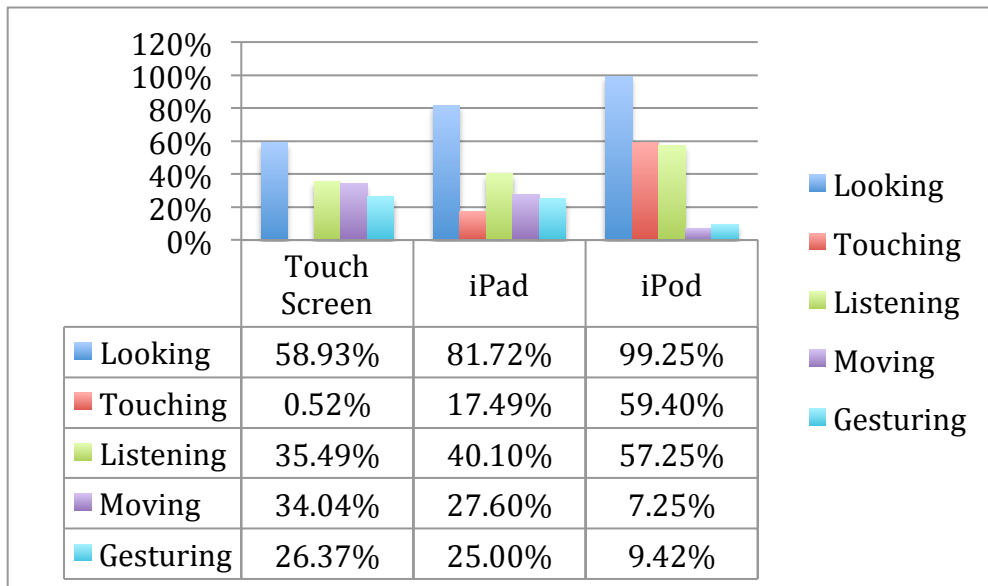


Figure 3. Incidence of Multisensory Behaviors By Device

Two, looking as a sign of engagement increased considerably across the devices, nearly 25% from the touch screen to iPad and about 40% from touch screen to iPod. Touching also increased substantially from the touch screen format (< 1%) to the iPad (about 18% of time) and even more dramatically to the iPod, occurring about 60% of time in the sample. Increase in the incidence of listening is less pronounced across devices, although from touch screen to iPod shows about a 20% increase. In brief, looking, touching and listening behaviors appear to increase as children gain more control of the device.

Three, moving and gesturing behaviors decrease as control of the device shifts from teacher to children being less so between touch screen and iPad (moving < 10%; gesturing approximately 1%) and greater between touch screen and iPod (moving approximately 27%; gesturing approximately 17%). In this respect, as the looking-touching-listening cluster of behaviors increases with child control of the device, the moving-gesturing cluster of behaviors tends to decrease, suggesting that greater control of the device on the part of the child may favor some motor behaviors over others (e.g., touching).

**Communication.** Figure 4 displays the frequencies of different types of communication by device in the two formats. In general the data show a higher incidence of facial expression and noises as child control of the device increases (iPad; iPod), and a decrease in language use (commenting, asking questions, answering questions). As we might expect, children used language more in teacher-led shared reading at the touch screen where they are encouraged to ask/answer questions and comment on the story line—an observation also corroborated in adult-led traditional storybook reading (Moody, Justice & Cabell, 2010). The difference in language use between the iPad and iPod is noteworthy, suggesting that the iPad reading environment may more closely resemble that of adult-child shared reading at the touch screen than the iPod reading environment.

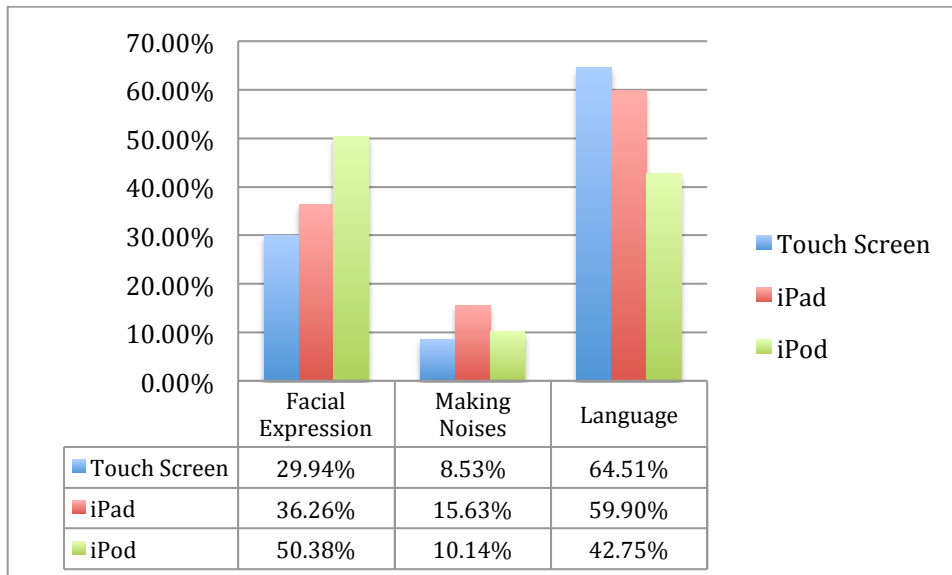


Figure 4. Incidence of Communication by Device

### Influences of Behavioral Regulation on Engagement

This set of analyses explored the potential influences of behavioral regulation on children's engagement with ebooks. Based on their HTKS scores, individual children were given a score of 1 (low behavioral regulation), 2 (medium behavioral regulation), or 3 (high behavioral regulation) and grouped according to these levels using a median split method. Groups then served as the independent variable for examining engagement per the typology.

**Control.** To examine the influence of behavioral regulation (BR) on control as an indicator of engagement, eye gaze toward the screen (attending to the screen) was the unit of analysis based on the theoretical assumption that a sense of control is rooted in the learner's "psychological investment in and effort directed toward learning" (Newmann, Wehlage, & Lamborn, 1992, p.12), which has been linked to future school achievement (Bodovski & Youn, 2011). Average time to onset and duration of eye gaze to screen across formats was determined by level of BR (low; medium; high) as summarized in Figure 5.

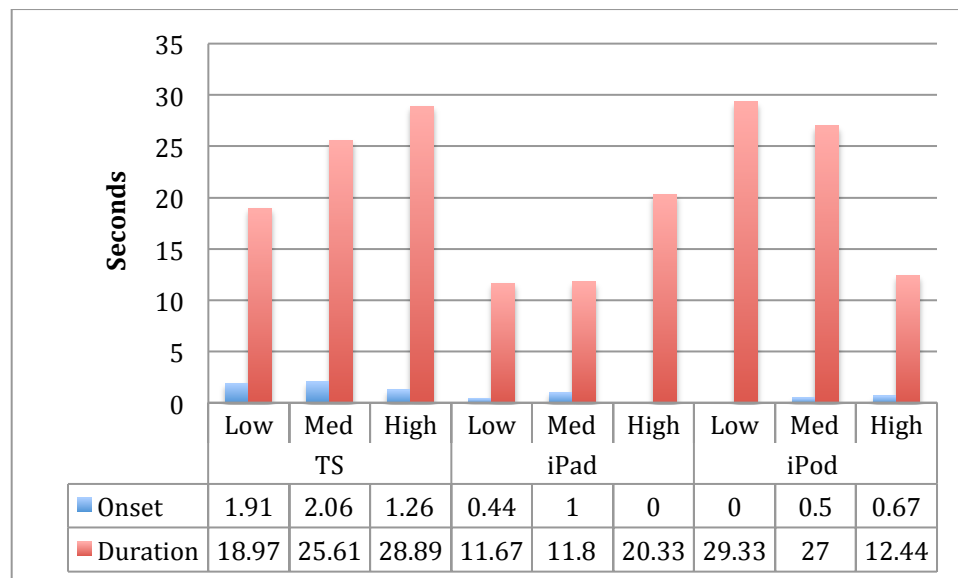


Figure 5. Average Time to Onset and Duration to Screen by Behavioral Regulation Level

Several descriptive observations emerge from this analysis. In general it indicates BR influences in teacher-led and child-led formats, but these differences are not significant. The data show the rapidity with which children at different BR levels attend to screens--within 2 seconds or so -- and their initial staying power at the screen, ranging between 12-30 seconds. It should be noted that the highest average duration occurred at the touch screen, perhaps due to 'press' of adult presence—a tendency also noted in play research (Bruner, 1980).

BR influences, however, do indicate significant variability for onset ( $p < .004$ ,  $ES = .742$ ); and duration ( $p < .007$ ,  $ES = .498$ ) by device, which has implications for fostering children's sense of control and regulating attention. For the low and medium BR groups, the iPod outperforms the other devices, capturing and holding attention to the screen more quickly and longer, thus affording the opportunity for feeling in control. For the high BR group, the iPad followed by the touch screen outperforms the iPod. The touch screen also attracts and holds their attention faster and longer than the other groups, affording a near 10 second advantage over

the low BR group; likewise with the iPad which captures the attention of the high BR group quickly and sustains it longer than for the low or medium BR groups (about 8 seconds).

**Multisensory Behaviors.** Figure 6 shows the influence of BR levels on the incidence of children's multisensory behaviors in general. While the incidence of behaviors shows similar patterns across BR levels, the low BR group tends to look less and listen more than other groups. The medium BR group tends to use the full complement of multisensory behaviors slightly more so than the other groups (e.g., looking, touching, gesturing). Overall BR levels do not appear to substantially influence multisensory behaviors as a means of engagement.

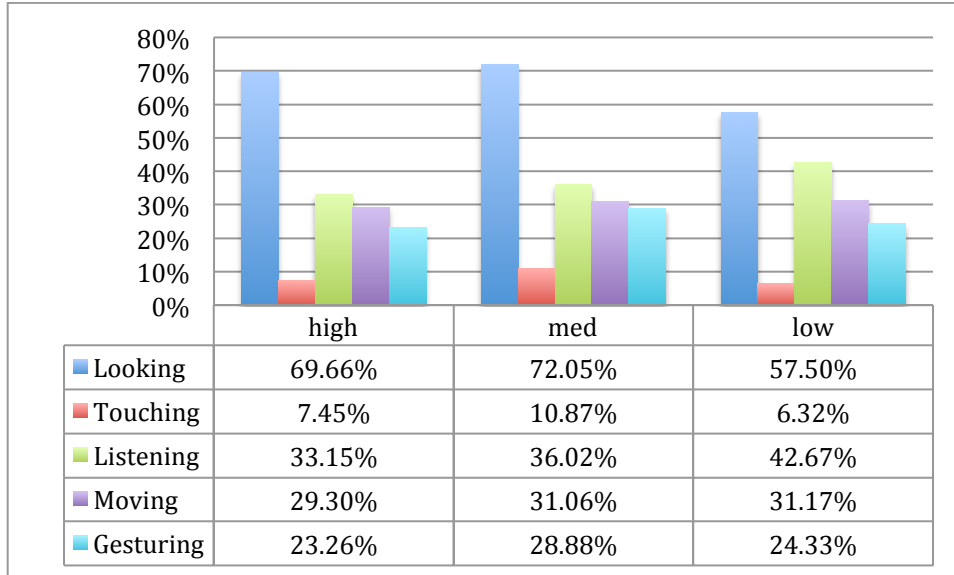


Figure 6. Incidence of Multisensory Behaviors by Behavioral Regulation Level

**Communication.** The impact of BR levels on communication as evidence of engagement is depicted in Figure 7. As with multisensory behaviors, these results show slight differences between BR levels on communication behaviors identified in the typology. Closer inspection of the language types showed that the high BR group tended to answer more questions (66% of total) than the medium or low BR groups (55% and 60% respectively); the medium BR group tended to ask more questions (8%) as compared with high and low BR groups (each about 2%); and the low and medium BR groups tended to make more comments (38%) than the high BR group (31%).

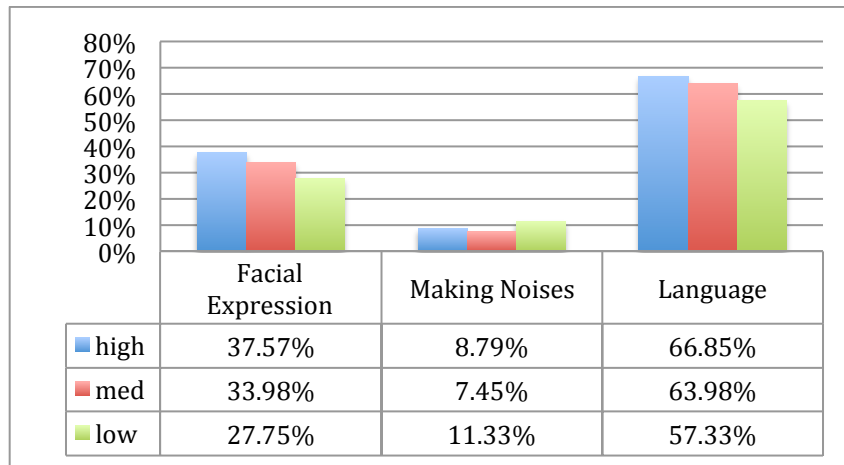


Figure 7. Incidence of Communication Types by Behavioral Regulation Level

## Discussion

This is a descriptive study that attempted to observe and describe children's engagement with ebooks in teacher-led shared reading at a stationary touch screen and independent ebook viewing, browsing and reading with handheld devices (iPad; iPod) in the preschool setting. It involved two phases, the first of which developed a typology of engagement categories and behaviors based on extant research and classroom-based video observations and the second which applied the typology to a second set of videotaped observations obtained from similar classroom settings.

The resulting typology aligns with observations of engagement behaviors found in prior research with traditional storybooks. Children express their participation in direct ways through multisensory behaviors, such as looking, touching and listening, and non-verbal and verbal communication, such as positive facial expressions (Moody, Justice & Cabell, 2010) and oral expression (e.g., answering questions) (Sipe, 2002). When given the opportunity, they assert control of the book as an object, primarily by holding it and turning pages. The typology also is consistent with research on children's engagement with digital devices which shows that preschoolers increasingly realize their ability to influence events on screens by poking, touching, swiping, and pretending; they demonstrate emergent 'multi-literate' behaviors, touching pages or words to hear them read aloud, labeling objects, asking questions and repeating dialogue, and actively manipulating on-screen games (Goldstein, 2011). Field observations in situ corroborated and further defined the categories and behavioral elements of the typology framework as an analytic tool for observing children's engagement with ebooks in the preschool setting. The typology, therefore, has possibilities as a research tool to further study the role and impact of engagement with ebooks in early literacy and the learn-to-read process at school. Do ebooks, for example, nurture foundational engagement behaviors with texts at an earlier age? Are certain patterns of engagement with ebooks reinforced over others and, if so, does this matter for the learn-to-read process, which makes heavy demands on engagement?

Our application of the typology to an observational sample created a descriptive picture of what children's engagement looks like in common preschool book reading formats. As we might expect there are differences between teacher-led and child-led settings by virtue of *who's*

*in charge*. Teacher-led shared reading at the touch screen appears to afford less control for children than teacher-monitored independent ebook browsing and reading when children are left literally to their own devices with the iPad and iPod. Control appeared to influence the incidence of multisensory behaviors with the behavioral cluster of looking-touching-listening increasing with child control and that of moving-gesturing tending to decrease. The look-touch-listen cluster bears watching for early literacy experience with ebooks because it involves multiple sources of information that may strengthen and bond interactions with visual and verbal content. This can work for or against learning to read. When predominantly oriented to visual content, which young children tend to favor (Evans & Saint-Aubin, 2010; Hayes & Birnbaum, 1980), the cluster can draw children's attention away from the word-level linguistic information they need to read print (alphabet letter knowledge; the alphabetic principle; sight words). When predominantly oriented to verbal content (word recognition; vocabulary; story line) enhanced by visual content, the cluster can support reading readiness skills (Kegel & Bus, 2011). Further research is clearly needed to explore the looking-touching-listening behavioral cluster in teacher-led shared reading at the touch screen, and in general research is needed on ebook design that intentionally embeds important linguistic content in the presentation. Quality ebook design may be especially critical for young children's independent ebook reading on handheld devices (Roskos, Brueck, & Widman, 2009; Roskos, Burstein, You, Brueck, & O'Brien, 2011). As observed in this study, the iPod and iPad devices offered a protected reading environment that strongly supported children's engagement with ebooks.

Control also influences the types of communication and the incidence of language for purposes of engagement, in particular. As noted in prior research (Moody, Justice & Cabell, 2010), teacher-led shared reading at the touch screen elicited more talk to encourage and maintain engagement. This makes sense given the instructional context and should be promoted. However, children's use of language to become and stay engaged also has implications for ebook design where 'assistants' can be built in that prompt and cue language use with the visual and verbal content in teacher-led and child-led settings. Properly timed interruptions for vocabulary instruction with audio-visual prompts in an ebook, for example, have been found to increase children's learning of target words (Smeets & Bus, 2011).

The analysis of behavioral regulation as a potential governor of children's engagement with ebooks yielded interesting results. Different levels of BR appear to have little effect on multisensory behaviors and communication as engagement mechanisms, but this observation is only preliminary and requires further research across a larger sample and settings. What these results do suggest is that children in general bring a full repertoire of behaviors to their engagement with ebooks similar to other interactive settings they encounter in the world (Shonkoff & Phillips, 2000), especially when the learning formats are arranged to support their interactions. More intriguing, perhaps, are the data related to control for purposes of engagement. Here we observe emerging patterns with implications for early and beginning reading instruction with ebooks. Children with high BR attend to the screen faster and attend longer to touch screens and iPads than their medium to low BR peers, gaining an 8-10 second advantage for feeling in control and regulating attention in these more instructionally lucrative reading environments that favor teacher facilitation. Children with low to medium BR gain a time advantage over their high BR peers with the iPod, giving them a sense of control but in a potentially less instructive reading environment. Does this matter? It may. Learners can process about one sentence of narration and 10 seconds of animation at any one time in a multimedia environment designed for learning (Mayer & Moreno, 2003). It follows that those with higher

BR may gain more in instructionally rich situations with ebooks whereas those with medium to low BR might gain less and small gains may have big consequences in reading development over time (Cunningham & Stanovich, 2001; Hart & Risley, 2003; Stanovich, 1986).

### **Limitations**

The study has several limitations that should be kept in mind when interpreting the results. It was situated in Early Reading First classrooms, which adhered to a scientifically based early literacy curriculum focused on essential skills that may influence reading behaviors and expectations. Less prescribed curricular approaches may have influenced categories and features of behavior differently, allowing more child control at the touch screen, for example. The study relied on convenience samples of small sizes from a few select Early Reading First classrooms, further compromising the construct validity of engagement in shared or independent ebook reading formats. Further iterations involving a broad range of Early Reading First program classrooms with larger samples will improve the credibility of the analytic framework for observing child engagement with ebooks in shared and independent reading. The completeness of video capture was also an issue, especially in phase one as equipment and procedures for consistent video observations in live settings were being implemented by the research team. Although remedied in phase two, relevant video data may have been lost at the outset and not included in the successive analyses that yielded the categories and salient behaviors used to create the typology as an analytic framework for observing children's engagement in phase 2. Future studies should strive to improve the thoroughness of the data to test the technical adequacy (soundness and usability) of the typology as an observational framework for examining children's engagement with screens in ebook reading. The influences of behavioral regulation on children's engagement with ebooks were only preliminarily examined, and the coding system used was restrictive. A more robust system of observation is needed to describe children's attention to screen as a baseline indicator of their sense of control in an ebook reading context. Collecting multiple onset-duration-return to screen samples of eye gaze may provide a more complete picture of attention that contributes to a sense of control at screen in shared reading. Further studies are needed to corroborate these descriptive observations and to improve the typology as a tool for more rigorous examination of children's engagement with ebooks in the preschool classroom.

### **Conclusion**

The ebook represents a technological advance in the book from a two-dimensional to a three-dimensional information tool, replacing the page with the screen and enlivening text with rich imagery, sound, and animation. Research on what this evolution means for children's engagement with books and their early literacy experience is indeed young. This study developed a typology for observing children's engagement with ebooks in commonplaces of preschool reading and explored what it looked like at the touchscreen and with handheld devices. The resulting descriptive observations inform the design of ebooks to support children's engagement and early literacy instruction with ebooks on different devices. Children's sense of control, multisensory behaviors and communication contribute to their engagement with ebooks and capture their attention, interest and enjoyment in the reading experience that primes them for learning. The typology provides an analytic tool for further descriptive research on children's

engagement with ebook features and content, and the consequences for their learning and learning to read.



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**Appendix A**  
List of Ebooks Used

Phase	Ebook Title	Source
1	<i>Bugs, Bugs, Bugs</i>	Tumble Books
	<i>The Fire Station</i>	Tumble Books
	<i>Subway Ride</i>	Tumble Books
	<i>All Aboard the Dinotrain</i>	Tumble Books
	<i>Jack And The Beanstalk</i>	Tumble Books
	<i>The Diary of a Spider</i>	Tumble Books
	<i>Mud Puddle</i>	Tumble Books
	<i>Mike and the Bike</i>	Mobi
2	Pigs	Tumble Books – iPod/iPad
	Boy Soup	Tumble Books – iPod/iPad
	Sink or Swim	Tumble Books – iPod/iPad
	Pocketful of Kisses	Tumble Books– iPod/iPad

## Appendix B

### Coding Definitions and Rules

Category	Definition	Salient Behavior(s)	Definition	Rule
Control	Power to take meaningful action and to see the results of decisions and choices (Murray, 1997)	Operating the device	Quick, easy access to and use of control buttons on devices; direct participation	Code CON if operating the device the majority of the time
Multisensory Behaviors	Using visual, auditory and haptic-kinesthetic senses	Looking	Eyes directed to the screen	Code L if eyes & position are oriented to the screen
		Touching	Fingers applied directly to the screen	Code T if holding the device and/or touching, tapping, scrolling, swiping the screen
		Listening	Attending to the audio stream of the ebook, not talking	Code LIS if not talking, but looking at the screen
		Moving	Positioning to view the screen	Code M if moving the body to orient to the screen by wiggling, shifting, rolling, sitting, standing
		Gesturing	Using bodily actions to communicate	Code G when using hands & body to make motions; may be talking
Communication	Using verbal and nonverbal behaviors to respond to language and express comprehension	Facial Expressions	Using facial gestures to express thought & feelings,	Code P (positive) if smiling or puzzling; Code N (neutral) If no expression; gazing; Code Neg (negative) if appears angry, sleepy, frowning
		Making Noises	Using sounds to express thought & feelings, such as squealing, laughing, gasping, etc.	Code S if making sounds that are not words
		Language	Using speech to comment, answer questions & ask questions	Code C for Commenting; A for Answering questions; Q for Asking questions