Toniebox Evaluation of Caregiver Reporting on Emergent Literacy and Screen Time for 3 to 5-year-olds

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I. Executive Summary

Emergent Literacy (EL), particularly that which occurs before kindergarten, is a complex and continuous phenomenon that includes the development of diverse overlapping domains. These include, but are not limited to, specific academic skills such as alphabet recognition and phonological awareness; contextual skills such as language comprehension, syntax, and vocabulary; and socioemotional skills such as attitude, interest, and communication. Each of these domains impacts the others; i.e., a deficit in one leads to a deficit in others, and growth in one leads to growth in others. Based on the bi-directionality of the skills and domains pertaining to EL, the existing evidence for the positive impact of audiobook listening on the literacy skills of older children, and the importance of developing strong EL practices in early childhood, this experimental evaluation examines the potential impact of an aural storytelling device -- the Toniebox -- on parental perceptions of 3 and 4-year-old children's EL capacity across a 12 week evaluation window.

The prevalence of digital media in homes and the documented deleterious effects of excessive screen time (defined as more than one-hour per day for children ages 3 to 5-years) on cognitive development in early childhood has led to researchers, educators, and parents to searching for effective methods of reducing screen time. This experimental evaluation also asked if introducing the Toniebox – screen-free aural story and music device – influenced a decrease in screen time for participating children.

In order to explore the possible impact of the Toniebox on EL and on Screen Time we collected multiple streams of data: quantitative comparison in a pre/post-test experimental design with an intervention group and a wait-list control group, data usage recorded by each Toniebox, and qualitative reporting collected via online surveys completed by caregivers and conversational interviews with the intervention group.

From the beginning to end of the 12-week evaluation, 3 to 5-year old children who received a Toniebox demonstrated a greater improvement of scores in a caregiver-response Emergent Literacy survey as compared to a randomized control group ($P < 0.05$). Children in the Toniebox Group improved their scores at a rate 31.72% greater than their Control Group counterparts.

From the beginning to end of the 12-week evaluation, introducing the Toniebox led to a highly significant reduction in excessive screen time for intervention group families as compared to control group families ($P < 0.005$).

Caregivers reported most appreciating the calming and self-regulatory impact of the Toniebox and children's capacity to use it independently. This indicates that the product is beneficial not only for children, but also for their caregivers.

II. Evaluation Motivation and Purpose

II.1 Emergent Literacy

Emergent Literacy (EL), particularly that which occurs before kindergarten, is a complex and continuous phenomenon that includes the development of diverse overlapping domains. These include, but are not limited to, specific academic skills such as alphabet recognition and phonological awareness; contextual skills such as language comprehension, syntax, and vocabulary; and socioemotional skills such as attitude, interest, and communication (Duke & Cartwright, 2021; Rhode, 2015). Each of these domains impacts the others; i.e., a deficit in one leads to a deficit in others, and growth in one leads to growth in others (Puspitasari et al., 2023; Rand & Morrow, 2021).

Existing research indicates that listening to audiobooks has a positive effect on literacy practices for students in elementary school through adulthood (Best, 2020; Deniz, et al. 2019). Read-alouds, or dialogic reading, is also considered a best practice to support EL in early childhood (Maureen, et al., 2022; Isbell, et al., 2004). The impact of audiobook listening on EL without accompanying visuals has not yet been assessed in early childhood.

Positive literacy experiences and practices in the pre-kindergarten years set children up for success in their later school years. For example, EL competencies in preschool are a valid predictor of reading fluency in first grade (Hand, et al., 2024; Missall, et al., 2007). Based on the bi-directionality of the skills and domains pertaining to EL, the existing evidence for the positive impact of audiobook listening on the literacy skills of older children, and the importance of developing strong EL practices in early childhood, this experimental evaluation examines the potential impact of an aural storytelling device – the Toniebox – on parental perceptions of 3 and 4-year-old children's EL capacity across a 12-week evaluation window.

II.2 Screen Time in Early Childhood

The prevalence of digital media in homes and the documented deleterious effects of excessive screen time on cognitive development in early childhood has led to researchers, educators, and parents to value effective methods of reducing Screen Time (for review, see Lieber, 2024; Irzalinda & Latifa, 2023; Beatty & Egan, 2020). The American Academy of Pediatrics (AAP) and the World Health Organization (WHO) recommend no more than one-hour per day of screen time in early childhood (ages 3 to 5-years); time beyond one-hour is consistently labeled "excessive" in the research literature (AAP, 2023; WHO, 2019; Muppalla, et al., 2023; McGough, 2022).

Globally, only 1 in 3 (35.6%) children are meeting these screen time guidelines, highlighting the need for enhanced public health efforts (McArthur, et al., 2022). Similar rates exist in America: only 1 in 3 (32.9%) children meet screen time recommendations of less than one hour per day (Friel, et al., 2020). It's also important to note that this statistic was published in 2020 and based on pre-pandemic data. An updated nation-wide examination of post-pandemic screen time use has not yet been published, but smaller scope evidence indicates there was a significant increase in screen time during the Covid-19 lockdowns (e.g. Ng & Ng, 2022; Bergman, et al., 2022; Trott, et al., 2022). This experimental Toniebox evaluation therefore also asked if introducing the Toniebox – a screen-free aural story and music device – influenced Screen Time for participating children.

II.3 Evaluation Questions

1. Do participants who receive a Toniebox show a different rate of change in scores in a caregiver-response Emergent Literacy survey over 12-weeks as compared to a control group?

    1.a Is the amount of time that the Toniebox is used correlated to change scores in the Emergent Literacy survey?

2. Do participants who receive a Toniebox show a greater reduction in Screen Time, as reported by a caregiver, over 12-weeks as compared to a control group?

    2.a What do caregivers report about their screen time use?

3. What are caregiver perceptions of the impact and value of the Toniebox for their child?

III. Methods

III.1 Design

In order to explore evaluation questions 1 and 2 – the possible impact of the Toniebox on EL and on Screen Time – we collected multiple streams of data: quantitative comparison in a pre/post-test experimental design with an intervention group and a wait-list control group, data usage recorded by each Toniebox, and qualitative reporting collected via online surveys and conversational interviews with the intervention group.

Both the intervention and control groups consisted of families who did not have prior familiarity with the Toniebox. Before beginning the evaluation period, all participants completed a pre-test caregiver questionnaire of their child's early literacy behaviors and screen time. Intervention group participants then received a Toniebox, selection of Tonies, and headphones in the mails. Control group participants received their Toniebox upon completion of post-testing.

Once the Tonieboxes were introduced for the intervention families, all intervention group participants responded to brief weekly check-ins to track Screen Time and use of the Toniebox (see Appendix). Based on prior research, we expect that self-reporting of screen time by caregivers to be less accurate than direct measures, but to be reliable and consistent (e.g. Perez, et al., 2023). Self-report is therefore a meaningful method of data collection because we are interested in the change in screen time reporting from pre to post, rather than how much screen time children have at any specific point.

At the completion of the 12-week evaluation window, all participants completed a repeated-measure post-test of the caregiver EL survey. Intervention group participants were invited to conversational virtual interviews.

The evaluation team received an approved waiver of informed consent from the UW-Madison IRB office due to this project being product evaluation as opposed to research; concurrently, the evaluation team conducted all data collection following best practices for confidentiality and ethics with human subjects.

III.2 Analysis

To analyze the quantitative EL survey data, we used a two-sample t-test to analyze the difference scores in the EL survey between the intervention and control groups from pre to post-test. The caregiver questionnaire in use is a slightly modified version of Boudreau's validated "Early Literacy Parent Questionnaire" (2005 – see Appendix for full survey). This parent response survey has a strong correlation to direct examiner-administered assessments of early literacy for children ages 3 to 5-years. Evidence from several studies suggests that parent report is a valid indicator of children's EL development. We selected parent report as a primary measure due to its validity in assessing children's EL capacity and its relative convenience: we hope that a simple online measure, as opposed to direct evaluation of children's EL, will enable more robust and consistent participation from a geographically diverse sample.

We conducted a correlational analysis of change scores in the literacy survey from pre to post for the intervention group and data usage recorded by each Toniebox.

A two-sample t-test was also used to assess changes in reported screen time for intervention and control groups at the beginning and end of the 12-week evaluation period.

In addition to the quantitative measure, we invited written comments in each week's online survey, and invited intervention group participants to take part in qualitative interviews at the end of the evaluation window in order to gain more nuanced insights into children's and families' use and perception of the Toniebox. Comments and interviews were analyzed with a thematic analysis lens (Saldana, 2014; Miles, Huberman & Saldana, 2013) to identify dominant themes across responses. Qualitative themes add context and depth to quantitative findings.

IV. Participants

Participants were solicited through marketing by the Tonies company. Participants who met the evaluation requirements (had a child in the correct age-bracket, did not currently own a Toniebox, fully and correctly completed the participation survey) were then randomly assigned to either the intervention group or the waitlist control group.

At the beginning of the evaluation, there were 70 participants in the intervention group and 50 participants in the control group. Due to expected attrition over the course of the study, at the end of the 12-week evaluation period we had retained 44 participants in the control group and 43 participants in the intervention group. Of the 43 participants who fully completed both pre and post-testing in the intervention group, 2 outliers were discarded, resulting in 41 intervention participants included in the final analysis.

At the beginning of the evaluation period, participating children ranged in age from 33-months to 56-months old and were evenly split between male and female. All participants spoke English as a primary language in the home. Participating families came from 20 different states, self-reported being predominantly suburban, and represented a diversity of family incomes.

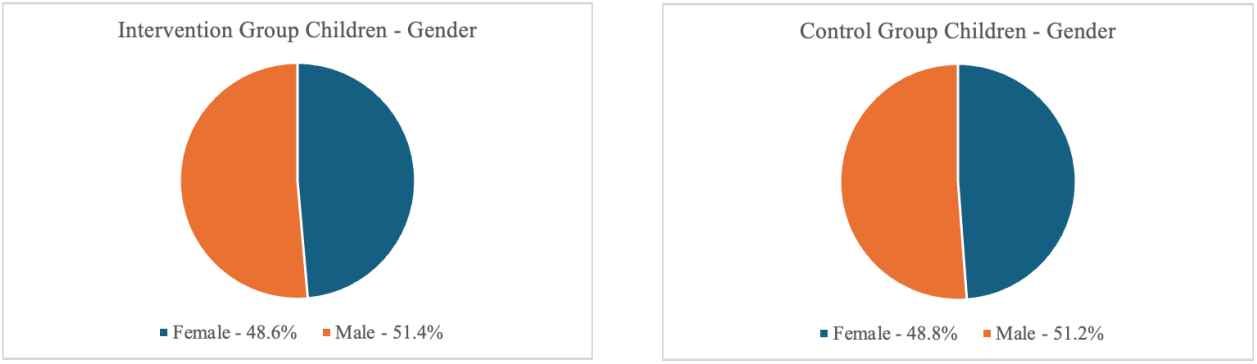


Fig 1: Gender distribution of participating children.

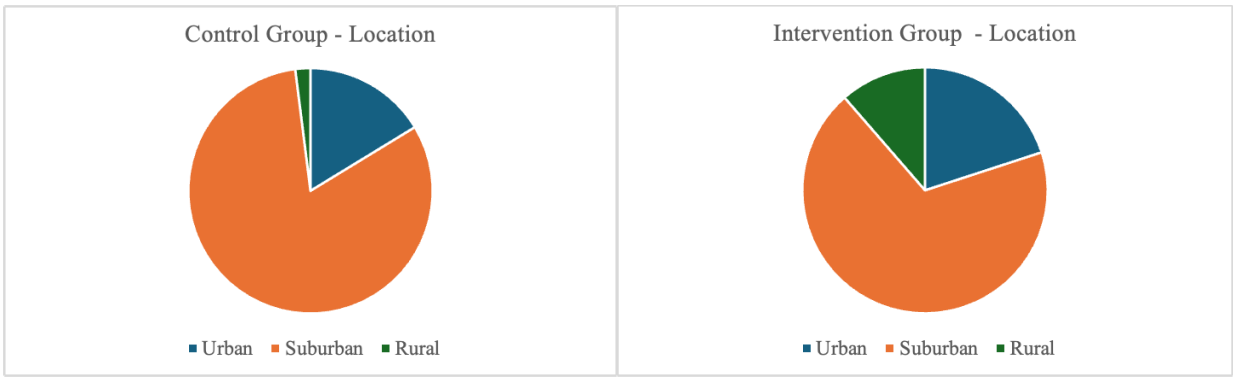


Fig 2: Self-reported home location of participating families.



Fig 3: Self-reported household income for participating families.

V. Findings

V.1 Emergent Literacy Survey

From pretest to posttest, the children in the intervention group improved their scores in the Emergent Literacy Survey an average of 17.46%, which is a significantly greater improvement than the children in the Control Group, who improved an average of 12.68%. With a *P* value of .0364, this difference should be interpreted as significant and unlikely to have been caused by chance.

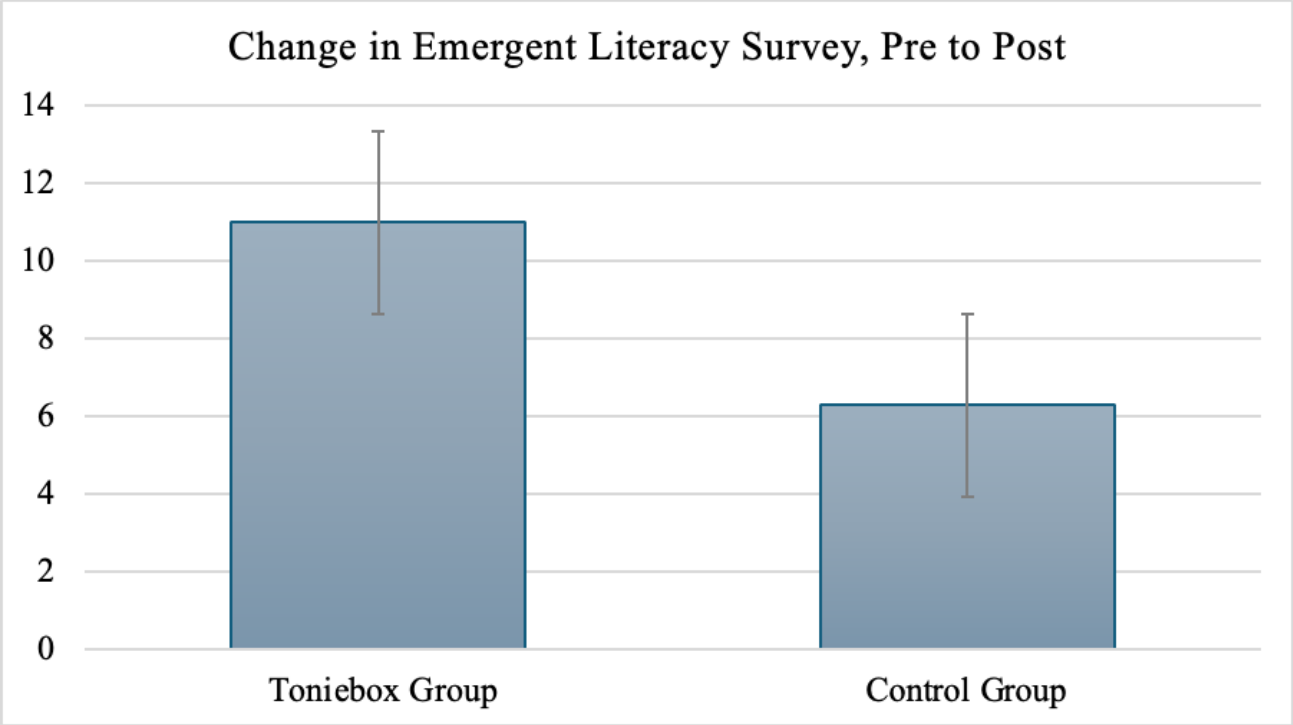


Fig 4: A bar chart depicting the improvement in the caregiver-response Emergent Literacy survey for intervention and control group children from the beginning to end of the 12-week evaluation period.

Across the three three-months of the intervention, we expected that all children would grow in their Emergent Literacy skills. The significant difference between the score improvement of the Toniebox Group vs the Control Group indicates that the introduction of the Toniebox had an impact on the rates of Emergent Literacy learning. **The rate of growth in Emergent Literacy scores for the Toniebox Group is 31.72% greater than that of the Control Group.**

V.2 Usage Data

Tonieboxes record usage data. Of the 41 intervention group participants included in the final analysis, there was significant variation in how much the Toniebox was played during the 12-weeks of the intervention. Participants averaged 4 hours/week of listening time and a median of 1.6 hours/week.

We conducted a linear correlation analysis to assess if more time listening to the Toniebox correlated to greater improvement in the EL survey for intervention group children. We found no correlation between minutes listened and change scores from pre to post ($r = .18$, $P = .28$). This indicates that time listening is not the most important variable that impacted the improved EL scores for the intervention group, and that other usage variables are more important for supporting emergent literacy. Further research is needed to identify what mechanisms influence the significant improvement in EL scores observed in pre to post testing for the intervention group.

V.3 Screen Time Reporting

For participant reporting, Screen Time was defined as "time during which engagement with a screen was the primary activity." At pre-testing, 65.7% of Intervention Group participants and 59.2% of Control Participants reported excessive screen time (i.e. – an average of more than an hour per day). This means that 37.55% of our entire sample population was meeting screen time recommendations at pre-test; this closely aligns with the 2022 global rate of 35.6% (McArthur, et al., 2022) and is slightly higher than the 2020 American rate of 32.9% (Friel, et al., 2020). The higher rate of excessive screen time use in our sample population may be attributable to the increase in screen time caused by the covid-19 pandemic.

From pretest to posttest, there was a 25.1% reduction in the rate of caregivers in the intervention group reporting over an hour of Screen Time each day as compared to before the Tonieboxes arrived. Conversely, there was a 6.4% increase in the rate of caregivers in the control group reporting over an hour of Screen Time each day as compared to the start of the evaluation period. With a *P*-value of .0002, this difference should be interpreted as highly significant and unlikely to be caused by chance.

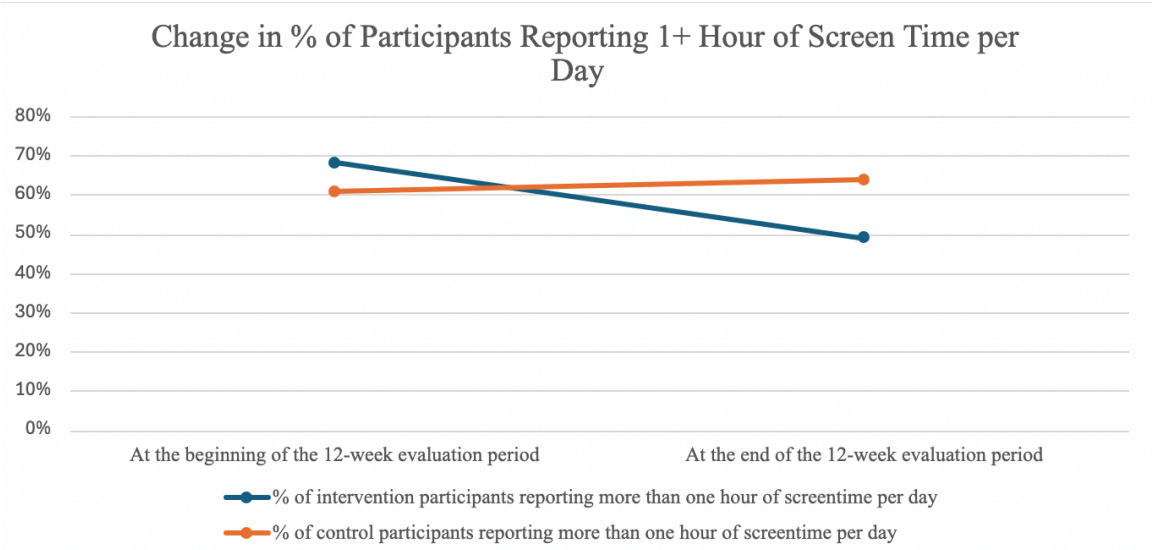


Fig 5: Change in the percentage of participants reporting over an hour of screentime per day from pre to post test for intervention and control groups.

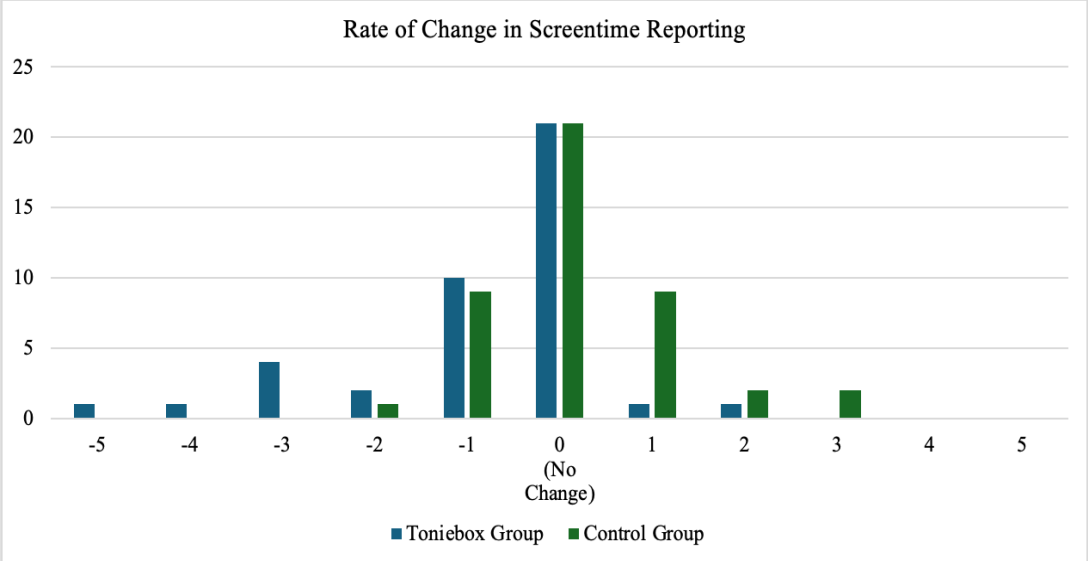


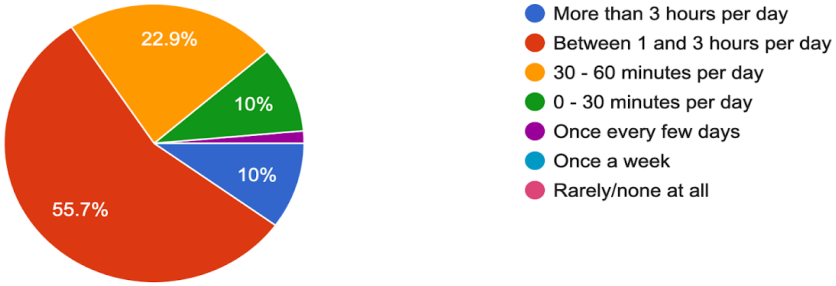
Fig 6: Bar chart depicting the rate of change from pre to post for the intervention and control groups.

From Baseline to 6-weeks, there was a 39.1% reduction in the rates of families reporting over an hour of Screen Time each day as compared to before the Tonieboxes arrived. From Baseline to 12-weeks, there was a 25.1% reduction in the rates of families reporting over an hour of Screen Time each day as compared to before the Tonieboxes arrived. Combined with survey comments, the early drop in Screen Time is likely due to the novelty of the Toniebox, which faded over time. The fact that even after 12-weeks, however, there is still a 25.1% reduction in the rates of families reporting over an hour of Screen Time each day, suggests that the product continues to have an impact on Screen Time even after the initial novelty and excitement of a new toy have worn off. Details are depicted in Figure 7 on pages 13-14.

Across 12-weeks, the toniebox group reduced caregiver reporting of excessive screentime from from 2 in 3 families (on par with global and national rates) to 1 in 2 families. Post-test reporting in which on 48.93% of the Intervention Group reported excessive screen time is not only a significant decrease within the sample population, but also a significantly lower rate of excessive screen time than global and national averages.

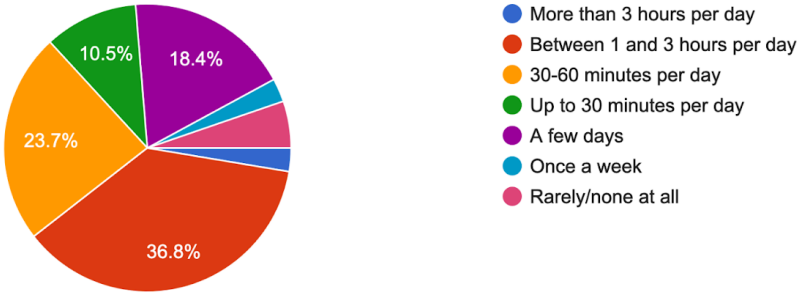
Screen Time Baseline - Intervention Group before Tonieboxes arrived

How much screen time, on average, does your child have in a week? (Time in which engagement with a screen is the primary activity)
70 responses



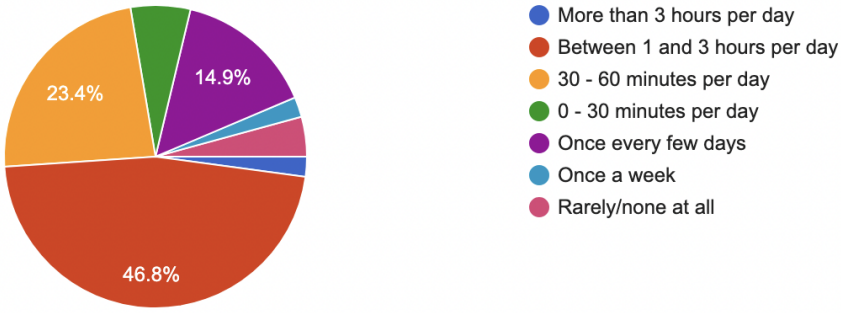
65.7% of participants report an average of more than an hour of Screen Time each day.

Screen Time Week 6 - Halfway through the evaluation period



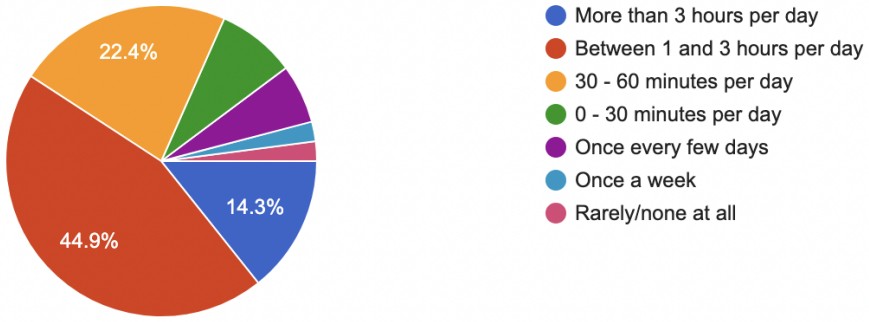
39.4% of participants report more than an hour of Screen Time each day; this is a 39.1% reduction in the rates of families reporting over an hour of Screen Time each day as compared to before the Tonieboxes arrived.

Screen Time Week 12 - End of the evaluation period



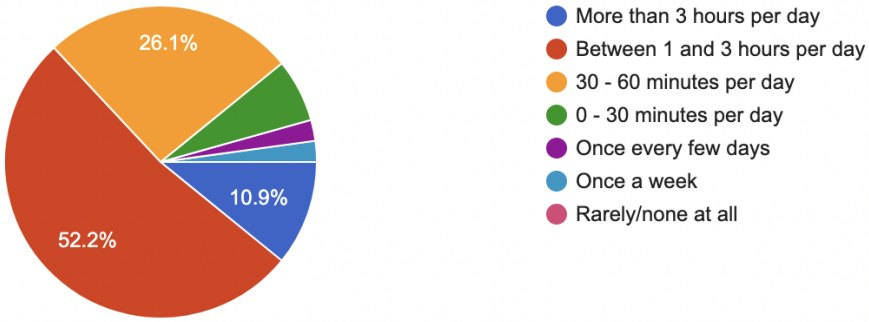
At the end of the evaluation period, 48.93% of participants report more than an hour of Screen Time each day; this is an increase as compared to the 6-week mark, but a 25.1% reduction in the rates of families reporting over an hour of Screen Time each day as compared to before the Tonieboxes arrived.

Screen Time Baseline - Control Group



59.2% of Control Group participants report an average of more than an hour of Screen Time each day.

Screen Time End of the evaluation period - Control Group



At the end of the evaluation period, 63.0% of Control Group participants report more than an hour of Screen Time each day. This is a 6.4% increase as compared to the start of the evaluation period.

Fig 7: A series of five pie charts depicting rates of screen time reporting for intervention and control groups at pre and post, and at the midpoint for the intervention group.

V.4 Interview Findings

All 70 intervention participants were invited to engage in conversational interviews via zoom to share more about their experience with the Toniebox. 12 people responded and scheduled interviews; of those 12, 9 attended their interview. The 9 interview participants all chose to take part because they had very positive experiences with the product and with the evaluation experience. Their interviews provide valuable insights into the complex real-life use of the Toniebox in a family setting, but should not be interpreted as representative of the larger sample. Based on the 9 interviews conducted, several patterns emerged regarding how participants use and benefit from the Toniebox:

1. Usage Patterns

- **Frequency and Timing**: Participants report varied usage patterns, with some children using the Toniebox during specific times such as bedtime, mealtime, or while playing. Others used it more sporadically. Examples of usage patterns reported include:
    - **Bedtime Routine**: Many caregivers use the Toniebox as part of the bedtime routine, helping children wind down by listening to stories or calming music.
    - **Meal Times**: Some families use the Toniebox during meals to keep children engaged at the table and reduce Screen Time.
    - **Car Rides**: multiple participants reported finding the Toiniebox valuable during car rides to keep children entertained without screens.
    - **Independent Play**: Children often listen to the Toniebox while simultaneously engaging in other play activities, such as playing with legos, Tonies figures, coloring, etc.
    - **Replacing Screen Time**: a number of families reported that the Toniebox replaced Screen Time. For some families, that reduction came from children choosing the Toniebox over screens; for others, the caregivers intentionally replaced screens with the Toniebox.

2. Engagement with Content

- **Story Selection**: Children tend to gravitate towards familiar characters or stories, which enhances their interest and engagement. For example, children who have seen movies or shows like *Wizard of Oz*, *Blue's Clues*, or *Miss Rachel* show increased interest in related Tonies figures.

- **Listening Duration**: The duration of listening varies; some children listen for long stretches, while others prefer shorter snippets, often repeating their favorite stories. Several participants reported their child listening to the same Tonie until it was fully memorized, and then moving on to a new story.

3. Emergent Literacy Development

- **Vocabulary and Language Skills**: Several caregivers observed improvements in their children's vocabulary and language skills, attributing some of this growth to the exposure from the Toniebox. Children used more complex words and sentence structures, often asking questions about new vocabulary they encountered in Toniebox stories.

> "She was kind of having trouble with speech, and I've noticed that since listening to more stories, she's hearing more language, and it has helped her develop that speech. … She would mix up the middle of her sentences, and now she's talking slower because I was like, listen to the story and listen to how much slower they talk, especially in the Paddington one. So it did help her with that."

> "Definitely, his vocabulary. … I would say, probably every other time he pulled [his Toniebox] out and listened to a story we got some kind of a question about what a word meant."

- **Interest in Reading**: Several caregivers intentionally connected their use of the Toniebox to books. Caregivers sometimes bought the book version of Tonies figures, such as *Room on the Broom*, and would follow along with their child. Several participants also expressed a desire for more direct connections between Tonies figures and books, and asked if the company ever sold them in sets.

> "He'll bring me a book, and I'll say, Oh, we have a Tonie that goes with this. Do you want the Tonie? Or do you want mommy to read it? And it varies. Sometimes he'll say, Well, let's do the Tonie, and sometimes he'll sit in my lap and say, no. I want you to read it."

4. Emotional and Social Benefits

- **Calming Effects**: The Toniebox serves as a calming tool for some children, helping them self-soothe during moments of frustration or anxiety. Some caregivers reported that their children would independently use the Toniebox to relax and calm down in moments of heightened emotion.

> "Maybe 2 months ago he started using it as when he was kind of upset or frustrated, he would go, lay down and listen to it. So it was kind of a calm down activity for him. He'd listen until he felt better, and then he'd come back to whatever activity we're doing."

- **Family Bonding**: Listening to stories together fostered family bonding, as caregivers and children shared moments of joy and laughter while engaging with the content. One family said they used the Creative Tonie to record Grandpa, who lives in another country, and how much that meant to their child.

> "We all enjoyed the fact that you could record your own voice messages, especially with, you know her grandfather not being here and being in England for most of the year or years. I think it's been really nice to be able to capture certain moments, and then she can cherish those and replay them and interact with those memories."

> "I think it's just been fun for us all to like. Listen to something together. The songs have been fun for us to dance and sing together."

> "He's been having really early morning wake ups because he misses Mom, like 4am. So I did recordings of me reading books on there, and then we let him turn on his Toniebox in the morning and listen to that, and so he can stay in bed, which gives us a little bit more time in the morning, which is nice."

5. Independent Use and Benefit for Caretakers

- **Independent Use**: Many children demonstrate a desire for independence by choosing their stories and engaging with the Toniebox without caregiver assistance. This self-directed play allows adults to attend to other tasks while their children are safely entertained and learning. This is one of the elements that participants reported appreciating the most. The ability of children to self-direct their use of the Toniebox sets it apart from other storytelling apps, like Spotify, that require caregiver help to access.

> "I like that he used it to explore new worlds. … It was nice for him to engage in an activity that was good for him that didn't need me or Dad right away."

> "I like the imagination that it's instilling. Like, he's able to sit there and listen to stories when I need to go and clean the house and I can't really be with him."

> "It helped boost her confidence. As in, I'm doing something for myself. I can put on my own headphones, change the music, you know, skip and stuff whenever she wanted to, so I think it's helped encourage even more independence and growth, and like learning in that sense because she's having to figure it out, I never told her how to use it."

> "It is a good way for him to kind of have more independent play. He likes to do magnet blocks a lot. But instead of like, Oh, Mom, build a house, he'll listen to his box and build his own house."
>
> "It [her child's independent listening] makes things less stressful. I don't have to play all day. I can like, get things done."

Additional Interview Observations

Two participants shared that their children have ADHD and that their children find the Toniebox to be a very effective focusing tool. These children use the Toniebox both to help them fall asleep and to play audio in the background of other play. For example, one caregiver shared that: "he kind of focuses on something more while he's listening. So it kind of gives his brain something to do while his fingers are doing something."

One participant, who is an elementary school teacher, shared that she brought her Toniebox to show her school librarian and suggested that they try introducing it in their school's self-contained special education classroom, especially for nonverbal students. She thinks that the simplicity of use and value of the storytelling would be really enjoyable for those students.

Several participants commented on the price of Tonies and the Toniebox being potentially prohibitive. Without this evaluation project, they would not have had access to the product. Some participating families have been able to find Tonies at their local library and really appreciate that access. Finding ways to expand Tonieboxes and Tonies in public libraries could be a positive action to support more access to the product for children of diverse socioeconomics.

Several participants said that being part of the evaluation process informed the way they thought about the Toniebox. For example, one participant shared that the weekly surveys caused her to think of the Toniebox "more as a tool and a learning resource … than a toy." This implies the evaluation project may have influenced use. Additionally, this insight could inform how the product is marketed.

Interview Conclusion

Overall, adult participants see the Toniebox as a valuable tool for enhancing children's literacy, providing entertainment, and fostering emotional well-being. The patterns of use indicate that it serves varied purposes in family life, from educational to calming, while also promoting independent play and reducing Screen Time. Caregivers appreciate that children are able to use it independently and gain positive learning experiences that don't require parental oversight.

V.5 Survey Comment Findings

Each weekly survey for the intervention group included an optional text box that invited caregivers to share observations, questions, new behaviors, etc. connected to the Toniebox. Across the 12-weeks of the evaluation, participants contributed 443 comments. Since the comment prompt was very broad – "Was there anything new or surprising in your child's interactions with the Toniebox this week, or anything else that you would like to share?" – there was a significant amount of variety in participant responses. Within this heterogeneity, two dominant themes emerged:

1. The Toniebox became a valuable tool for children's self-regulation and focus during times such as meals, independent play, and car trips, or calming down after big emotions.
2. The Toniebox was frequently used as a productive element of the bedtime routine, helping children to calm down and fall asleep.

Other comments add context to quantitative findings on Screen Time. A number of families shared comments observing a decrease in Screen Time motivated roughly evenly between grown-up-driven reductions (grown-up redirects to Toniebox) and child-driven reductions (child asks for Toniebox instead of screen media).

V.5.i Individual Survey Comments

The following comments should not be interpreted as representative of the full sample, but offer meaningful insight into individual experiences:

> "He goes straight to his box every morning to play a Tonie. He has not been asking for shows nearly as much."
>
> "Her teacher has also noticed she is more engaged and has better moods at school."
>
> "This week my kiddo started walking around the house with it so they can continue listening even when out of their room. There has been zero cries for the TV to be on!"
>
> "When our kiddo is upset we have used it as a tool to help redirect his thinking and calm him down/ a good tool to use for breaks and alone time/space."
>
> "I have definitely seen their vocabulary increase and their appreciation for music expand."
>
> "The Tonie box has really helped him calm down and focus. It is an activity that helps him with self-regulation and focusing."
>
> "The Toniebox is a better alternative to Screen Time. I think it helps her with her imagination and makes her listen to the story."

V.6 Qualitative Data Conclusion

Across written comments and conversational interviews, caregivers reported valuing: the Toniebox's positive impact on their children's self-regulation, focus, and bedtime routines; their perception of the Toniebox as both entertaining and educational; and that the Toniebox could be operated independently by their children thus freeing caregivers for other tasks.

Curious about how these themes aligned with or diverged from caregiver perceptions of screen time, the research team conducted a post-hoc literature review. A recent (2023) review and meta-synthesis of parent reporting on early childhood screen time presents valuable insights into possible reasons for the Toniebox's significant positive impact on screen time reduction for the Intervention Group. In this Chong, et al. review – including 20 studies and reflecting the experience of 1,311 parents – the authors report two of the primary reasons why parents encourage excessive screen time: "Distraction: the Babysitter" and "Educational means" (pg. 921). Parents described encouraging screen time to keep their children occupied and entertained, while "busy with household chores", "running errands", or "work demands" (e.g. Hinkley, et al., 2018; Bentley, et al., 2016). Parents mentioned being overwhelmed at times and requiring some time to themselves, referring screen time as a "lifesaver" and a "coping tool" to entertain their children (Eyler, et al., 2021; Chen, et al., 2020). The second most common reason parents gave for encouraging screen time is its perceived value as educational (Chong, et al., 2023). Despite these valid reasons for encouraging screen time, parents in 16 of the 20 studies analyzed expressed concerns about the detrimental impacts of excessive screen time.

The interviews and comments gathered in this Toniebox evaluation indicate that the aspects of the Toniebox that caregivers value – particularly its ability to be used independently by children and its educational value – directly align with the reasons that parents report encouraging screen time. Reducing screen time in early childhood is an important public health concern (e.g. AAP, 2024; Karai, et al, 2022; Xiang, et al., 2022). Public health organizations and pediatricians who recommend reducing screen time are not always addressing the valid reasons why caregivers rely of screens. Offering actionable alternatives that meet the same needs for caregivers is likely a more effective communication strategy than simply advocating for reductions in screen time (e.g. Minges, et al., 2015; Maibach, et al., 2023). Based on the qualitative data in this evaluation report, the Toniebox appears to be an effective alternative that meets those needs.

VI. Conclusion

Interpreting data from all sources – quantitative Emergent Literacy survey scores, caregiver Screen Time reporting, and Toniebox usage data, and qualitative survey comments and interviews – yields the following primary evaluation takeaways:

1. Over a 12-week span, introducing the Toniebox led to a greater improvement in Emergent Literacy scores as compared to a randomized control group for 3 to 5-year olds ($P < .05$). Children in the Toniebox Group improved their scores at a rate 31.72% greater than their Control Group counterparts.

    1.a The accelerated growth in EL for the intervention group has no correlation to minutes listened. This indicates that aspects of Toniebox engagement other than duration of listening have an impact on literacy development. These aspects could be time of day, patterns of use (active vs. passive, alone vs. with caregivers, etc.), type of Tonie (music vs. story, etc.), additional enrichment (such as introducing books along with listening), or other variables. More research is needed to understand these mechanisms.

2. Over a 12-week span, introducing the Toniebox led to a highly significant reduction in screen time for intervention group families as compared to control group families ($P < .005$).

    2.a Caregiver reporting in survey comments and interviews indicates that the motivation for this reduction in screen time varied: it was sometimes initiated by the child choosing a Tonie over screen media, and was sometime initiated by an adult intentionally using the Toniebox as an alternative for screens.

3. Caregivers most appreciate the calming and self-regulatory impact of the Toniebox, and children's capacity to use it independently. This indicates that the product is beneficial not only for children, but also for their caregivers.

Based on this evaluation, the tonies company should feel very confident that the Toniebox significantly reduced excessive screentime for 3 to 5-year-old children in the intervention group as compared to the control group. The intervention group demonstrated greater improvement on a caregiver-report Emergent Literacy survey as compared to the control group; further research is necessary to understand the specific mechanisms that led to that increased growth. Qualitative comments and interviews indicates that the Toniebox is not only a positive addition for children, but also a valuable tool for caregivers due to the toy's calming and self-regulatory impact and children's ability to use it independently.

VII. Appendix

Emergent Literacy Survey (adapted from Boudreau, 2005)

Please answer the following questions by indicating your response on the scale

Reading Books

1. Does your child ask you to read to them?

   Never/rarely On occasion Weekly Daily Several times per day

2. How often do you read to your child?

   Never/rarely On occasion Weekly Daily Several times per day

3. Does your child independently point to or talk about pictures when you read stories?

   Not currently Has but rarely Occasionally A few times per story Very frequently

4. Does your child ask questions about characters or events during story reading?

   Not currently Has but rarely Occasionally A few times per story Very frequently

5. Does your child pretend to read the story in a book? (such as sitting with a book and producing speech similar to the actual story in the book)

   Never Has but rarely Weekly Daily Several times per day

6. Does your child fill in words or lines from a story when reading with you? (When reading a book they know well, says the next line or word before you read it).

   Not currently Has but rarely Occasionally A few times per story Very frequently

7. Do you attempt to teach the names of the letters in the alphabet and/or alphabet sounds when reading?

   Not currently Has but rarely Occasionally A few times per story Very frequently

8. In comparison to other activities, how would you rate your child's interest in books?

1	2	3	4	5
Activity liked least				Favorite activity

Response to Print

9. Do you point out signs and words such as restaurant names or street signs to your child?

Not currently Has but rarely Occasionally Weekly Daily

10. Does your child show interest in grown-up reading materials (i.e. novels, newspaper, magazines, etc.)?

Never/rarely On occasion Weekly Daily Several times per day

11. Does your child ask for help in reading words such as on the street or words on food packages?

Never/rarely On occasion Weekly Daily Several times per day

12. Does your child recognize words in the environment (such as packaging, signs of stores, etc.) in your environment?

Never/rarely On occasion Weekly Daily Several times per day

13. Does your child read any words by sight (common words they have memorized and can identify, such as mom, cat, etc.)?

Not currently On occasion Knows a word Knows several words Knows many words

Language Awareness

14. Do you play rhyming games with your child?

Not currently Has but rarely Occasionally Weekly Daily

15. Does your child play rhyming games with you or others?

Not currently Has but rarely Occasionally Weekly Daily

16. Does your child produce rhymes by themselves?

Never/rarely On occasion Weekly Daily Several times per day

17. Does your child notice and say something when they hear words that rhyme? (i.e., "That rhymes!")

Not currently Has but rarely Occasionally Frequently Very frequently

18. Does your child make up stories and tell them?

Never Has but rarely Weekly Daily Several times per day

19. Does your child tell stories they learned from books, movies, tv, etc.? (i.e., do they narrate the plot of a movie they saw with a clear sequence of events, named events or characters, etc.)

Never Has but rarely Weekly Daily Several times per day

20. Does your child tell stories about real life? (i.e., do they tell you a story from their day with a clear sequence of events, distinct characters, etc.)

Never Has but rarely Weekly Daily Several times per day

21. Does your child sing simple songs?

Never/rarely On occasion Weekly Daily Several times per day

Interest in Letters

22. Can your child identify some letters of the alphabet? (such as pointing to the letter "A" when you ask them to?)

    Not currently Has but rarely Occasionally Frequently Very frequently

23. Does your child attempt to make the sounds of alphabet letters?

    Not currently Has but rarely Occasionally Frequently Very frequently

Writing

24. Does your child draw pictures?

    Never/rarely On occasion Weekly Daily Several times per day

25. Does your child write, or attempt to write, letters?

    Never/rarely On occasion Weekly Daily Several times per day

26. Does your child ask you to write for them?

    Never/rarely On occasion Weekly Daily Several times per day

27. Does your child ask you how to spell items?

    Never/rarely On occasion Weekly Daily Several times per day

28. Does your child write, or attempt to write, words?

    Not currently Has but rarely Occasionally Weekly Daily

Weekly Survey Questions

1. How often did your child use their Toniebox this week?
    a. More than an hour every day
    b. Every day for 30-60 minutes
    c. Every day 5-30 minutes
    d. Every few days
    e. Once a week
    f. Rarely/not all
    g. Other

2. Do they have any favorite Tonies or ways of using the Toniebox this week?
    a. [Short answer]

3. How much screen time, on <u>average</u>, has your child had this week? (Time during which engagement with a screen was the primary activity)
    a. More than 3 hours per day
    b. Between 1 and 3 hours per day
    c. 30-60 minutes per day
    d. Up to 30 minutes per day
    e. A few days
    f. Once a week
    g. Rarely/none all
    h. Other

4. Was there anything new or surprising in your child's interactions with the Toniebox this week, or anything else that you would like to share?
    a. [Short answer]

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