Language Comprehension and Screen Time Predict Preschoolers' Visual & Auditory Selective Sustained Attention

Marisa M. Palencar & Catherine A. Best

Kutztown University

BACKGROUND

- Selective sustained attention is a critical skill that begins in infancy and continues to develop during childhood and well into adolescence and adulthood.

- Developmental research focused on selective and sustained attention suggests steady improvements occur between 5 to 10 years of age, with poorer performance overall on tasks requiring greater attentional demands (Betts, Mckay, Maruff, & Anderson, 2006).

- Yet testing selective sustained attention in preschool children often presents methodological challenges if tasks are not sensitive to younger developmental needs, especially when using less-engaging measures designed to test older children (Goodwin, Lomas, Koedinger, & Fisher, 2015).

CURRENT AIMS

- The current study investigated preschool children's ability to selectively sustain attention to both auditory and visual stimuli, using original kid-friendly tasks with varied difficulty levels.

- We hypothesized that children's attention skills should be comparable across the auditory and visual games.

- We hypothesized that by manipulating task difficulty, we would find developmental patterns across age for attention skills. Attention should improve with age, even within preschool years, and performance accuracy should be better for less difficult attention tasks.

- We also hypothesized that children's attentional accuracy would be greater if they have better language comprehension abilities and less day to day exposure to screens/media devices.

PARTICIPANTS

- Children were recruited from two different Active Learning Center Daycares in Lehigh County, Pennsylvania.

- Parents provided written consent prior to testing, and children gave their own assent on-site before testing.

- All children were pre-screened for any hearing problems, developmental delays, or sensory issues.

n	Age Range	Gender	Diversity
31	3 - 5 years	16 girls; 15 boys	3 primary races

- An additional 6 children were tested but not included in the analyses due to having autism spectrum disorders and sensitivity concerns (e.g., sounds).

STIMULI & PROCEDURE

- All children were individually tested in 2 computer games, and presentation order was counterbalanced.

SNOWFLAKE Matching Game (visual attention)

- Children viewed 1 version of visual stimuli (snowflake shapes) presented in randomized order across 4 difficult levels.

- Difficulty was defined by color similarity and duration of fall time.

  - **Level 1 (easiest)**: 6 different color stimuli; 5 second duration
  - **Level 2 (less easy)**: 6 different color stimuli; 1.5 second duration
  - **Level 3 (difficult)**: 6 same color stimuli; 5 second duration
  - **Level 4 (most difficult)**: 6 same color stimuli; 1.5 second duration
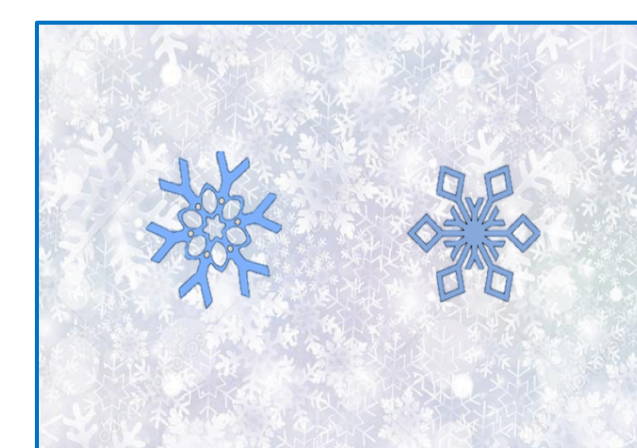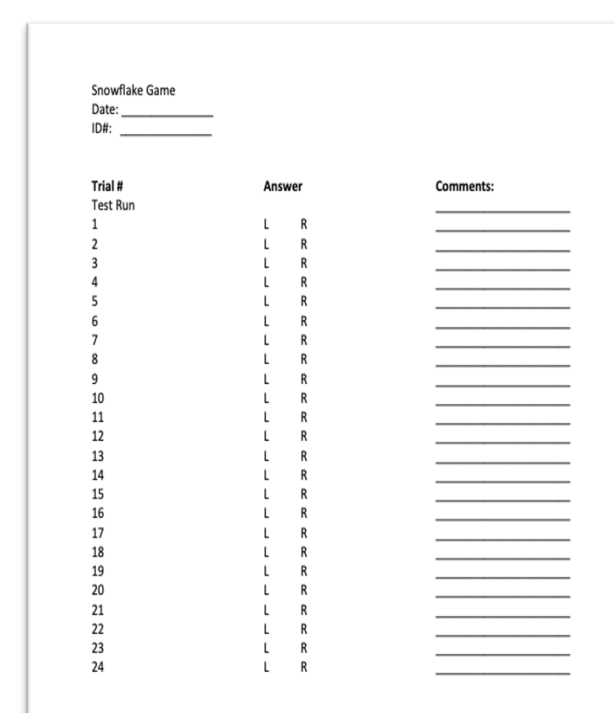
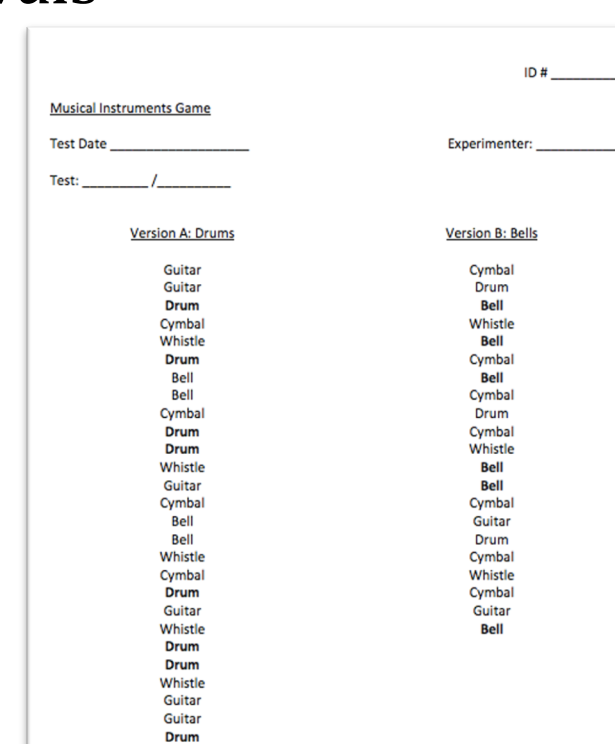Target Snowflake   Forced-Choice: Level 4

- First, children watched the target snowflake fall until it disappeared from the screen. Then in a forced-choice test, children were asked to use a magic wand to identify the target snowflake seen previously.

MUSIC Listening Game (auditory attention)

- Children heard 2 versions of auditory stimuli (musical instruments) presented in differing levels of difficulty.

- Difficulty was defined by the number of target sounds, number of distractor sounds, and the inter-stimulus-intervals (or pacing) of the sounds heard.

  - **Bell Game (easy)**: 6 target sounds + 15 distractors, presented with evenly paced intervals
  - **Drum Game (difficult)**: 8 target sounds + 19 distractors, presented with randomly paced intervals

Drum as Target Sound   Bells as Target Sound

- Pictures of the target sound remained on a computer screen the entire game, as a reminder of the auditory target.

- Children listened for the target sound, either bells or drums, depending on the version. They were asked to press a toy button every time they heard that target sound but not to press the toy button if they heard a different sound (distractor).

STIMULI & PROCEDURE

Parent Surveys

- Parents completed a survey to assess their child's demographic information, developmental delays, language comprehension skills, and screen time habits.
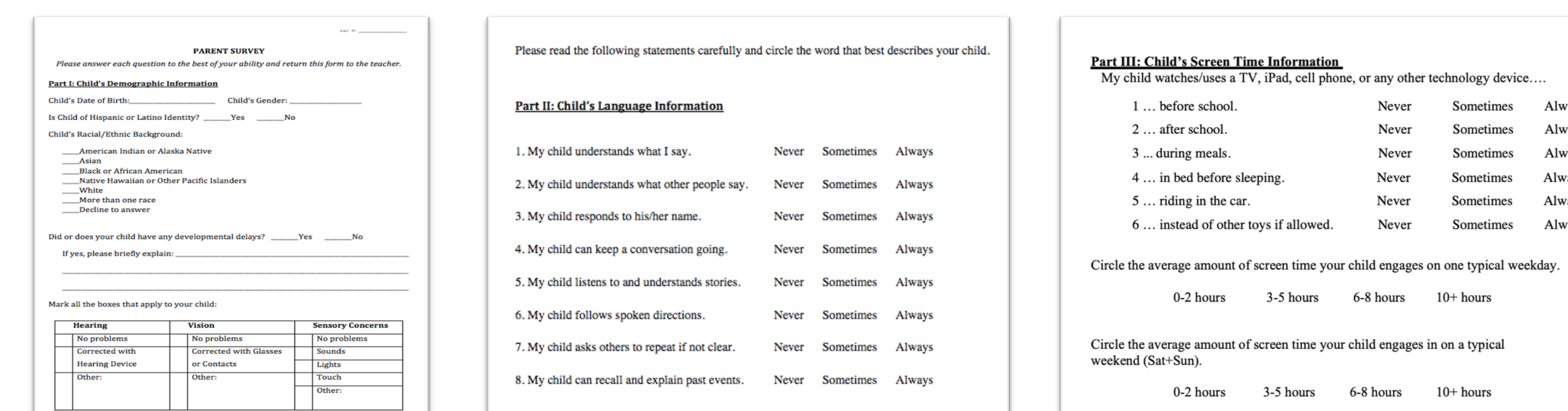

RESULTS

Overall Accuracy

- Children's performance was significantly correlated between the visual and auditory modalities, $r = +.52$, $p = .002$.

Visual Selective Sustained Attention Accuracy

- A repeated measures ANOVA revealed a significant main effect of difficulty, $F(1,24) = 2.95$, $p = .04$, $\eta^2 = .095$. Children were more accurate in the easiest visual level 1 ($M = .85$, $SE = .03$) than in the most difficult level 4 ($M = .78$, $SE = .03$), $t(30) = 2.83$, $p = .01$.
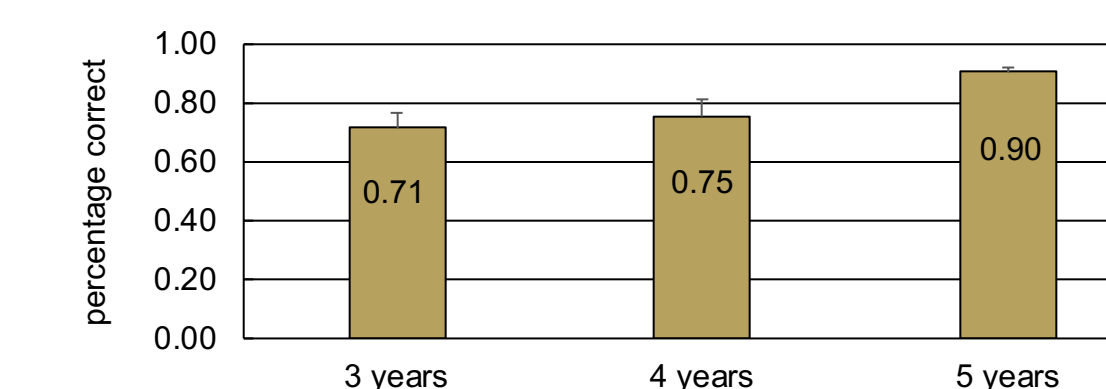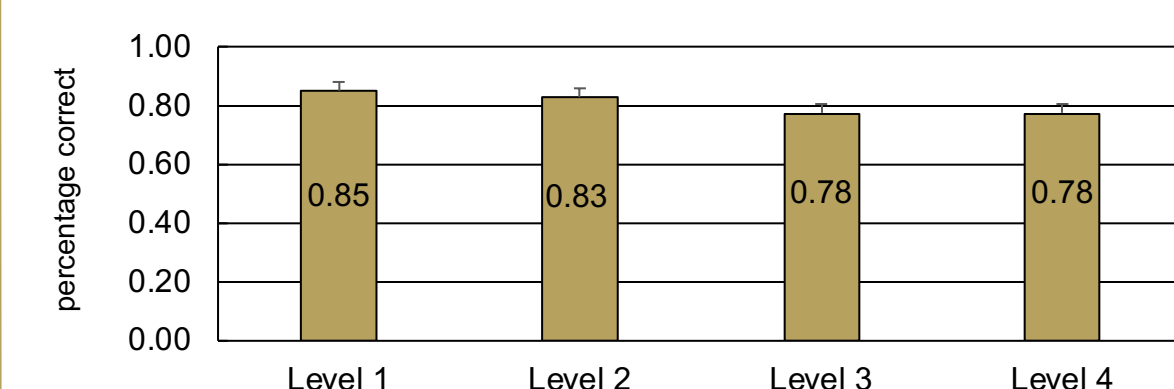
- A main effect of age was also found, $F(1,24) = 5.98$, $p = .01$, $\eta^2 = .299$, with older children performing better than younger children.

Auditory Selective Sustained Attention Accuracy

- Signal detection theory (d prime) was utilized to account for the number of hits, misses, and false alarms. If children hit the toy button the entire game, then that would mean they didn't detect the target sound, and their d prime would be 0. Therefore, the greater the d prime score, the better the detection accuracy.

- A repeated measures ANOVA revealed a significant main effect of task difficulty, $F(1,26) = 5.13$, $p = .03$, $\eta^2 = .165$. Children were significantly more accurate in the easy auditory version ($M = 1.84$, $SE = 0.22$) than in the difficult version ($M = 1.38$, $SE = 0.20$), $t(28) = 2.46$, $p = .02$.
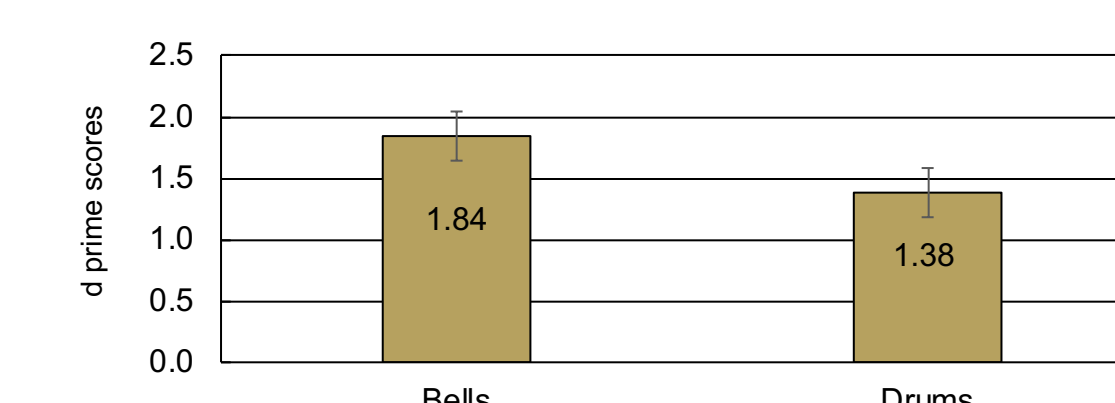
- Although there was no significant interaction between age and task difficulty, age was significantly correlated with children's performance on the difficult (drums) game, $r_s = .39$, $p = .04$, with 5-year-olds performing the best.

RESULTS

Language and Screen Time Survey Results

- Spearman correlations revealed two areas of language comprehension, responding to one's name, $r_s = +.32$, $p < .05$ and understanding spoken directions, $r_s = +.37$, $p < .03$, that were significantly correlated with auditory selective sustained attention, but not with visual selective sustained attention.

- Additionally, strong negative correlations were found between children's screen time use at meals and children's auditory attention, $r_s = -.38$, $p < .05$ and visual attention $r_s = -.48$, $p < .01$.

CONCLUSIONS

- There was a positive correlation between performance on the two modalities of selective sustained attention.

- As predicted, preschoolers were more accurate at detecting auditory and visual targets when the game was easier (bells or snow levels 1/2) than more difficult (drums or snow levels 3/4) suggesting young children's selective sustained attention is still developing and becoming more refined with respect to the number of attentional demands placed on them.

- Additionally, having better language comprehension skills was somewhat related to greater attentional accuracy for auditory attention. This result is supported by previous research showing that active imaginative play by making up stories with toys is important for practicing sustained attention in childhood (Christakis, Zimmerman, & Garrison, 2007).

- Finally, the current results showed that screen time during meals predicted poor sustained selective visual and auditory attention. Meals with others naturally promotes social communication exchanges. By tuning into a device, children tune out opportunities to interact and communicate.

- Future research should focus on selective sustained attention skills in children diagnosed with autism spectrum disorders to better understand the wide range of individual differences in attention skills.

REFERENCES

Betts, J., & Anderson, V. (2006). The development of sustained attention in children: The effect of age and task load. *Child Neuropsychology, 12,* 205-221.

Christakis, D. A., Zimmerman, F. J. & Garrison, M. M. (2007). Effect of block play on language acquisition and attention in toddlers. *Archives of Pediatric and Adolescent Medicine, 161 (10),* 967-971.

Godwin, K., Lomas, D., Koedinger, K., & Fisher, A. (2015). Monster mischief: Designing a video game to assess selective sustained attention. *International Journal of Gaming and Computer-Mediated Simulations, 7 (4),* 18-39.