Talking Shape: Parental Language With Electronic Versus Traditional Shape Sorters

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ABSTRACT— As the traditional toys of the past are quickly being replaced with electronically "enhanced" toys, it is important to understand how these changes impact parent–child interactions, especially in light of the evidence that the richness and variety of these interactions have long-term effects on diverse areas of cognition (Hart & Risley, 1995). Here, we compared the quantity and quality of the language children hear during play with either a *traditional* (nonelectronic) or an *electronic* shape sorter designed to teach children about geometric shapes. Spatial toys and spatial language, in particular, were explored since recent work has established that parents' use of spatial language links to children's short- and long-term performance on spatial tasks (Pruden, Levine, & Huttenlocher, 2011), and that spatial skills are relevant to success in learning mathematics and science (Newcombe, 2010). Traditional toys prompted more parental spatial language and more varied overall language than did electronic toys.

Simply walking down a toy aisle in a store or entering a child's playroom provides a clear illustration that many traditional toys (e.g., shape sorters, stacking blocks, mailbox toys, and even puzzles) are being reproduced in electronic formats. However, despite widespread adoption and use of these "modern" versions, it has not yet been fully established how the "enhancements" offered with electronic toys (e.g., sound effects, music) affect the nature of parent–child interactions during play. The limited research completed to date suggests that parent–child interactions with electronic toys differ from those with traditional toys in important ways. Play with electronic toys involves less pretense and elaboration and is mostly adult- rather than child-directed (Bergen, Hutchinson, Nolan, & Weber, 2009), possibly because parents are less responsive to children's attentional bids (Wooldridge & Shapka, 2012). Research also suggests that some digital material can be distracting. The buttons and e-games embedded in electronic versus standard books, for example, can usurp parent–child discussion and can decrease children's story comprehension (Parish-Morris, Mahajan, Hirsh-Pasek, Golinkoff, & Collins, 2013). Given that even simple "enhancements" such as pop-up features in standard paper books have the potential to distract from learning (Chiong & DeLoache, 2012; Tare, Chiong, Ganea, & DeLoache, 2010), the increased availability of additional features in electronic toys must be considered. These findings are worrisome in light of the research that suggests that the quality of parent–child interactions have long-term impacts in a variety of domains, including language (Hart & Risley, 1995), conceptual understanding (Fender & Crowley, 2007), numerical cognition (Gunderson & Levine, 2011), and spatial cognition (Pruden et al., 2011).

The importance of toy choice on one area of cognition, namely spatial cognition, is of particular interest for a number of reasons. First, spatial cognition is an important element in the development of mathematics and science skills (Newcombe & Frick, 2010; Wolfgang, Stannard, & Jones, 2001) with long-lasting implications (Wai, Lubinski, & Benbow, 2009). With our country's increasing focus on

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Science, Technology, Engineering, and Math (STEM; Office of the Press Secretary, 2010), it is significant that spatial cognition is affected by experience (Uttal et al., 2013). For example, puzzle play between the ages of 2 and 4 years predicts performance on a nonlinguistic spatial transformation task at 4.5 years (Levine, Ratliff, Huttenlocher, & Cannon, 2012) and preschoolers' puzzle skill correlates with performance on a range of spatial tests (Verdine, Troseth, Hodapp, & Dykens, 2008). One of very few randomized control trial studies has shown that experience with spatial toys (Legos®, Wikki Stix®, etc.) also improves mathematical and spatial skills in kindergarten and first grade (Grissmer et al., 2013). Performance on spatial assembly tasks (reproducing block structures from a model) among 3-year-olds predicts to spatial and mathematics skill at ages 4 and 5 (Farmer et al., 2013; Verdine, Golinkoff et al., 2014); unfortunately, performance already differs by socioeconomic status (SES) even at these early ages.

Second, spatial language appears to highlight relevant spatial information or illustrate spatial concepts and thus children may be disadvantaged if they do not hear spatial language. For example, the experimenter's use of relational spatial language (*top*, *middle*, and *bottom*) increases children's performance on a spatial task requiring children to locate a hidden card (Loewenstein & Gentner, 2005).

Finally, parents can play a major role in augmenting spatial skills in children. Recent work establishes that parents' use of spatial language, words such as *above* and *beside*, is associated not only with a child's use of spatial terms in those conversations, but also with gains in *nonverbal* spatial cognition across time (Pruden et al., 2011). Pruden et al. (2011) observed over 13.5 hr of parent–child dyadic interactions. They measured parents' spatial language as well as children's performance on tests of spatial cognition. The variation in parental spatial language production was wide with the number of spatial language tokens ranging from 5 to 525 ($M = 167.06$, $SD = 120.52$) and this variation was also evidenced in the child's spatial language production ranging from 4 to 191 ($M = 74.44$, $SD = 45.71$). Crucially, parental spatial language predicted child's spatial language as well as the child's performance on both concurrent and future tests of spatial cognition. Thus, early spatial play and hearing spatial language likely have significant impacts on children's problem solving and achievement.

Shape toys, in particular, are of interest because there is evidence that children's shape learning is an extended process (e.g., Satlow & Newcombe, 1998; Verdine, Lucca, Golinkoff, Newcombe, & Hirsh-Pasek, 2015) and these toys are specifically designed to promote geometric knowledge and spatial cognition in young learners by inviting comparisons between shapes. Shape sorters can also build geometric knowledge through adults' use of spatial language (e.g., triangle, sides, etc.) during joint play. One way to understand the influence of toy choice on behavior is by investigating the spatial words children hear when playing with a shape sorter.

The current study capitalizes on new developments in "educational" electronic toys and evaluates whether the proliferation of these toys promotes the use of more parental spatial language than old-fashioned, silent toys. While some research has shown that parent–child interaction can suffer with electronic toys (Wooldridge & Shapka, 2012), this article comparing interactions around traditional and electronic shape sorters—toys that require children to insert shapes into matching openings—is one of the first studies to ask whether these two types of toys provide not only differing opportunities for language development in general, but also spatial language in particular.

Here, we investigate two specific empirical questions. First, how does quantity and quality of the language children hear—both produced by a parent and produced by a toy—compare between toy types? Second, does parents' use of *spatial* language differ when playing with electronic versus traditional shape toys? We hypothesize that the language children hear when playing with a traditional shape sorter will be of higher quality (i.e., more varied), and contain a higher quantity of spatial language when compared with interactions around its electronic counterpart. We expect that parent–child play with electronic shape sorters that provide language and sounds on their own may distract the child and parent from the task of shape sorting, possibly reducing overall language production by the parent and impacting spatial language production specifically. If these hypothesis are supported, it will suggest that play with electronic shape sorters affords different learning experiences than play with traditional shape sorters.

METHODS

Participants

The 24 parent–child dyads (child age $M = 24$ months; range = 20 months, 2 days – 27 months, 21 days; $SD =$ 70.97 days; 17 females) were predominantly white, middle-class, and monolingual. Each of the two toy conditions contained 12 children. The research was reviewed by the institutional review board of a large university in the mid-Atlantic region of the United States and all researchers completed human subjects training. Families were recruited by telephone using a database of birth records for a single visit to the lab. All children received a certificate of appreciation; no other compensation was given.

Procedure

In a between-subjects design, dyads were randomly assigned to a condition in which they played in a university laboratory with one of two shape sorting toys (Table 1) for an average of 7 min. Parents were asked to play with their assigned toy as they would at home but not given any further instruction. In the *traditional toy* condition, the dyad was given a nonelectronic shape sorter. It had five blocks (approximately 2.5 in. in height by 2 in. in width; circle, square, triangle, star, and plus symbol) to insert into a plastic bucket with holes matching the shapes. The *electronic toy* condition also had five blocks (approximately 3 in.; circle, square, triangle, star, and heart) and a series of holes to put them in, but differed from the traditional toy in that it also had headlights that lit up, three musical piano keys, and three colorful buttons which said *stop*, *go*, and *slow down* when pushed. A plastic dog "driver" would sway from side-to-side when the toy was moved. The toy would also respond to children inserting shapes by saying the name of the shape or playing sounds. See Table 1 under the Toy Speech heading for an example of some of the things the electronic toy said. Both toys were chosen because the primary "activity" was a five-shape, shape-sorting task.[1]

Some participants refused to continue in the play sessions. To ensure that dropout rate did not influence the results, participants with at least 6.5 min of codeable video were retained. Session length for the final sample was not significantly different between conditions and a similar number of participants was dropped for inadequate session length (traditional = 2; electronic = 3). The minimum timeframe of 6.5 min was instituted to ensure an adequate language sample including time after some of the novelty of the toy dissipated. Because of slight variances in session length, unless otherwise noted, speech *rate* is reported (i.e., words per minute; the overall number of words of a specific type divided by session duration for that participant).

Dyads were videotaped and all parental and toy utterances transcribed. The videos for 17 children were retranscribed to assess transcription reliability. The correlation between transcribers for overall number of words was 0.96 which was sufficiently high to proceed with further coding. Overall *quantity* of language production was assessed by tracking the rate of words used per minute (both general language and spatial language specifically) in three "talker" categories: *parent* words, *toy* words (language produced by the toy in the electronic toy condition, see Table 1 for transcript), and *total* words (i.e., all language heard regardless of source; equivalent to parent words in the traditional toy condition). Examining the language from parents alone and the parent plus the toy allowed us to compare conditions for parent language production and also account for the language produced by the toy.

To investigate the *quality* of the language children heard in both conditions, we used three measures. First, the rate of unique words produced was tracked by calculating the number of unique words within a transcription using a Microsoft Word macro. Language *quality* was measured using rate of unique words because of the importance of varied language for children's vocabulary development (Hart & Risley, 1995; Rowe, 2012). Second, spatial language production was identified using a previously developed coding scheme (Cannon & Levine, 2007). We coded for spatial language production for a number of subcategories (i.e., shape names; place referentials [e.g., *here* and *there*]; locations and direction; etc.), but preliminary analyses showed no effect of condition on any specific category so only overall spatial language production was included in further analyses. Using these data, we calculated a proportion of spatial terms relative to the overall number of words produced by the parent, the toy, and combined. The correlation between transcribers for the number of spatial terms was 0.95. A third indicator of quality of speech was the focus, or the content, of the speech. We classified the focus of each utterance as directly related to the shape-sorting functions of the toy (shape-related; e.g., "Look! A circle" or "Put the shape in there."), toy-related but not focused on the shape sorting functions (toy-related; e.g., "Look! A bus!" or "Where are the wheels?"), or off-topic (e.g., "What do you want for lunch?"). We then calculated the proportion of each kind of utterance in parents' speech.

RESULTS

Preliminary analyses found no impact of child gender so this factor was dropped from further analyses. A multivariate analysis of variance (ANOVA) with condition and each of the independent variables was used to examine differences between the quantity and quality of the language children hear comparing the toy types (see Table 2 and Figures 1 and 2). There was a significant effect of condition on the quantity of the language children hear: the rate of *total* (parent + toy) words was higher in the electronic toy condition ($M = 91.20$ words) than the traditional toy condition ($M = 70.53$) (see Figure 1). However, there was no effect of condition on overall rate of *parent* words alone (electronic $M = 55.82$; traditional $M = 70.53$) and, in fact, the trend was for less overall parental talk in the electronic toy condition. Thus, the condition effect indicating a higher quantity of total words in the electronic toy condition was not a result of more parent speech, but rather attributable to the additional toy speech.

Next, we examined the *quality* of the speech (see Figure 2). There was no effect of condition on the rate of unique *parent* words (electronic $M = 16.45$; traditional $M = 18.23$) or unique *total* words (electronic $M = 20.98$; traditional $M = 18.23$), but children in the traditional toy condition did hear a higher proportion of unique words when considering both *total* words (27.2% vs. 23.1%) and *parent* words only (27.2% vs. 18.0%). This pattern is consistent with the electronic toy contributing a large quantity of mostly repetitive language (see Figure 2, panel A).

Table 1
Examples of Speech (Representative Partial Transcripts) From the Parent and Toy in the Traditional and Electronic Toy Conditions and Pictures of the Toys Used

Traditional toy

Parent speech:
Want to try to put them in here? That's an orange star. Where does it go? No, it doesn't fit there. Do you want to try that one? Good boy. The green square? Where does the green square go? What does it look like? It doesn't go in the circle. That's a square. Do you see a square? Do you see a square? Good boy. The red triangle? No, try again. No? We tried it—didn't we put something there already? What? Yes, you see that, that's ok. Here, let's play here. No, no here. That's not the toy, this is the toy. Good boy. Yes, that's where the triangle goes! Move it around? What? You want to put it in there? Try again. No, different one. No, that's where the triangle went. Remember we tried to put the triangle there? Here, look what's this one? What's that one? Did it fit? Good boy! Yep, let's try that one again. Turn it around. You got to move it.

Electronic toy

Parent speech:
Do you want to walk around with it? Want to walk that way? Do you want to press some buttons on it? Does it have any buttons to press? That's right. Okay, it's on now. What's in there, *name*? Is that a peephole? Come here. Let me see that toy. Bring it over here. No, you're very interested in that peephole? Can I see the toy, *name*? Wow. What is in here? What is that? There's stuff in there? Wow. Here, push this button. Push that button again. Push this button. Push this button. All right! You got them all out! Do you want to see something fun? Where does the circle go? Oh, can you try again? Good job! Where does that one go? Does it fit in there? Does it go in another one? Can you tilt it? Do you want to try the other one? Yeah, let's try that one. Oh, so close! Keep trying. You did it! Push. Push it in. Want to push it all the way in? Yay!

Toy speech:
Let's go on a learning journey. Round and round the little wheels must go. The van is driving [new button press interrupts toy speech]. Let's go on a learning journey. Let's go on a learning journey. Drive safely. Remember yellow. Stop, look, and listen before you cross the street. Round and round the little wheels must go. The van is driving faster. The light turns red the car must stop, screech goes the tires. Where is the green piano key? Drive safely. Remember to buckle up. Stop, look, and listen before you cross the street. Round and round the little wheels must go. The van is driving faster. The light turns red the car must stop, screech goes the tires. Byebye. Byebye. Let's go on a learning journey. Round and round the little wheels must go. The van is driving faster. The light turns red the car must stop, screech goes the tires. Drive safely. Drive safely. Remember to buckle up.

Table 2
Descriptive Statistics for the Language Use Variables by Speaker and Overall With Analysis of Variance (ANOVA) Results Comparing the Traditional and Electronic Toy Conditions

	Traditional toy		*Electronic toy*		*Comparison*		
Study factors	*M*	*SD*	*M*	*SD*	*F(1,22)*	*p*	η_p^2
Age (days)	734.83	69.43	715.58	74.23	0.43	.52	.02
Session length (min)	6.99	0.09	7.16	0.28	3.69	.07	.14
Parent words							
Overall word rate	70.53	28.92	55.82	15.45	2.41	.14	.10
Unique word rate	18.23	5.79	16.45	3.92	0.78	.38	.03
Spatial word rate	10.63	3.64	7.56	2.55	5.72	**.03**	.21
% unique words	27.20	6.06	18.00	2.60	23.61	**<.001**	.52
% spatial words	15.78	4.20	8.18	2.41	29.59	**<.001**	.57
Content/focus							
% shape	83.56	11.14	69.81	12.51	7.79†	**.01**	.27
% toy (not-shape)	3.73	4.75	23.42	12.09	27.32†	**<.001**	.57
% off-topic	12.70	8.85	6.77	5.13	3.77†	**.07**	.15
Toy words							
Overall word rate	—	—	35.37	7.79	—	—	—
Unique word rate	—	—	7.30	1.38	—	—	—
Spatial word rate	—	—	1.44	0.75	—	—	—
% Unique words	—	—	7.30	1.38	—	—	—
% Spatial words	—	—	1.44	0.75	—	—	—
Total words (parent + toy)							
Overall word rate	70.53	28.92	91.20	16.04	4.69	**.04**	.18
Unique word rate	18.23	5.79	20.98	3.76	1.93	.18	.08
Spatial word rate	10.63	3.64	8.88	2.34	1.56	.22	.07
% unique words	27.20	6.06	23.06	1.69	5.18	**.03**	.19
% spatial words	15.78	4.20	9.79	2.12	19.48	**<.001**	.47

Note: Speech *rate* is reported in words per minute (the overall number of words of a specific type divided by session duration for that participant). *Content/focus* is reported in proportion of parent speech that was focused on: the shape toy aspect of either toy, the toy features or functions not related to shape, and off-topic language. *p*-values are bolded for rows in which there was a significant difference between the traditional and electronic toy conditions.
†Note that the video file for one child was corrupt and not used for this secondary analysis of the focus of parents' speech. For this ANOVA, the degrees of freedom differed: *F*(1,21).

Our second question was whether the type of toy specifically impacted the amount of spatial language produced by parents as reflected by the proportion of their speech that contained spatial terms. Less of *parents*' speech related to space when playing with the electronic toy relative to the traditional toy (electronic $M = 8.2\%$; traditional $M = 15.8\%$). The difference in parent spatial speech reflected an overall decrease in spatial language for the electronic toy condition. When the toy language production was included and *total* language was investigated, children in the electronic condition still heard less spatial language as a percentage of the total words spoken (electronic $M = 9.8\%$; traditional $M = 15.8\%$; see Figure 2, panel B).

Finally, we wanted to examine the *content*, or focus, of the language produced by parents to determine how the type of toy may have impacted what the parents discussed in the play session above and beyond the use of spatial terms specifically. The decrease in spatial terms between conditions could be explained by a general decrease in the amount of speech that was focused on the toy, or alternatively, perhaps the parents spoke just as much about the toy but offloaded the production of language relating to the shape-sorting functions (shape-related utterances) to the toy. There was a significant effect of condition on the proportion of utterances that were shape-related (see Figure 2, panel C). Parents spoke more about the shape-related functions of the toy in the traditional condition than in the electronic condition (electronic $M = 69.1\%$; traditional $M = 83.6\%$). There was also a significant effect of condition on the proportion of utterances that were toy-related (but not relating to the shapes or shape sorting functions) but this followed an opposite pattern with more toy-related speech in the electronic condition (electronic $M = 23.42\%$; traditional $M = 3.73\%$). Finally, there was a trend for more off-topic speech in the traditional toy condition but this effect did not reach significance (electronic $M = 6.8\%$; traditional $M = 12.7\%$).

DISCUSSION

Our results demonstrate that parents spoke with similar frequency when playing with electronic and traditional toys but that the quality of their language differed in a number of ways. When the utterances of the toy were added

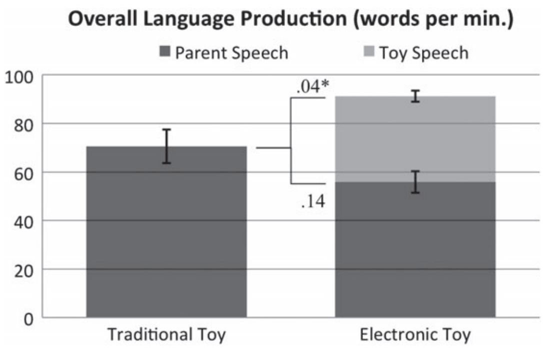

Fig. 1. Quantity measure of overall language production by the parent and by the toy for the traditional and electronic toy conditions.
Note: Brackets indicate the comparisons made for each graph with accompanying *p*-values for those comparisons. Error bars represent standard error of the mean. For the electronic toy condition, error bars at the top are for the combined total of parent and toy speech and error bars in the middle are for parent speech only.
*Comparison is statistically significant ($p < .05$).

into the calculation in the electronic condition, children heard more language overall; however, it was of lower quality as reflected by a decreased proportion of unique language offered. Thus, whereas parents in the electronic sorter condition said things such as “Push this button” and “Push that button again,” parents with traditional toys said things such as “The green square?” and “Where does the green square go? What does it look like?” Second, parents used less spatial language when playing with the electronic shape sorter and this effect was due to an overall decrease in speech about the intended shape-related functions of the toy and in increase in speech about the features of the toy itself. These results mirror those found by Parish-Morris et al. (2013), who reported that parents produced many more directive utterances than utterances about story content with electronic console books as opposed to traditional books. These results suggest that technologically enhanced toys, in some cases, impede high-quality language use with young children. This finding is troublesome in light of the many studies showing that early language exposure is important. The quantity and quality of language addressed to children is a key predictor of children’s later vocabulary and school success (Hart & Risley, 1995; Rowe, 2012) and spatial language has important impacts on spatial skills (Gentner, Özyurek, Gurcanli, & Goldin-Meadow, 2013; Pruden et al., 2011).

Given our results and those from previous research showing that play with electronic toys relative to play with traditional toys is associated with decreased pretense and elaboration (Bergen et al., 2009), less encouragement and engagement (Wooldridge & Shapka, 2012), and more distraction (Chiong & DeLoache, 2012; Tare et al., 2010), it is imperative to ask “Why?” Why might these studies find

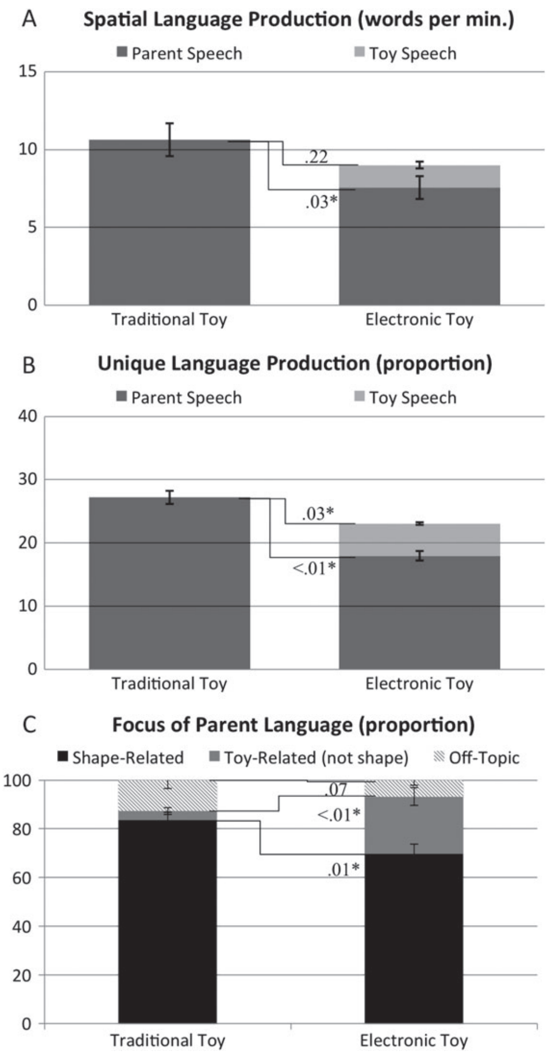

Fig. 2. Quality measures of language production by the parent and toy for the traditional and electronic toy conditions including: spatial language production (panel A); proportion of unique language (panel B); and the focus of parent language production (panel C).
Note: Brackets indicate the comparisons made for each graph with accompanying *p*-values for those comparisons. Error bars represent standard error of the mean. For panels A and B, the error bars at the top of the electronic toy condition are for the combined total of parent and toy speech and error bars in the middle are for parent speech only. For panel C, the error bars are for parent speech only.
*Comparison is statistically significant ($p < .05$).

that traditional toys support higher quality parent–child interaction? The current study suggests that parents may take a back seat to electronic toys and, as a result, produce less on-topic language (in this case, spatial language focused on sorting shapes) and focus more on aspects of the toys that are not related to their main functions. Indeed, in this study, the parents in the electronic toy condition talked more about the nonshape features of the toy than those playing with the traditional version. Thus, the nonshape features of the toy may actually distract from the learning goal in mind.

It is important to examine how the nature of the play experience itself may differ when playing with different types of toys. Play with an electronic toy may tend to revolve more around making it produce its programmed responses or exploring additional features than on the stated learning goal. The study on electronic console books (Parish-Morris et al., 2013) which found that the electronic features distracted 3-year-olds from the task at hand supports this conclusion. If electronic toys are associated with differences in parent–child interaction, this is a key discovery as their use may hinder children's learning. Evidence indicates that guided play, in which an adult or more capable play partner follows a child's lead while supporting the learning of new material, results in increased learning of spatial concepts when compared to both didactic (direct instruction) and free play (not goal-directed) contexts (Fisher, Hirsh-Pasek, Newcombe, & Golinkoff, 2013). One possible reason is that in guided play situations, parents and children are social partners and parents' language is contingent and responsive to children's interests. It is an open question as to how the type of toy children play with impacts the play style of their parent or play partner, but it is clear from this and other work that the design of toys can have a serious impact on how they are used and what language they elicit.

Research shows that the play situation matters for both parent language and learning (Ferrara, Hirsh-Pasek, Newcombe, Golinkoff, & Lam, 2011). In a direct comparison of the amount of parental spatial talk to 3- to 4.5-year-olds across three play contexts (free play, guided play, and direct instruction), guided play resulted in increased spatial word production by the parents compared to the other two conditions. Crucially, in guided play, the parent *follows* the child's lead, targeting aspects of the play situation the child wants to learn more about. It appears that this purposeful and guided interaction is crucial as these same benefits were not gained in the free play setting in which parents were also interactive. It is in these types of guided interactions that an electronic toy cannot compete. Simply put, current electronic toys cannot react to a child in the same way an engaged adult can. Toys cannot follow a child's gaze, for example, a particularly powerful cue that has been shown to promote word learning in toddlers (Dunham, Dunham, & Curwin, 1993). An electronic toy is agnostic as to whether a child is holding a circle when it prompts the child to insert a square. Further, language directed to a child, rather than overheard by a child, predicts later vocabulary (Shneidman, Arroyo, Levine, & Goldin-Meadow, 2013). In this regard, parents are almost certainly superior to interactive toys for learning because their language reflects what a child looks at, touches, and moves toward. As electronic toys become more sensitive and contingent to children's prompts, it will be crucial to examine how this increase in contingency impacts learning.

The current study suggests a number of new areas of investigation. Perhaps most crucially, it would be important to replicate and extend this work with a larger and more diverse sample. As the quality of children's input varies greatly and is impacted by SES, determining whether these effects are similar across different demographic groups is an area prime for study. Another outstanding empirical question is how electronic toys impact parent–child interactions over longer time periods. Perhaps over a longer session parents would decrease their reliance on the electronic toy to guide the interaction. Alternatively, one can imagine as the play session increases in length, the difference in linguistic input may be cumulative. One potential limitation of this study is that the data cannot speak to the experience that children have with these toys when alone. Perhaps electronic toys promote longer engagement with the educational function of the toy when a child is left alone. Furthermore, while electronic toys cannot provide the diverse and responsive language of a human, in the absence of a play partner perhaps hearing *some* language is better than the silence of a traditional toy.

At this time, no electronic toys offer the same level of contingency and responsiveness as that offered by a real-life play companion. Even apps on tablets and smartphones, while offering more contingency than electronic toys, are not equivalent to true human interaction. Yet the benefits and drawbacks of including electronic aspects to a toy will likely depend on the design, what is being taught, and the context in which it is being used. At present, some electronic toys "take over" the presentation of new information and largely direct the child's experience. This work suggests that something as simple as the type of toy may impact the quality of a parent–child interaction. Future work should investigate how different types of electronic media (toys, apps, television, etc.) impact parent language.

There are several strengths of this study. The design mirrored an everyday play activity as much as is possible in a controlled laboratory setting. No directions were given to parents beyond asking them to play as they would at home and parents were not aware of our focus on spatial language. Finally, the dyads played without the presence of an experimenter. The electronic toy used here decreased the language quality by repeating the same phrases over and over and reduced the proportion of unique language children heard. This lack of variability is significant given what is known about the importance of rich and varied language for children's development. Unfortunately, parents without a 4-year college degree are more likely to purchase electronic media and believe that it has a positive impact on learning (Hart Research Associates, 2009). Given that children from lower SES households generally hear poorer quality language, the present findings suggest that underprivileged parents who are more likely to turn to electronic toys may be exacerbating the problem by also providing toys that elicit lower quality language. Coupled with the finding that parents often overestimate what their infants learn from electronic media (DeLoache et al., 2010), even the most engaged and well-intentioned parents may choose primarily electronic toys and inadvertently provide less enriched language to their toddlers.

This study suggests that traditional toys may promote a greater amount of and more varied spatial talk from parents as well as more on-topic speech related to the shape sorting activity compared to those playing with an electronic version of the same toy. Given the clear links between spatial language and spatial skills (Pruden et al., 2011) and early spatial skills and later mathematical outcomes (Verdine, Irwin, Golinkoff, & Hirsh-Pasek, 2014), this study suggests that traditional toys hold more promise than electronic toys for the development of spatial cognition and improvement of school-readiness. In some cases, electronically "enhanced" toys may impede rather than promote the high-quality interactions that foster learning.

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NOTE

1 In surveying the market to select a toy for this study, all of the widely available electronic sorters we identified were modeled after another entity (e.g., vehicles, buildings, animals, etc.) and included "enhancements" that were unrelated to shapes or the sorting task (e.g., piano keys, songs unrelated to shapes, etc.). These properties appear to be nearly ubiquitous for this category of toys and largely unavoidable for the parents buying them.

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