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# Teachers' Interactions with a Young Child with: Comparing iPad and non-iPad Use

## Abstract

*The purpose of this study was investigating teachers' interaction with a young child with ASD when they were using iPad to support language and communication skills development. A case study method was applied. Business-as-usual classroom interaction was analyzed. Utterances were divided into two conditions (iPad-use and non-iPad-use) to compare effectiveness on supporting the child's engagement in teacher-child interaction. In addition, interviews with teachers were conducted to collect more information about their own perspectives regarding iPad use with the student with ASD. Results of the study indicate that child-teacher joint attention and teachers' verbal assistance happened more frequently when iPad was not used. In addition, surprisingly, teachers put a minor emphasis on iPad use for targeted instruction for language and communication skills development, different from their initial claim. These findings suggest that more professional development for teachers' iPad use in language and communication skills development should be provided.*

*Keywords: ASD, iPad, Teachers' Interaction, Language Development.*

## Introduction

Technology has changed the way that children learn; many schools are using technology as a teaching tool to develop positive skills and interactions. Student with Autism Spectrum Disorder (ASD), too, can benefit from using technology to learn new skills or behaviors. iPad use, specifically, can make the education process efficient (Dhir, Buragga, & Boreqqah, 2013). The roles of classroom teachers, when it comes to utilizing technology tools with students with ASD, however, has yet to be discovered. In the current study, therefore, we emphasize teachers' language use, analyzing whether or not (and how) the child with ASD verbally interacted with the teacher. In addition, we analyze whether or not the joint attention between the child and the teacher was established, which is an important aspect of language for communication pragmatics. More specifically, we describe how teachers' language use is associated with iPad use when they work with the child with ASD in one-to-one sessions.

## Conceptual Framework and Relevant Research

*Social Interaction using technology support with children with ASD in classroom*

Both the basic learning theory and curriculum adaptation theory provide an aspect of theoretical foundation for this study (Fernández-López, Rodríguez-Fórtiz, Rodríguez-Almendros, & Martínez-Segura, 2013). Successful learning requires well-designed and well-managed instruction, as well as the engagement of the students. Technology tools with well-designed and well-managed instructions can enhance engagement of all children because of their adaptability that allows differentiation to meet individual needs and abilities. Furthermore, augmentative and multimodal aspects of available technology tools such as iPads and tablet PCs can support communication needs, which is significant for children with ASD. In particular, iPad-enhanced augmentative and alternative communication (AAC) systems such as the

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Picture Exchange Communication System (PECS; Frost & Bondy, 2002) and Speech Generating Devices (SGD; American Speech-Language-Hearing Association [ASHA], 1997) can facilitate independent communication of children with ASD in learning-teaching contexts.

Sociocultural learning theory (e.g., Vygotsky, 1978) emphasizes social activity as an important vehicle for learning, which becomes the most important conceptual foundation for this study. According to Vygotsky (1978), interactions between a learner and the more capable other(s) in the zone of proximal development make learning happen. A school classroom is a main context under which children develop social relationships with their teachers and peers. In order to develop high quality classroom achievement, teachers should focus on the way they interact with children (Burchinal, Vandergrift, Pianta, & Mashburn, 2010; Howes et al., 2008). Specifically, when teachers are responsive and sensitive to children's needs, they can help children to perform well on social skills, academic skills and language skills (Mashburn et al., 2008; Prescott, Jones, & Kritchevsky, 1972). It is also a primary in providing opportunities for children to experience a sense of belonging, which is a main element in emotional and physical health (Madill, Gest, & Rodkin, 2014). Children achieve high intrinsic motivation for learning when they feel they are connected to their educators and classmates (Furrer & Skinner, 2003). Teacher-child interaction gives students a sense of security, when a teacher puts in effort and genuine interest in helping a child if he/she is struggling (Pianta, 2001), and engages children in activities (Myers & Pianta, 2008). Joint attention is an important requisite for learning-teaching interactions and for many aspects of human development (Moore & Dunham, 1995). Joint attention in interactions between a child with ASD and the teacher becomes one of many target skills addressed in educational settings, because joint attention is one of the main challenges of ASD (Bhat, Galloway, & Landa, 2010; Bruinsma, Koegel, & Koegel, 2004). As tablet devices like the iPad can increase general attention and motivation and can decrease challenging behaviors (Goldsmith & LeBlanc, 2004), they can be useful tools to develop joint attention between child with ASD and the teacher. While a few re-

searchers (e.g., Dykstra, 2014; Peck, 1985) did studies about teachers' interactions with children without ASD, there are a limited number of studies about teachers' interactions with children with ASD.

#### *Relevant Research about iPad Use for Language Development of Children with ASD*

Impairment in language and communication is one of the main diagnostic criteria for ASD (Goodman & Scott, 2012; Kwok, Brown, Smyth, & Cardy, 2015; Paul, Campbell, Gilbert, & Tsiouri, 2013; Talay-Ongan & Wood, 2000). In early years of their life, before schooling begins, children with ASD get lower scores on receptive language (Chawarska, Klin, Paul, & Volkmar, 2007). The majority of children with ASD who experience early expressive language delays exhibit some remaining problems by the age of five years (Howlin, Mawhood, & Rutter, 2000). While children without ASD show normal growth in social peer communication during their school years, children with ASD exhibit weakness in social communication (Murdock, Ganz, & Crittendon, 2011). During their school years, for instance, children with ASD show weakness in understanding language, attention shifting, eye contact initiating and responding to peers, which affect their social interaction with peers (Perryman et al., 2013). Thus, impairment in receptive and expressive language is a hallmark feature of children with ASD (Kwok et al., 2015; Paul et al., 2013).

While studies about teachers' interactions with children with ASD focusing on receptive and expressive language are sparse, Perryman and her colleagues' (2013) study about parents' interactions with children with ASD can support an argument that teachers' interactions make differences. Perryman and her colleagues examined the relationship between parental follow-in comments and the receptive language level for 37 children with ASD (mean age = 21 months; range from 15 to 24 months) who exhibited difficulties in receptive language. The researchers measured students' receptive language before and after their parents provided follow-in comments. They found that parents' follow-in comments helped children significantly in early receptive language growth.

The Apple iPad has been a well-known technological tool for children with

ASD, specifically for decreasing problematic behaviors during instruction and for increasing academic engagement (Neely, Rispoli, Camargo, Davis, & Boles, 2013), increasing communication behaviors (Flores et al, 2012), supporting numeracy skills development (Jowett, Moore, & Anderson, 2012) and increasing compliment behaviors (Macpherson, Charlop, & Miltenberger, 2014). In terms of language and communication of children with ASD, the iPad was found to be an effective tool to improve the expressive language ASD (Perryman et al., 2013; Cardon, 2012) and to increase authentic dialogue in play with peers (Murdock et al, 2013). However, there are always risk factors in language and communication of children with ASD (Howlin et al., 2000). These difficulties include behavioral issues, attentional issues (Stevenson, Richman, & Graham, 1985) and cognitive and academic delays (Urwin, Cook, & Kelly, 1988).

In sum, the research on effective language development support for children with ASD has favored the use of iPads. This research has been advancing, as new studies have started focusing on nuanced within-differences (e.g., comparing different design elements or displays of different iPad applications) going beyond between-differences (e.g., comparing iPads and paper-based picture-card systems). We still found the lack of literature about classroom teachers' interactions with children with ASD. Studies frequently used an experimental design that did not provide detailed microanalysis of interactions among teachers and children. Moreover, the literature body has focused only on children's language use, while the children's teachers have potentially affected children's language use. Thus, we do not have enough information on how teachers use their language with children with ASD, specifically during iPad use. We need more information about how teachers use language with their students to provide better guidance to teachers and teacher educators.

## Methods

The current study investigated utterances of one child with ASD and her two teachers. While it is a single case study, the microanalysis with an utterance as the unit of analysis (instead of an individual child as the unit of analysis) can increase the power. However, any attempts to generalize the

results of the current study need caution. The current study is guided by the following research questions.

1. Does joint attention happen more frequently in one single case study when the iPad is used than when the iPad is not used during one-to-one sessions between the teacher and the child with ASD?
2. Does verbal assistance from the teachers happen more frequently in one single case study when the iPad is used than when the iPad is not used during one-to-one sessions between the teacher and the child with ASD?
3. What type of verbal assistance is associated with iPad use during one-to-one sessions in one single case study between the teacher and the child with an ASD?
4. Does one teacher use the iPad with the child with ASD more frequently than the other teacher in one single case study?

## Participants

The participants were a 49-month-old child called Kayla (pseudonym, all participants' names and the school's name are pseudonyms henceforth) and her two teachers Ms. Oakley and Ms. Taylor. We obtained the consent of Kayla's caregiver and two teachers for the research participation. The research participants and the first author had discussed the research project in detail as well as their rights to discontinue the research participation and the researchers' responsibilities to protect the research participants' anonymity and confidentiality. Kayla was diagnosed with autism spectrum disorder. Kayla attended a developmental preschool called Learning Tree. She was selected as the research participant because she was the only child whose parent gave Learning Tree permission for research activity involvement. Kayla was fairly compliant with classroom directions and participated in classroom activities such as listening to read-alouds, sing along, language development activities, arts and crafts, learning area play, and physical activities. According to Ms. Oakley and Ms. Taylor's description of Kayla, however, she could be easily distracted from one-to-one interac-

tions between she and the teacher. Ms. Oakley stated:

*“Have to do a lot of prompting. A cow says, a cow says, a cow says, and then she will get it. She push push pushes... she likes very fast pace... do this, do this, what do you do with this, how do you do this, ... for her to go. Cause if we stop, we will lose her.”*

Ms. Oakley and Ms. Taylor reported that Kayla's receptive language is better than expressive language. Based upon the results of Preschool Language Scale-5th edition (PLS-5; Zimmerman, Steiner, & Pond, 2011), her Auditory Comprehension score was 77 (SS), which is higher than the mean standard score of children with ASD (SS=67) from Zimmerman et al's study (2002) on PLS-4. On the other hand, her Expressive Communication score was 60 (SS), which is lower than the mean standard score of children with ASD (SS=66).

Ms. Oakley had a bachelor's degree in special education with five years of teaching experience in different settings for children with disabilities. Ms. Taylor was working on her bachelor's degree in special education at a local university. Ms. Taylor had two years of teaching experience with children with ASD.

#### *Setting and Context*

This study was conducted at a developmental preschool for children with a wide variety of disabilities in the United States, called Learning Tree. Although typically-developing children (without known disabilities) could be enrolled when space was available, according to the policy of Learning Tree, all enrolled children including Kayla had a wide variety of disabilities. Therefore, the setting operated as a special education school rather than an inclusion setting. The ratio of teachers to children was 1-to-1. In addition, a physical therapist, an occupational therapist, and/or a speech language pathologist regularly visited their classrooms to work with the teacher and specific children. Learning Tree had various learning areas to encourage children's play and social interaction. These learning areas were designed to facilitate individual activities for music, math, art, language development, and physical activities.

Kayla's teachers often used paper-picture cards to increase interactions with Kayla. These cards displayed various pic-

tures of animals, foods, and Learning Tree teaching staff. Each picture card had one specific object on as Kayla's speech prompt. The teachers spoke a prompt on each picture card such as “what is this?”, “who is this?”, or “what does this say?” When Kayla's teachers were interacting with her via the picture cards, they kept the records of Kayla's responses to indicate whether or not they were accurate and on target. For instance, when Ms. Taylor asked Kayla, “what is this?”, referring to the picture of a monkey on one of the picture cards, the target answer was monkey. If Kayla responded with the sound a monkey makes as “moo”, Kayla did not earn the point.

Each teacher in Learning Tree was given an iPad (4<sup>th</sup> generation Wi-Fi only model with 16GB flash memory storage); there was no particular training or policy regarding how the teachers used the iPads with the children. The teachers made their own decisions when or how to use iPads; there was no particular applications recommended by the school administration. The administrators mentioned that Learning Tree used iPad as a language development tool. Each teacher's iPad had different iPad applications (apps, henceforth) including letter tracing apps, interactive eBooks, phonics apps and coloring apps. There were a few apps that were particularly popular among the teachers and the children, such as Toca Boca Hair Salon and Mr. Potato Head. Toca Boca Hair Salon is an app that allows the player to change the hairstyle of the doll on the screen by brushing the hair, putting accessories on the hair, or coloring the hair. The player can also wash and dry the doll's hair. Mr. Potato Head is an online version of a popular toy for young children. Children combine the empty potato with various facial parts as they do with the physical toy. Among all the possible apps on Ms. Oakley's and Ms. Taylor's iPads, Kayla frequently chose Toca Boca Hair Salon. While apps of language development tools designed particularly for children with ASD (e.g., PECS Phase III or Niki Talk) were available in iTunes store, these apps were not observed in Learning Tree teachers' iPads. However, according to interviews with Ms. Oakley, she once used an app for Kayla's receptive language. Each scene had six pictures that Kayla could choose from for the verbally given word. Because Kayla wanted to just touch

wherever she wanted to, Ms. Oakley could not have Kayla's cooperation for her goals. Then Ms. Oakley did not use educational or functional apps for Kayla. Kayla did not receive any explicit instruction from Learning Tree teachers for using iPads or any specific apps. Kayla's parent reported that Kayla regularly used iPads at home.

#### *Research Design*

A case-study design is applied in this study. There have been criticisms against experimental conditions, as results are often distorted by research participants with ASD (Cabay, 1994). The case-study design allowed us to avoid ethical issues (e.g., retaining intervention for the establishment of baseline; Goodisman, 1982). Ms. Oakley and Ms. Taylor did not receive any instructions from the researchers. Their business-as-usual classroom interactions with Kayla were observed and videotaped for analyses. The interviews with these teachers were supplemented. Therefore, primary data collection for research relates to qualitative research design (Lincoln & Guba, 1985). Meanwhile, qualitative data without controlled analytic procedures is challenged in terms of lack of validity and credibility (Cabay, 1994; Prior & Cummins, 1992). We employed structured analytic procedures suggested by researchers in language development (Dickinson, Hofer, Barnes, & Grifenhagen, 2014). The results are to be used to improve professional practice in the chosen single context.

#### *Data Collection*

##### *Teacher-child interaction data*

We collected teacher-child dyad interaction data for quantitative analysis. Weekly audiovisual data collection of teacher-child dyad interaction sessions (10 to 20-minute-long each) occurred within the three-month period of January, February, and March. All audiovisual data was transcribed and parsed into utterances for coding.

##### *Teacher interview data*

Two interviews were conducted per teacher. The interviews were audiotaped and transcribed. Memos and field notes during and after each interview were generated as another set of qualitative data (Lincoln & Guba, 1985). Memos and field notes related to the researchers' reflections on what had occurred during the interview and the observation of the teachers. The research-

ers' questions, thoughts, concepts, assumptions, and ideas for analysis and writing were included in the memos and field notes (Strauss, 1987). The first interviews were semi-structured with the same prepared questions about the teachers' perspectives regarding iPad use with children with ASD and with Kayla specifically. The same list of questions were used for both teachers for coherent data collection in the first interviews. The second interviews were conducted based on the memos and field notes about the first interviews. The second interviews were more conversational and open-ended than the first interviews, which were quite different between two teachers in the second interviews. The second interview with Ms. Oakley was focusing on her difficulties expressed distinctively in the first interview. Ms. Taylor mostly talked about different iPad apps that she used with her students including Kayla.

#### *Data Analysis*

##### *Quantitative analysis of the teacher-child interaction data*

An utterance was the unit of analysis for the teacher-child interaction data. Utterance is a unit of speech bounded by silence, which is not necessarily a complete sentence. Sometimes a single word is considered as an utterance. Other times, a couple of sentences can be considered one utterance based on the interlocutor's accent or the length of breath. Whereas a sentence is a unit of written language, an utterance is a unit of oral language (MacWhinney, 2000; Miller & Chapman, 1996). Researchers of oral language use an utterance as the unit of analysis instead of a sentence (e.g., Bowers & Vasilyeva, 2011; Combs, 2010; de Rivera et al, 2005; Hoff, 2003; Justice, Weber, Ezell, & Bakeman, 2002). However, at an interaction turn, when non-verbal actions instead of a verbal utterance were used, the interaction change was considered to be a unit of analysis.

There were four main coding schemes: child's verbal response (observed and not observed); attention (joint and disparate attention); teachers' verbal assistance (observed and not observed); teachers' verbal assistance (closed-ended question, open-ended question, reinforcement, transition reminder, and verbal correction). Definitions and examples of codes are provided in Table 1. The co-authors analyzed the 25% of the data together to establish

the coding schemes. Then the second author independently coded the entire data four times (one coding scheme each time). For the inter-coder reliability testing, the first author independently coded the 25% of the entire data, following the same coding procedures of the second author's analysis. ReCal2, a web-application, calculated the

inter-coder reliability for each coding scheme. The Kappa scores that reflect correction for chance agreement score were .954, .851, .965, and .817 respectively for four coding schemes. These scores met the benchmarks suggested as substantial agreement by Landis and Koch (1977).

**Table 1.**  
*Examples and definitions of categories for coding teacher and child interaction*

<i>Code</i>	<i>Definition</i>	<i>Example</i>
Verbal Response observed	Child's verbal utterance occurred adjacent to the teacher's utterance	The teacher asks the child, "who says Moooo?" The child answers, "a cow."
Verbal Response not observed	Child's verbal utterance did not occur after the teacher's utterance	The teacher asks the child, "who says ho ho?" The child does not answer verbally.
Joint Attention	A pair of utterances of the teacher and the child can be referred to the same shared topic.	The teacher and child are playing together. The teacher looks at and points to a horse toy and says "look at this horse." The child responds by following the teacher's gaze and point, and so looks at the hours.
Disparate attention	A pair of utterances of the teacher and the child cannot be referred to the same shared topic.	The teacher holds a horse up and asks the child, "what is this?" The child does not look at the horse or the teacher, without responding to the teacher's question
Teacher's Verbal Assistance	Teacher verbally interacts with the child for assisting the child's engagement in the conversation.	When the child is not responding to the teacher's question, "what is this (pointed on her nose)?" the child is not responding. Then the teacher provides a verbal assistance by saying "no (the first two morphemes of nose)" with a raised accent at the end. Then the child says the word nose.
Teacher's Verbal Assistance: Closed-ended Question	Teacher's question that requires a simple one-word response such as yes or no	Teacher asks student: do you want help (yes/no question).
Teacher's Verbal Assistance: Open-ended question	Teacher's question that allow the student to express an opinion without being influenced by the teacher	Teacher asks student: "what happened to your animals?"
Teacher's Verbal Assistance: Reinforcement	Teacher's verbal assistance used as a reinforcer to increase certain behaviors or actions in rate, or is otherwise strengthened	Teacher is showing a picture of a tree and ask what it is. The child answers, "it is a tree." Then the teacher reinforces the answer by saying "good job."
Teacher's Verbal Assistance: Transition Reminder	Teacher's verbal assistance used to remind the child of what will happen next	Teacher says "one more min and then we are all done."
Teacher's Verbal Assistance: Verbal Correction	Teacher's verbal assistance that recognizes erroneous response and to initiate some effort to improve or correct it	Teacher shows a picture of a hand and ask what it is. The the child answers "it is a nose." The teacher corrects the answer by saying "no, it is a hand.'

We conducted  $\chi^2$  analyses to determine associations between iPad use and other variables (e.g., joint attention, teachers' verbal assistance). A  $\chi^2$  analysis is also employed to discover the teachers' individual preference difference regarding iPad use. For the analyses regarding joint attention and teacher's preference for iPad use, we used 1315 utterances that include the teacher's and the child's. We only analyzed the teacher's utterances ( $N = 659$ ) for the teachers' verbal assistance variables. The continuity correction was not applied for  $\chi^2$  analyses, because it causes significance values to become too conservative (Camilli & Hopkins, 1978; Howell, 2002).

#### *Qualitative analysis of the teacher interview data and field notes*

The interview transcripts and the first author's field notes were read several times by the first author and another researcher. By doing so, we could earn additional insight. In addition, the constant comparative approach (Merriam, 1998) was used during the repetitive reading of the data. After the initial key-words were identified, they were organized into clusters of super-ordinate themes. We continued to refer to the original interview transcripts and field notes throughout the analysis process to ensure that the findings were grounded in the data. Themes were reviewed by another researcher and discussed with the teachers for the respondent validity check. NVivo10 was used for the qualitative data organization. Excerpts for each theme in this manuscript were selected from the coding summary extracted from NVivo10. The first author and a research assistant analyzed the same interview transcripts using NVivo10. Based on the results from the inter-rater reliability coding comparison query in NVivo10, we determined that the three salient themes (Differentiating educational use and non-educational use of iPads; Considering the child's developmental level in using iPads; Teachers' individual preferences of iPad use with Kayla) were attainable with a high agreement rate (89.22%).

## **Results**

### *iPad Use and Joint Attention between the Teacher and the Child with an ASD*

Does joint attention happen more frequently in one single case study when the iPad is used than when the iPad is not used during

the one-to-one session of the teacher and the child with an ASD? To answer this question, we conducted a  $2 \times 2$   $\chi^2$  analysis. We categorized 1315 utterances into non-ipad or ipad conditions, which became the independent variable titled iPad Use. Then we analyzed the same set of 1315 utterances by coding either disparate attention or joint attention, which became the dependent variable titled Attention. The continuity correction was not applied because it causes significant values to become too conservative (Camilli & Hopkins, 1978; Howell, 2002), although the chi-square value was significant in either way. Table 2 presents the  $2 \times 2$  contingency arrangement between the independent variable (iPad Use) and dependent variable (Attention). Results indicate statistically-significant association in the contingency arrangements ( $\chi^2 = 101.150$ ,  $df = 1$ ,  $p = .001$ ) with a medium-to-large effect size (Cohen's 1988,  $d = 0.58$ ). Absolute values of standard residuals of all associations were significant as they were above the conventional benchmark (1.96), which means the observed value of each association was significantly different than the expected value. The standard residual analysis of each association is as follows. Joint attention was more frequently observed than expected in utterances without iPad use, whereas it was less frequently observed than expected in utterances with iPad use. In addition, disparate attention was less observed than expected in utterances without iPad use, while it was more observed than expected in utterances with iPad use.

### *iPad Use and Teachers' Verbal Assistance*

Does teachers' verbal assistance happen more frequently in one single case study when the iPad is used than when the iPad is not used during the one-to-one session of the teacher and the child with an ASD? To answer this question, we conducted a  $2 \times 2$   $\chi^2$  analysis only using teachers' utterances ( $N = 659$ ). We categorized teachers' utterances into non-ipad or ipad conditions, which became the independent variable titled iPad Use. In the same set of teachers' utterances, teachers' verbal assistance was analyzed for the dependent variable. We coded 1 for the teachers' utterances where verbal assistance was observed. All leftover utterances of teachers' were coded as 0 where no verbal assistance was observed. As aforementioned in the attention analysis

section, the continuity correction was not applied, although the chi-square value was significant in either way. Table 3 presents the 2 X 2 contingency arrangement between the independent variable (iPad Use) and dependent variable (Teachers' Verbal Assistance). Results indicate statistically-significant association in the contingency

arrangements ( $\chi^2 = 15.421$ ,  $df = 1$ ,  $p = .001$ ) with a small-to-medium effect size (Cohen's 1988,  $d = 0.31$ ). A notable observation in standard residuals indicates that teachers were unlikely to provide verbal assistance when the iPad was used, which is significantly different than the expected level.

**Table 2.**  
*Cross Tabulation Between iPad Use and Attention*

iPad Use		Attention Coding	
		Disparate Attention	Joint Attention
Utterances without iPad Use	Count	296	701
	Expected Count	371.5	625.5
	Percent within the category	29.7%	70.3%
	Standard Residual	-3.9	3.0
Utterances with iPad Use	Count	194	124
	Expected Count	118.5	199.5
	Percent within the category	61.0%	39.0%
	Standard Residual	6.9	-5.3

**Table 3.**  
*Cross Tabulation Between iPad Use and Teacher's Verbal Assistance*

iPad Use		Verbal Assistance	
		Verbal Assistance not observed	Verbal Assistance observed
Utterances without iPad Use	Count	77	422
	Expected Count	93.9	405.1
	Percent within the category	15.4%	84.6%
	Standard Residual	-1.7	0.8
Utterances with iPad Use	Count	47	113
	Expected Count	30.1	129.9
	Percent within the category	29.4%	70.6%
	Standard Residual	3.1	-1.5

As verbal assistance is a broad term that includes various types, we further analyzed the teachers' verbal assistance variable into six categories: No Assistance, Closed-ended Question, Open-ended Question, Reinforcement, Transition Reminder, and Verbal Correction. We conducted 2 X 6  $\chi^2$  analysis only using teachers' utterances ( $N = 659$ ). The independent variable was iPad Use. The continuity correction was not applied, although the chi-square value was

significant in either way. Table 4 presents the 2 X 6 contingency arrangement between the independent variable (iPad Use) and dependent variable (Teachers' Verbal Assistance). Results indicate statistically-significant association in the contingency arrangements ( $\chi^2 = 35.431$ ,  $df = 5$ ,  $p = .001$ ) with a small-to-medium effect size (Cohen's 1988,  $d = 0.48$ ). Significant standard residuals were observed only in the associations with open-ended question use. Teachers'

open-ended question use was more frequently observed than expected in their utterances without iPad. Alternatively,

teachers' open-ended question use was less frequently observed than expected in their utterances with iPad.

**Table 4.**  
*Cross Tabulation between iPad Use and Teachers' Verbal Assistance*

iPad Use		Verbal Assistance					
		No Verbal Assistance observed	Closed-ended question	Open-ended question	Reinforcement	Transition Reminder	Verbal Correction
Utterances without iPad Use	Count	77	99	184	98	36	5
	Expected Count	93.9	103.0	156.7	100.0	40.9	4.5
	Percent within the category	15.4%	84.6%	36.9%	19.6%	7.2%	1.0%
	Standard Residual	-1.7	-0.4	2.2	-0.2	-0.8	0.2
Utterances with iPad Use	Count	47	37	23	34	18	1
	Expected Count	30.1	33.0	50.3	32.0	13.1	1.5
	Percent within the category	29.4%	23.1%	14.4%	21.3%	11.3%	0.6%
	Standard Residual	3.1	0.7	-3.8	0.3	1.4	-0.4

*Teachers' Preference in Using iPads with the Child with an ASD*

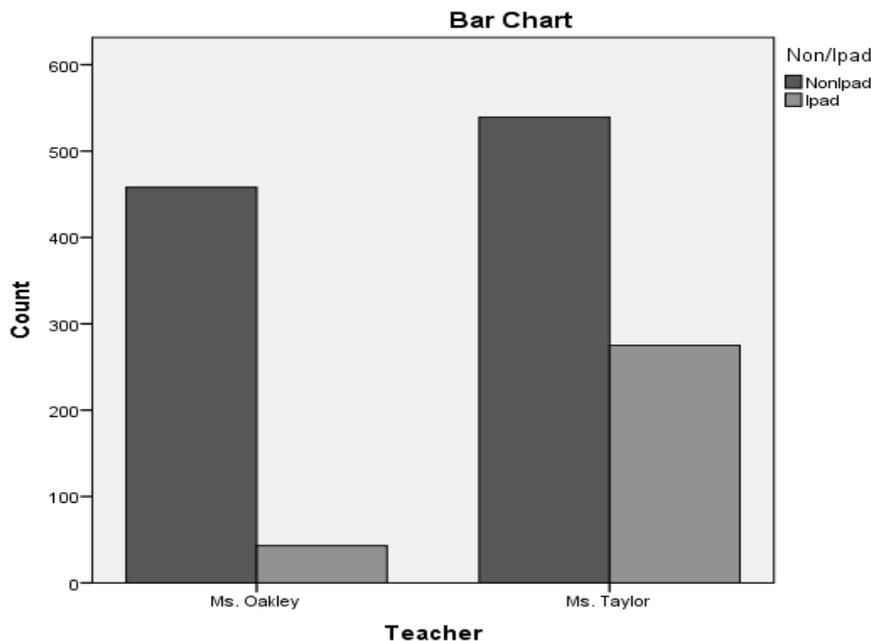
Does a teacher use iPads with the child with an ASD more frequently than the other teacher in one single case study? To answer this question, we conducted a 2 x 2  $\chi^2$  analysis using all utterances of two teachers and Kayla (N = 1315). The iPad use variable became the dependent variable of this analysis. The teacher variable (Ms. Oakley and Ms. Taylor) became the independent variable. As aforementioned in the attention analysis section, the continuity correction was not applied, although the chi-square value was significant in either way. Table 5 presents the 2 X 2 contingency arrangement between the independent

variable (Teacher) and dependent variable (iPad use). Figure 1 exhibits the differences of two teachers' utterances with iPad use and without iPad use. Results indicate statistically-significant association in the contingency arrangements ( $\chi^2 = 107.424$ ,  $df = 1$ ,  $p = .001$ ) with a medium-to-large effect size (Cohen's 1988,  $d = 0.60$ ). The observed value of each association was significantly different than the expected value. The standard residual analysis of each association is as follows. In Miss Oakley's session iPad use was less observed than expected, whereas iPad use was more frequently observed than expected in Ms. Taylor's utterances.

**Table 5**  
*Cross Tabulation Between Teacher and iPad Use*

Teacher		iPad use	
		iPad was not used	iPad was used
Ms. Oakley's sessions	Utterance Count	458	43
	Expected Utterance Count	379.8	121.2
	Percent within the teacher variable	91.4%	8.6%
	Percent within the iPad use variable	45.9%	13.5%
	Standard Residual	4.0	-7.1
Ms. Taylor's sessions	Utterance Count	539	275
	Expected Utterance Count	617.2	196.8
	Percent within the teacher variable	66.2%	33.8%
	Percent within the iPad use variable	54.1%	86.5%
	Standard Residual	-3.1	5.6

**Figure 1.**  
*Comparisons of two teachers' utterances when iPad is used and when iPad is not used*



*Teachers' Perspectives about Using iPads with the Child with an ASD*

As a method of methodological triangulation (Creswell & Plano Clark, 2011), individual interviews with the teachers were conducted for us to learn their perspectives and preferences about iPad use with Kayla. For clarity of presentation, we organized the data in three salient themes: differentiating educational use and non-educational use of

iPads; considering Kayla's developmental level; teachers' individual preferences of iPad use with Kayla. These themes are not mutually exclusive and there is a dynamic interaction among them.

*Differentiating educational use and non-educational use of iPads.*

Both teachers were distinguishing functional or educational use of an iPad from non-

functional use. Functional or educational use when the teachers chose the iPad app that are designed for receptive language and expressive language activities. For instance, after being given a verbal prompt of a word, the child is required to choose a picture of the prompt in the receptive language activity app. In an expressive language activity app, on the other hand, the child is required to say a word to the teacher on the picture prompt on the screen. These behaviors needed to happen with the joint attention between the teacher and the child. On the other hand, non-functional use was when Kayla was using the iPad for her own will without the teacher's engagement with her. Any type of iPad apps could be used non-functionally. Even iPads considered to be educational by the teachers could be used for Kayla's steaming off. Kayla could touch any part of the screen from any iPad apps. She could go back to the main page to pick another iPad app.

Both teachers mentioned some educational topics such as animal sounds, letters, and numbers:

*Ms. Oakley: Now we are working on making requests. We just wanted to introduce something functionally and developmentally that might go along with public schools. So maybe we will start with letters.*

*(Excerpt from the first interview with Ms. Oakley)*

*Ms. Taylor: She might say number one number two and number three. But she might not know what number one number two and number three are. You know that might be a good place to start for her. The functionality of them.*

*(Excerpt from the first interview with Ms. Taylor)*

*Soh: Do you see any possibility to use iPads for expressive language?*

*Ms. Oakley: I am trying to think of the situation that we could... Yeah we could probably, ... maybe with animal sounds? I think she might do well with that. Maybe hearing the cow and you know ... touching the animal and ask some questions... Yeah... I think she might do well with that.*

*(Excerpt from the second interview with Ms. Oakley)*

Meanwhile, neither teacher was addressing functional language use (e.g.,

instrumental, regulatory, interactional, personal, heuristic, imaginative, informative; Halliday, 1975) using iPads with Kayla. Ms. Oakley briefly mentioned Kayla's level of functional language use responding to Soh's question regarding Kayla's communication with her. However, she did not make any connections between iPad use with Kayla and functional language development. She stated:

*Ms. Oakley: Absolutely not functional language. Well, she can distinguish what she wants. If she wants to play with a horse, she would say horse. If she wants more sandwich, she will say more. More what? Then she would not say sandwich.*

*(Excerpt from the second interview with Ms. Oakley)*

*Considering Kayla's developmental level*

The teachers used iPads as a reinforcer for Kayla, which is different from their educational or functional use of it. This observation is evidenced in the following excerpt.

*Ms. Oakley: I think what I learned is, even though she doesn't use it functionally, it's still reinforcing for her. So I just decided to use it as reinforcement for her. We're using some book things in iPad. Her attention span is so short when it comes to that. She's touching things before she can even do it. So if her reinforcement is just being in her own world kind of steaming off with the iPad, that's what I use it for, (be)cause that's what is working for her now.*

*(Excerpt from the second interview with Ms. Oakley)*

iPad is perceived as a content to learn how to use for these teachers. They believed that the functional or educational use of iPad is not yet developmentally appropriate for Kayla. She interpreted the current iPad use as a reinforcer with Kayla to be transitional to more structured way that can be applied in the future.

*Ms. Oakley: I think there were six pictures on a page in that app. Will she do it correctly? No way. It will be a huge step for her.*

*(Excerpt from the second interview with Ms. Oakley)*

*Ms. Taylor: I did some research about language apps. I found an app about farm animals. She will be good with that. Maybe for next year? Absolutely not for this year.*

*(Excerpt from the first interview with Ms. Taylor)*

*Soh: Sometimes when Kayla was using the iPad for steaming off, you were talking with her.*

*Ms. Oakley: Just to see if I can get into her world. And I like to talk to her when she is doing it sometimes. She's never gonna be able to use it with someone. But I can talk to her a little bit here and there when she uses it. Then eventually I can work with her on iPad some day.*

*(Excerpt from the second interview with Ms. Oakley)*

#### *Teachers' individual preferences of iPad use with Kayla.*

Ms. Oakley considered iPad use with Kayla to be difficult. The analysis of her word use indicated that "hard", "frustrated" and "uncomfortable" were frequently used adjectives when she talked about iPad use with Kayla.

*Ms. Oakley: When she was first time using it, we were doing selecting one of two (pictures). Nine out of ten times, before the prompt was finished, Kayla was touching the screen. She didn't understand she had to listen and comprehend what was asked. She was just touching the cow before she even heard cow. She has gone a lot better with that, but I have hard times using it workwise. I use it as a reinforcer.*

*(Excerpt from the second interview with Ms. Oakley)*

Alternatively, Ms. Taylor did not show any evidence of her difficulty. She liked the fact that Kayla enjoyed touching things on the iPad. This qualitative finding is relevant to the quantitative finding with regards to the two teachers' difference of frequency of utterances with iPad during the sessions with Kayla.

## **Discussion**

The professional literature on iPad's use with children with ASD has rarely addressed teacher's individual differences in providing instruction and intervention. Our

study compared two teachers' interactions with the same child with an ASD, quantifying different aspects of their utterances and actions (e.g., iPad use, joint attention, and verbal assistance). We supplemented the quantitative data with the interviews with the teachers to learn about the teachers' own perspectives. By doing so, we discovered the teachers' individual differences in preferences and frequencies of iPad use. While, for children with autism, the effectiveness of early intervention on their social and communication skills has been supported by research (Rogers & Vismara, 2008), children's differences in responses to the intervention have been observed (Sallows & Graupner, 2005; Smith, Groen, & Wynn, 2000). This observation requires more information about various factors that account for children's differences in responses to the intervention (Ruble & McGrew, 2013; Stahmer, Schreibman, & Cunningham, 2011). Amongst possible factors, some teacher factors such as years of teaching, administrative support, stress level, and emotional exhaustion have been investigated in research (Ruble & McGrew, 2013). However, teachers' interaction styles including different functions of language use and verbal assistance types have rarely been explored as a factor for affecting the language outcomes of children with ASD. The current study can serve as a catalyst for future studies that explore various teacher variables.

Both teachers described iPad use for Kayla as a reinforcer, although their school administrators described that the iPad was used for language development activities. Teachers' interactions with Kayla were significantly less frequent when they were letting Kayla use an iPad than when an iPad was not used. For instance, Ms. Oakley could not interact with her on her planned language activities while she was on the iPad; she ended up letting Kayla "steam off" with the iPad. Our data does not allow us to argue Ms. Oakley and Ms. Taylor's planned language activities on the iPad relate to research-supported quality instruction particularly for the language development of children with ASD. However, when teachers apply hands-off policies about children's iPad use, the children have limited opportunities to hear the teachers' advanced language and to improve their language use with the teacher's scaffolding in the context of iPad use. More simply,

children will have less opportunities to experience joint attention. In our data, joint attention between the teacher and the child was established more often when an iPad was not used than when an iPad was used. Joint attention is an important foundation for communicative language. As Flores and her colleagues (2012) cautioned, there is a challenge involved in iPad use regarding joint attention. Because the device is designed for touching, children are very likely to touch different elements on the screen for exploration and for fun (Geist, 2012). Future research has to address how the teachers still can interact with the children to provide language modeling and language facilitation without hindering their exploration and play on iPad. Parallel talk or self talk use (Paul & Chapman, 2007) can be investigated for this purpose.

Is iPad use with children with ASD a developmentally appropriate practice? Published research about iPad use for children with ASD has not addressed issues regarding developmental appropriateness. In the interviews with the teachers in our study, however, both teachers mentioned that the functional use of iPad seemed to be developmentally inappropriate for Kayla. Both teachers still tried to interact with Kayla regarding what was happening on the iPad screen. This type of interaction, based on the first author's observation, was more naturalistic and authentic than scripted and teachers' pursuing communication with Kayla. It is a fair statement that teachers have to provide developmentally appropriate educational experiences for all children (Campbell et al, 1998). When the pre-planned scripted approach is not developmentally appropriate, teachers should still find developmentally appropriate ways to use iPads to support children's language development. Studies about naturalistic or hybrid strategies, which avoid scripted approaches, to enhance children's language productivity have been accumulated (Fey, Cleave, Long, & Hughes, 1993; Girolametto, Pearce, & Weitzman, 1996; Weismer & Robertson, 2006). While these strategies could be considered, the teachers were not aware that the naturalistic interaction that they attempted during Kayla's iPad use could be used for language development.

The results of this study regarding teachers' verbal assistance are providing implications for teachers' questioning. Questioning is considered to be one of

most frequently used teaching strategies (de Rivera, Girolametto, Greenberg, & Weitzman, 2005; Harlen, 1999). Open-ended questions, while there are other types of questions (e.g., closed-ended questions, prompting questions), are generally favored amongst educationists and suggested for teachers' use with their students (Author; Lee, Kinzie, & Whittaker, 2012). Interestingly, in this data, open-ended questions were more frequently observed when iPads were not used. It is unlikely, however, that the teachers were purposefully using open-ended questions for language development support when they allowed Kayla to use the iPad. As a matter of fact, the literature about intervention strategies for children with ASD has rarely addressed open-ended questions, which is surprising compared to other education literature that emphasizes teachers' open-ended question use. Future studies can provide the teachers with knowledge about adequate question use for their students with ASD.

### **Implications**

The results of the current study provide insight about how teachers' iPad use with a child with an ASD is related to joint attention with the child, verbal assistance for the child, and the teachers' own preference. A notable finding is that joint attention and verbal assistance took place more frequently when iPads were not used than when an iPad was used. The results of the study provide implications for future research and practice.

#### *Research*

Research has to consider teachers' individual differences as an important factor for the language development of children with ASD. We focused only on two teachers. Future studies with larger sample sizes can facilitate the development of adequate research methods for instructions and interventions for children with ASD considering teachers' individual differences.

#### *Practice*

The results imply that professional development of teachers for children with ASD needs teacher educators' attention in regards to iPad use for the language development of children with ASD. The participating teachers rarely considered the de-

velopment of authentic communication abilities for children with ASD (Cabay, 1994) regarding language development using iPads.

### Limitation

There are limitations to be addressed when considering the findings of this case study. The limitations of this study can be discussed in terms of sample size and participant selection as follows.

We had a small number of participants. In fact, our unit of analysis was individual utterances instead of individual person. So our sample size based upon the number of utterances can be still appreciable. However, adding utterance samples from more participants can potentially provide different results from ours.

This study was conducted at a special education school and all the students in this school are considered to have severe disabilities. Teachers and children with ASD in an inclusion classroom can potentially provide different results from ours.

There was a selection bias with regards to the participants. The researcher could not get involved in choosing the target child because of the strict rules of the school to protect the child's identity, so the school administrators and the teachers were responsible for finding the participant for the study.

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