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The Effect of Parental Interaction on Emotional Learning with Interactive Devices in Children Ages Three to Five

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EMOTION LEARNING APP IMPROVES EMOTION KNOWLEDGE IN CHILDREN AGED THREE TO FIVE

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Abstract

As the popularity of child-friendly tablet-based apps and games has grown, the need to evaluate the effects of tablet play has also developed. The current study used an app designed for children ages two to five years called “Daniel Tiger’s Grr-ific Feelings” to examine whether prosocial interactive media can be beneficial for emotional development. The present study was modeled after a study by Rasmussen et al. (2018), wherein children ages three and four years spent two weeks with an experimenter- adapted version of the same app. This experimenter adaptation consisted of limiting children’s access to a subset of the available games. Similar to this prior study, the present study also investigated the efficacy of this interactive media (specifically its efficacy in learning emotional skills, such as emotion recognition and emotion understanding). However, unlike the prior study, this study allowed children to access all features of the app to see if the results found by Rasmussen et al. (2018) replicate, and to improve ecological validity. This study also contained a parental interaction component, whereby some children were assigned to a condition in which parents were encouraged to interact with their child during app usage, and some children were assigned to a condition in which parents were encouraged to allow their child to independently use the app. Regardless of parent interaction, children’s emotion recognition scores increased after app interaction, but their emotion understanding scores did not. These findings suggest that young children can learn basic emotional skills using educational apps without the requirement of parental interaction, and that they can transfer that learning.

Table of Contents

Acknowledgements i
Abstract ii
Table of Contents iii
Introduction 1
Method 7
Results 10
Discussion 11
References 15
Table 1. 19
Figure 1 20
Figure 2. 21

The Effect of Parental Interaction on Emotional Learning with Interactive Devices in Children Ages Three to Five

The amount of time children spend with various types of media is increasing, which is especially true for tablets, as they have greatly increased in popularity (Common Sense Media, 2017). Many tablet-based apps and games have been marketed as educational. As the time spent with these games increases, more research must be conducted to learn whether educational media is actually teaching children the skills it intends. One subset of these games focuses on emotion development, a factor that is being viewed as increasingly important for both social and academic success (Denham & Brown, 2010). Games focusing on the development of emotional skills are therefore especially relevant to emotional development.

Emotional competence includes the ability to express vivid emotions, the ability to discern the emotional states of self and others and talk about them fluently, and the ability to regulate one's own emotions (Denham, Blair, DeMulder, Levitas, Sawyer, Auerbach-Major, & Queenan, 2003). The successful development of emotional competence is associated with several positive outcomes. Higher emotional competence is a direct predictor of math and reading achievement, and teacher reports of school performance (Blankson, Weaver, Leerkes, O'Brien, Calkins, & Marcovitch, 2017). It is associated with higher levels of social competence and interaction with peers, and is also a direct predictor of spelling and teacher reported social skills (Denham et al., 2003; Trentacosta & Izard, 2007).

Emotional competence is divided into emotion knowledge and emotion regulation. Emotion knowledge, which is the ability to recognize and understand emotions from facial, behavioral, and social cues, is an important predictor of positive child development trajectories (Trentacosta & Fine, 2010). For example, emotion knowledge has been found to be associated with social and academic competence years later (Izard, Fine, Schultz, Mostow, Ackerman, &

Youngstrom, 2001). It is related to closeness with teachers, learning to follow directions, and having a positive attitude towards school and learning in general (Garner & Waajid, 2008), as well as cognitive ability, adaptability, willingness to try new things, playing well with others, and responding well with strangers (Izard, Schultz, Fine, Youngstrom, & Ackerman, 1999). Further, emotion knowledge is negatively related to inattention (Izard, Schultz, Fine, Youngstrom, & Ackerman, 1999).

Another subsection of emotional competence is called emotion regulation. This refers to the internal and external ways one controls the occurrence, strength, and expression of emotions (Morris Silk, Steinberg, Myers, & Robinson, 2007). Emotion regulation is related to positive outcomes such as higher peer acceptance (Kim & Cicchetti, 2010). It is also related to many aspects of academic success, including classroom productivity, early reading ability, and math scores (Graziano, Reavis, Keane, & Calkins, 2007). Emotion regulation is also related to general school readiness (Blair, 2002). Having good emotion regulation is also associated with lower symptoms of anxiety and depression (Kim & Cicchetti, 2010).

Emotional competence develops through a socialization process, which occurs through three processes. First, children observe the emotional displays and interactions of their parents, and later, peers and teachers. Through this, children learn to model these reactions. Observing others allows them to understand the contexts in which different emotions are appropriate. Second, parents also intentionally teach their children about emotional competence through specific behaviors. These behaviors include teaching their children specific strategies for emotion regulation, or encouraging when their child controls their emotions. Third, parenting style informs the process of emotional competence socialization. Conflict between adults in the child's life is a predictor of poor emotional competence, and things like secure attachment

between parent and child, and parent expression of positive emotion can predict the development of emotional competence (Morris et al., 2007).

As children receive more exposure to electronic media, and therefore less parental influence, perhaps there will be increasingly important ways that this medium will influence children's emotional competence. Although we know little about the effects of tablet applications, we can make educated guesses based on the many studies of television viewing. Mares and Woodard (2005) examined thirty-four studies of the effects of television on children to see whether the prosocial or antisocial effects of media are stronger. While other researchers have taken stances on either end of this argument, Mares and Woodard's findings were right in the middle. Children who watched prosocial television behaved more positively or had more positive attitudes, but this finding was no stronger than the increase in aggressive behaviors that arose from watching antisocial content. The data in this meta-analysis suggest that children's altruism and aggression can be increased depending on the content they watch (Mares & Woodard, 2005).

The importance of media content specifics has also been directly examined in experimental contexts. For instance, Christakis, Garrison, Herrenkohl, Haggerty, Rivara, Zhou, and Liekweg (2013) aimed to reduce children's aggression by manipulating the media they watch. The intervention substituted quality prosocial programming for programming with high amounts of aggression, which successfully increased the social and emotional skills of the preschoolers (Christakis et al. 2013). However, a later and more comprehensive review casts doubt on the positive findings of Christakis. Poitras et al. (2017), argue that the negative effects of general television viewing are greater. In their systematic review, higher levels of general television viewing were associated with lower prosocial skills, and a higher risk for aggression in

the five toddler studies and three preschooler studies (Poitras et al. 2017). These studies merely recorded television viewing and did not control what television programming was watched. The systematic review by Poitras et al. (2017) contradicts the results of Christakis et al. (2013), finding each hour of prosocial television viewing increased the likelihood of antisocial behavior in the three preschooler studies. Thus, there is mixed evidence that the type of programming can affect the development of social and emotional skills.

Most past research on electronic media use in early childhood examined television rather than more active or social electronics such as video games or tablets (Hinkley, 2017). Herodotou (2017) points out a severe lack of research about the relationship between tablet use and social and emotional development. To the extent we do know about app efficacy, it relates mostly to education. Within the realm of cognitive benefits, parental interaction has been very important for tablet learning (Herodotou, 2017). It has been shown that educational apps are most effective when they focus on content rather than distractions, when the content is relevant to the child's life, and when it encourages parental support (Zosh, Lytle, Golinkoff, & Hirsh-Pasek, 2017). However, it is unclear how effective educational apps can be on social and emotional development, or how important parent interaction may be.

Direct comparisons between learning from television vs. computer games shed additional light on this issue. Studies have been done on exposure to different kinds of media and their effects on social and emotional skills. Hinkley (2017) investigated relationships between the type of media a child consumed and their social and emotional skills after two years. In comparison to television viewing, increased computer use was associated with lower interpersonal skills. However, baseline computer use was associated with increased stress management skills. Counterintuitively, sedentary video game play was also positively linked to interpersonal and

stress management skills. Notably, this study did not test the social and emotional skills of participants at the first time of the study, which allows for the possibility that participants with higher social and emotional skills gravitate towards these types of media, and lowers the confidence in their findings (Hinkley, 2017).

The specific nature of content might matter, but so too might be the ways in which children view media, and if they receive parent input while watching. Little research has been done on parent interaction and its role on social and emotional development, or on the association between prosocial television programming and social and emotional development in preschool age children (Rasmussen, Shafer, Colwell, White, Punyanunt-Carter, Densley, & Wright, 2016). Specific episodes with the topics of empathy, self-efficacy, and emotion recognition for the children in the experimental group were chosen. The parents either watched with their children and talked about the show, watched and did not discuss the show, or they did not watch the show with their child. The interaction was positively associated with children's empathy scores.

The present study explores emotion knowledge (specifically emotion recognition and emotion understanding) in young children aged three to five using the app "Daniel Tiger's Grr-ific Feelings." This study is based closely on a study by Rasmussen et al. (2018), wherein children ages three to six spent two weeks with an experimenter adapted version of the app "Daniel Tiger's Grr-ific Feelings." The app consists of four different interaction areas. In the Trolley Game, children direct a trolley to determine a minigame to play that teaches them about different words to express their feelings. The Sing Along section has eighteen songs for the child to sing with Daniel Tiger to express and control their feelings. In the Photo Booth, children can photograph themselves feeling certain emotions by mimicking Daniel Tiger's facial expression. Finally, the Easel allows children to use various coloring tools and stickers to learn healthy

emotional expression. Each game is designed to teach children how to recognize and understand emotions.

In the study by Rasmussen et al. (2018), participants were split into three conditions. The first condition involved watching *Daniel Tiger's Neighborhood* episodes and interacting with the app for two weeks. The second condition played with the *Daniel Tiger* app and watched *Bubble Guppies* as a control television show designed to teach children science, math, and reading. Those in the third condition served as a control. They watched *Bubble Guppies* and played with the *Bubble Guppies* mobile app, which focuses on learning the alphabet and basic math skills. Children interacted with their media for two weeks. Researchers measured the changes in emotion knowledge, and emotion regulation, and also measured the amount of parent interaction by asking about their typical interactions with their children while watching educational television. Children who played with the *Daniel Tiger* app in both the first and second condition had many promising results, such as superior lasting emotion knowledge and application of emotion regulation skills, in comparison to the control group. Surprisingly, parent interaction did not seem to have any impact on any aspects of emotion learning. They suggest that the interactive nature of the app allows children to more readily benefit from it, and therefore there may not be a need for parent interaction for this type of educational applications (Rasmussen, 2018).

Two limitations make the results of this study less conclusive. First, the form of the app tested in this study is not the form of the app that is accessible to the public (Rasmussen et al., 2018). Researchers used a modified form of the app containing only a trolley game, where children learn about the use of language to express emotion, and a photo booth game, where they can mirror proper emotion expressions. While these two games provide good learning

opportunities for children, leaving out the other parts of the app also prevents the results from applying to the reality of children playing on the app. Second, although parental interaction did not seem to help in children's learning of socio-emotional skills, parental interaction was left an uncontrolled variable (the researchers did measure it, but it was not manipulated in that study).

Similar to the Rasmussen study, the present study analyzed interactive media as a method of learning emotional skills, namely emotion recognition and emotion understanding. This study allowed children to access the entire app to see if the results found by Rasmussen et al. (2018) are accurate to the real app. This study also manipulated parental interaction to assess its role in interactive media based emotional learning. Using a pretest posttest design, emotion recognition, which is the ability to recognize emotions from facial cues, and emotion understanding, which is the ability to identify emotions based on situational cues, were measured.

Method

Participants

A total of 11 participants from 38 to 71 months of age (M = 55.08, SD = 10.93) and one of each of their parents or primary caregivers were recruited for this study. 54.5% were girls (n = 6). 100% of parents identified their children as White. Data from one additional child were not included, because the child was unwilling to cooperate.

Materials

The mobile app, "Daniel Tiger's Grrific Feelings," was used in this study. This app has four games – a trolley game, a photo booth game, a sing along section, and an easel. Each game is designed to teach children how to recognize and understand emotions.

Two subtypes of emotion knowledge, emotion recognition and emotion understanding, were measured. Children's emotion recognition was measured based on procedures used by Rasmussen et al. (2016, 2018), and adapted from Denham (1986). Four photographs and four

drawings of a person of the same biological gender as the child were used. Each photo or drawing depicts either a happy, sad, angry, or afraid emotion. Children were asked to tell the researcher what emotion they believed the person was feeling in each of the photos and drawings. Their answers were recorded, transcribed, and coded as correct (1 point) or incorrect (0 points). Children could receive between 0 and 4 points for the drawing identification task and the photo identification task. These scores were combined to form an emotion recognition score (Time 1: $M = 5.64$ $SD = 2.42$; Time 2: $M = 6.91$, $SD = 1.14$). This aligned with procedures by Rasmussen et al. (2018). Interrater reliability calculated on 36% of the responses, using coding of two independent coders, was faultless (k = 1).

Also replicating the procedure by Rasmussen (2018), children's emotion understanding was assessed with a procedure adapted from Ribordy et al. (1988). This procedure used short situations about a person designed to suggest a certain emotion (e.g., a character named Susie is described as dreaming about a monster in her nightmare). Children were read twelve stories about a person of the same biological gender as the child and asked how the person would feel in the situation. For example, the correct answer for two situations was "disgusted." Children's answers were recorded, transcribed, and coded. In cases where the answer was similar to but not exactly the correct answer, coders consulted with each other to determine correctness. For example, other correct answers considered correct were "gross," or "icky." Children scored 3 points for correctly identifying the emotion, 2 points for correctly identifying the valence, and 1 point for an incorrect response. The mean scores were calculated to form an average emotion understanding score (Time 1: $M = 2.13$, $SD = 0.51$; Time 2: $M = 2.28$, $SD = 0.31$). This aligned with procedures by Rasmussen et al. (2018). Interrater reliability on 36% of responses was sufficiently high (k = .921).

Procedure

Participants first completed the intake process at the lab. Parents completed a questionnaire with background descriptive questions concerning past exposure to tablet learning and Daniel Tiger. Children had a pre-test to assess their baseline emotion understanding and recognition. The participants were instructed to play with the app for about 10 minutes a day for two weeks. Participants were randomly assigned to one of two groups: parental interaction or no parental interaction. In the parent interaction group, parents were asked to interact with their child in relation to playing with the app "Daniel Tiger's Grr-ific Feelings," and record the amount of time their child plays with it. Participants in this condition reported using the app for about 145 min during the 2-week study period (M = 144.60, SD = 67.34). The parents in the group without parental interaction were only asked to record the amount of time their child plays with the app. Participants in this condition reported using their assigned media for 132 min on average (M = 132.17, SD = 32.12). Children in both conditions interacted with the four games described above. An independent subjects t-test failed to find significant differences between the amount of time spent on the app, $t(9) = -.404$, $p = .696$. See Table 1 for a timeline.

Researchers met with the participants two times (herein referred to as Time 1, and Time 2): once at the beginning of the study, and again about 2 weeks later. During both visits to the lab, children's emotion recognition and emotion understanding were tested. Emotion recognition was tested by applying procedures used by Rasmussen et al. (2016), and adapted from Denham (1986). Children were shown four emotion photographs of an adult and four emotion drawings of a person of the same biological gender as them. Children were asked to explain what the person is feeling in each image. Children's emotion understanding was assessed with a procedure

adapted from Ribordy et al. (1988). They were read situations about a person that is the same biological gender of the child and were asked how they would feel in a given situation.

Results

I conducted a 2 (parent interaction condition: Parent Interaction vs. No Parent interaction) x 2 (emotion recognition time: Pre App Use vs. Post App Use) split plot ANOVA with emotion recognition time as a within-subjects variable, and with parent interaction as a between-subjects variable. There was no significant main effect of parent interaction condition (No Parent Interaction M = 5.67, SD = .671; Parent Interaction M = 7.00, SD = .74), $F(1,9) = 1.793$, p =.213. There was a significant main effect for emotion recognition time, such that emotion recognition scores increased from Time 1 to Time 2 (Time 1: M = 5.64, SD = 2.42; Time 2: M = 6.91, SD = 1.14), $F(1,9) = 6.188$, p <.05. Finally, there was no emotion recognition time x parent interaction condition interaction (Time 1, No Parent Interaction M = 4.83, SD = 2.93; Time 1, Parent Interaction M = 6.60, SD = 1.34; Time 2, No Parent Interaction M = 6.50, SD = 1.23; Time 2, Parent Interaction M = 7.40, SD = .89), $F(1,9) = .764$, p = .405. Means for emotion recognition scores can be seen in Figure 1.

A 2 (parent interaction condition: Parent Interaction vs. No Parent interaction) x 2 (emotion understanding time: Pre App Use vs. Post App Use) split plot ANOVA with emotion understanding scores as a within-subjects variable, and with parent interaction as a between-subjects variable was conducted. There was no significant main effect of parent interaction condition (No Parent Interaction M = 2.15, SD = .17; Parent Interaction M = 2.28, SD = .18), $F(1,9) = .275$, p =.613. There was not a significant main effect for emotion understanding time, (Time 1: M = 2.13 SD = .51; Time 2: M = 2.28, SD = .31), $F(1,9) = 1.911$, p =.200. Finally, there was not an emotion understanding time x parent interaction condition interaction (Time 1, No

Parent Interaction M = 2.04, SD = .63; Time 1, Parent Interaction M = 2.23, SD = .37; Time 2, No Parent Interaction M = 2.25, SD = .33; Time 2, Parent Interaction M = 2.32, SD = .32), $F(1,9)$ = .341, p = .574. Means for emotion understanding scores can be seen in Figure 2.

Discussion

After playing with the app, children could more accurately identify emotions when presented photos and drawings of emotionally expressive faces. This learning occurred both with and without parental interaction. In fact, parent interaction had no effect on learning from the app. This suggests that the app is able to provide a mentally and socially engaging experience that is capable of teaching at least certain aspects of basic emotion knowledge.

Children did not increase in their ability to identify emotions based on stories, reflected by no improvement in emotion understanding scores after app interaction. One possible reason for this finding would be that the app does not effectively teach these more advanced skills. Understanding the situations that bring about an emotion is more difficult than simply being able to recognize an emotion. While “Daniel Tiger’s Grr-ific Feelings” does associate situations with their appropriate emotion, it rarely asks children to identify the correct emotion for the situation (PBS, n.d.). The app does directly ask children to identify emotions based on cartoon facial cues (PBS, n.d.).

Another possible reason why there was no improvement in emotion understanding scores could be that the method used to measure emotion understanding did not accurately measure children’s learning on the app. Campbell et al. (2016) propose an alternative method of measuring emotion understanding in which researchers use puppets to act out a situation instead of telling the situation to the child. This alternate method may keep children better engaged with the researcher, and therefore produce more accurate answers. Future research could incorporate

alternate measures of emotion understanding to more precisely understand what the app is teaching.

For both emotion recognition and emotion understanding, parent interaction had no effect on scores. This suggests that educational apps may allow children to learn socio-emotional skills without the need for parent interaction. This could be because apps provide enough interaction to keep children engaged with the content. This would give educational apps an advantage over television programming, which requires parent interaction to produce learning (Rasmussen et al., 2016).

One question research on educational applications for young children must address is the issue of transfer of learning. That is, how well does the app relate to real encounters in the child's life? There is a chance that the app only teaches very specific things to children. This limited generalizability also limits the benefits of the app. If children have difficulty taking what they learn from the app and applying it to their daily life, that makes the app less effective. In a previous study of tablet play, researchers found that learning a physical problem-solving task through an educational app was as effective as learning the task using a physical version of the puzzle (Huber et al., 2016). This suggests that tablet learning in general can translate to real-world skills. Another aspect of the issue of transfer is how well the measures in this study directly measure what is being taught in the app. Because the children were looking at unfamiliar faces in the emotion recognition task, some transfer must be occurring. However, the extent of the transfer is unknown.

Future studies should also consider using a variety of measures of emotional competence. This study mainly focused on the development of emotion knowledge, but "Daniel Tiger's Grr-ific Feelings" may be teaching children about other aspects of emotional competence, such as

emotion regulation and emotional expressiveness (Rasmussen et al., 2018). For example, the Sing-Along section allows children to sing songs that are designed to help them manage their emotions (PBS, n.d.). Campbell et al. provide an extensive list of effective measures of each type of emotional competence skill that could be used for similar studies (2016). Many of these measures include parent or teacher questionnaires, which allow the adults who know the child best to comment on the child's development (Campbell et al., 2016). This perspective could be important in measuring the effects of emotional learning apps.

Another factor to examine is whether enjoying the app has any effect on learning. Perhaps liking the app would increase the amount the child attends to it. If this were the case, the app may be more salient for different audiences. For example, age or other demographic differences may play a role in a child's interest in the app, which might then affect their learning.

This research has several limitations and the results should be evaluated with these taken into consideration. One possible improvement to this study would be to see whether this learning lasts by testing children 1 month after the intervention. Most tests of media effects look at learning directly after intervention, but some researchers suggest that it may take longer to encode media learning (Jensen, Bernat, Wilson, & Goonewardene, 2011). This may be especially true with media that contains story-based distractions. If these delayed effects are seen in adults, they might also be much more important in children (Jensen et al., 2011). The earlier study by Rasmussen et al. (2018) was able to test children 1 month after the intervention, but found mixed results. Younger children, three to four years old, scored higher approximately one month after the intervention, but older children, five to six years old, scored worse 1 month after the intervention (Rasmussen et al., 2018).

Another limitation to this study was that it was restricted due to its smaller sample size. Time constraints did not permit collecting a larger and more representative sample. If a representative sample were to be obtained, there are a few directions that would be especially important to pursue. First, there may be age differences in learning. Rasmussen suggests that older children might learn less from the app because they have already understood most of what the app is designed to teach, or because the app might not hold their attention as well (2018) As stated previously, enjoying the app may play a role in learning. This could differ by age.

Another possible direction to pursue with a larger sample would be whether income level differences impact learning. Raver (2002) suggests that children in low-income families stand to benefit the most from media-based socio-emotional lessons due to the family's financial issues. The affordability of these apps may allow children in families with a low socioeconomic status to develop emotion skills. Also, children in low income families have a higher risk of behavioral and academic problems (Raver, 2002). Because success in these areas is tied to early emotion learning (e.g., Blankson et al., 2017; Denham & Brown, 2010; Trentacosta & Fine, 2010), it is especially important for children in low income families to learn emotion competence skills early (Raver, 2002). This position is also affirmed by the Common Sense Census (2017), which found that children of families in the lowest third of income earners are spending the most time with screen media. This makes examining socioeconomic status especially interesting.

Ultimately, this study suggests that young children effectively transfer learning from educational apps to measures of emotion recognition. However, while children can learn basic emotion knowledge through the app, there appeared to be limited capability to learn more advanced emotion knowledge, i.e., predicting others' emotions. The learning that was observed was done without the need for parent or other adult interaction, which allows children to use

educational apps on their own to effectively supplement other forms of emotion learning. While there are many more directions to explore, this study provides initial evidence that educational apps do not need to be combined with parent interaction to produce results.

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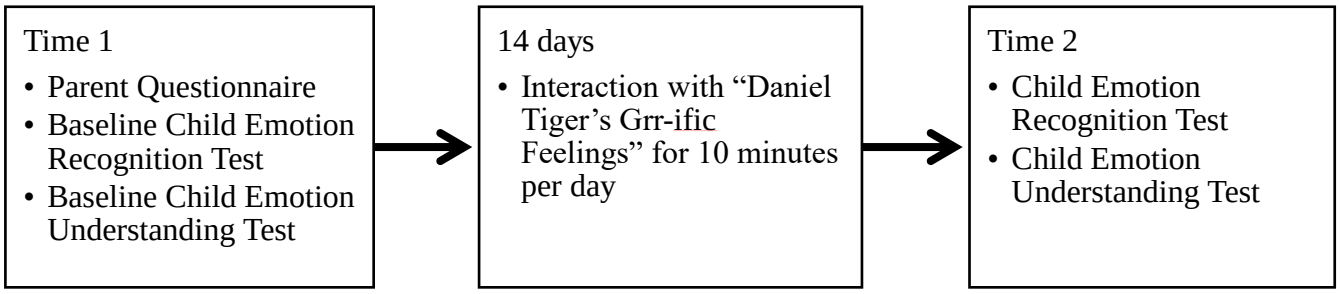

Table 1. Timeline of study procedure.

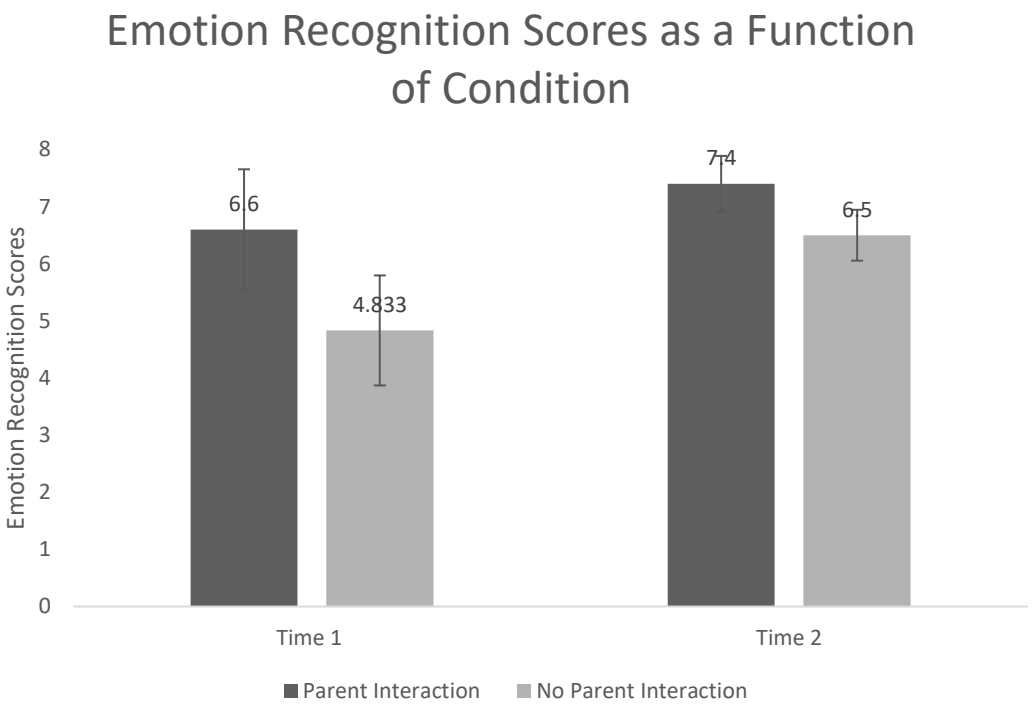

Figure 1. Means for emotion recognition scores as a function of parent interaction.

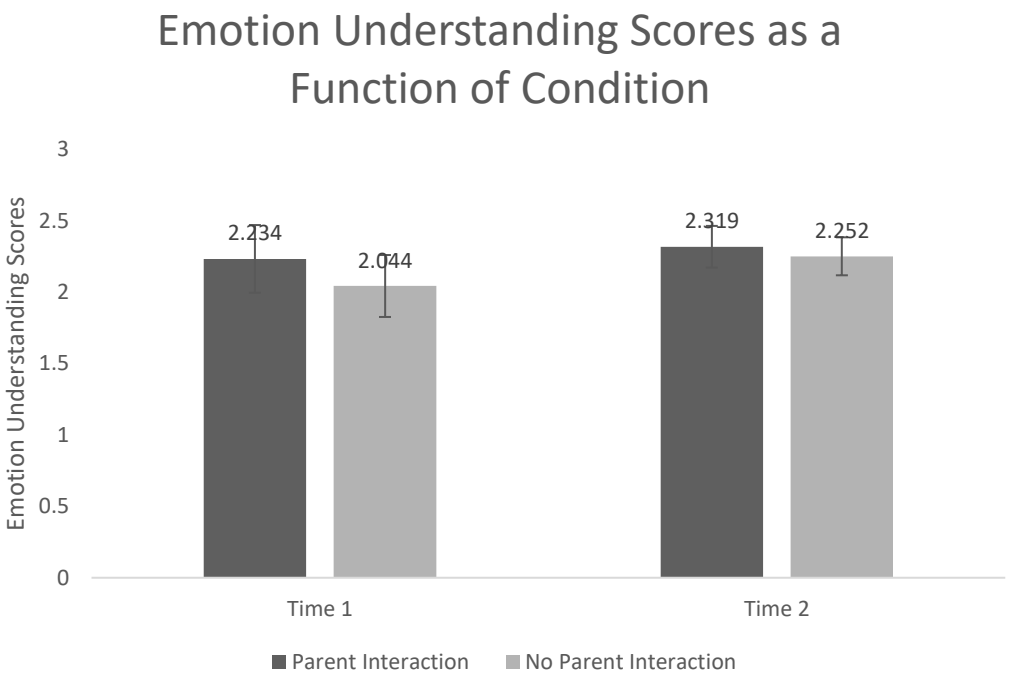

Figure 2. Means for emotion understanding scores as a function of parent interaction.