PROBLEM-SOLVING WITH ORANGUTANS (*PONGO PYGMAEUS* AND *PONGO ABELII*) AND CHIMPANZEES (*PAN TROGLODYTES)*: USING THE IPAD TO PROVIDE NOVEL ENRICHMENT OPPORTUNITIES

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ABSTRACT

The Houston Zoo is home to ten chimpanzees (*Pan troglodytes)* and six orangutans (*Pongo pygmaeus* and *Pongo abelii*). The iPad was recently introduced and evaluated for a six month time period to determine if it was a viableenrichment activity for these orangutans and chimpanzees.. In an effort to keep the iPad novel, give each ape an equal opportunity for interaction, and due to time constraints, all individuals were given five minute sessions at least twice a month during this time period. A variety of applications were offered for the apes to interact with or observe on the iPad. These applications were divided into categories dependent on certain criteria including auditory stimulation, visual stimulation, interaction level, screen usage, and problem solving component. Their interest level and interaction were recorded for the iPad itself as well as for specific applications. The data were examined to look for trends in interest level and interaction for the two species, for each gender, and for each age group. The juveniles had the most interest in the iPad as well as in the highest variety of applications. Adult females also showed a high level of interest in the iPad but often had specific applications that they favored based on individual preferences. Adult males had the lowest interest level in the iPad. Differences between the species were minimal with both species showing a preference for brightly colored applications that also provided auditory stimulation. The information gathered from this evaluation is being used to further develop the iPad as an enrichment activity by providing insight into what types of applications would be the most enriching to introduce to these two species in the future.

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INTRODUCTION

Environmental enrichment has become a common practice in zoos as a way to enhance the quality of life of captive animals by providing stimuli designed to improve their physical and psychological well-being (Clarke, 2011). Most enrichment is aimed at engaging the animals and encouraging natural behavior. Enrichment devices may mimic common situations the species would face in the wild when completing everyday tasks such as foraging for food or seeking shelter. As an alternative, enrichment may be designed to provide cognitive challenges (Meehan and Mench, 2012).

In the wild, chimpanzee (*Pan troglodytes)* and orangutans (*Pongo pygmaeus* and *Pongo abelii*) have been quite innovative in accomplishing many daily tasks. Tool use is an example of this problem solving ability in action. Chimpanzee tool use has been observed in a variety of cases: oil palm nut cracking in Bossou, Guinea (Biro and Inoue-Nakamura, 2003), hunting prosimians in Fongoli, Senegal (Pruetz and Bertolani, 2007), and termite fishing in Gombe National Park, Tanzania (Lonsdorf, 2005). Orangutans also engage in tool use. Examples of observed orangutan tool use include leaf protection from ants or spiny item in Ketambe, Sumatra (Wich et al., 2009), eating *Neesia* fruits in Suaq Balimbing, Sumatra (Van Schaik 2001) and branch hook use in Kaja, Borneo (Wich et al., 2009).

Enrichment in a captive setting can give chimpanzees and orangutans the opportunity to engage in problem solving as they would in the wild. The use of problem solving challenges as enrichment for great apes has also been proposed as a way to give these intelligent primates more control in a captive environment. In the wild, great apes can effect change in their own

environment through modification of their own behavior. Problem solving enrichment can give captive animals this same opportunity (Meehan and Mench 2012). Furthermore, Clarke suggests that not only should cognitive tasks be used as enrichment but that the effort should be made for devices and tasks to match individual motivation and skill (Clarke, 2011).

The development of new technology has created more enrichment opportunities for keepers to incorporate into their husbandry routine. Computer technologies such as touchscreens have been incorporated as enrichment devices in multiple institutions for both orangutans (Perdue et al., 2012) and chimpanzees (Herrelko et al., 2012) in recent years. The iPad is another such opportunity. Its small size makes it very mobile and the screen is easily accessible for chimpanzee and orangutan fingers. The quantity and variety of applications available can be used to challenge the apes with new problems to solve as well as continuously create novel situations for them. It also allows the enrichment session to be tailored to fit each individual primate.

The goal of this study was to determine if the iPad would be a suitable enrichment option for the orangutans and chimpanzees at the Houston Zoo. A suitable enrichment option is one that would provide stimulation for the orangutans and chimpanzees based on their interactions with the iPad and their behavioral responses when presented with the iPad. It is important that any enrichment, such as the iPad, provided to animals in captivity is accomplishing its purpose and adding to the animal's quality of life. The problem solving tool "S.P.I.D.E.R." is one model that can aid keepers in developing enrichment ideas that promote species appropriate behavior and provide the animals with choices and control. The steps for

analyzing and discussing include Setting Goals, Planning, Implementation, Documenting, Evaluating, and Readjusting. This study included all steps of the S.P.I.D.E.R. model but focuses on the evaluation stage within this process.

A secondary objective was to determine if any behavioral trends existed that could be useful in tailoring iPad enrichment sessions to individuals based on their species, ages, and genders. This information would be beneficial for other zoological institutions interested in implementing the iPad as an enrichment device.

METHODS

The study involved presenting the iPad as an enrichment activity to the chimpanzees and the orangutans housed at the Houston Zoo. This chimpanzee community includes two families including 5 males and 5 females that are housed together. The age range includes a 8-year old male and a teen male, 3 females and 1 male in their twenties, and two males and two females in their late thirties/early forties. The chimpanzees are ex-entertainment chimpanzees that came from a private facility in California. The chimpanzees were integrated into one community in the fall of 2010 at the Houston Zoo.

The orangutans in the study live in four separate groups. However, occasional introductions among members of different groups occur in order to mimic natural conditions of these semi-solitary apes. An adult male in his late thirties occasionally is introduced for a few hours once per month to one of the adult females, when she is receptive. A female juvenile, 9 year-old, orangutan is introduced to the infant female for a few hours three days a week. The rest of the week, she and the juvenile male are housed together. An adult female in her thirties

and her juvenile, 9 year-old, son make up the third pair. The fourth pair consists of a 2 year-old female infant and her surrogate mother who is in her early forties. The orangutans were all born in captivity at various zoos in the United States. All but two were hand raised.

The study involved presenting the iPad to individuals or small groups of animals in separate holding areas off exhibit. Sessions lasted a total of five minutes and occurred at least twice per month for each individual regardless of interest level over a 6-month period. Animals could choose not to interact with the iPad, but still the opportunity was offered for the full five minutes. No food rewards were given to entice interest in the iPad. Sessions were occasionally ended early if the animal exhibited behaviors that were unwanted for husbandry reasons such as grabbing at the iPad or exhibiting aggression towards a keeper or another ape. The sessions would also be ended if the animal showed signs of stress or fear, although this did not occur during the study period.

iPad applications were evaluated based on components they possessed. These components included auditory stimulation, visual stimulation, tactile interaction level, problem solving, and screen usage (Table 1). Tactile interaction refers to the opportunities within the application for individuals to effect the application by touching the screen and is divided into three categories; high, intermittent, and none. Problem solving refers to applications that would necessitate a specific task be completed. Screen usage refers to the percentage of the iPad screen that is utilized during the application and is divided into two categories; high meaning greater than 50% and low meaning 50% and under. Applications could possess multiple components. In each five minute session, multiple applications were presented to the individual on the iPad. The animal's interaction time, applications used and other relevant data

were recorded. The average interaction time over the 6-month period was calculated for each individual. Data collected were compared between species, genders, and age classes for qualitative trends in interaction time with the iPad, interaction time with the iPad when presented with specific applications, and if the interaction time for applications was related to specific components of the applications. As this was an inductive study design, the analysis was qualitative, not quantitative.

RESULTS

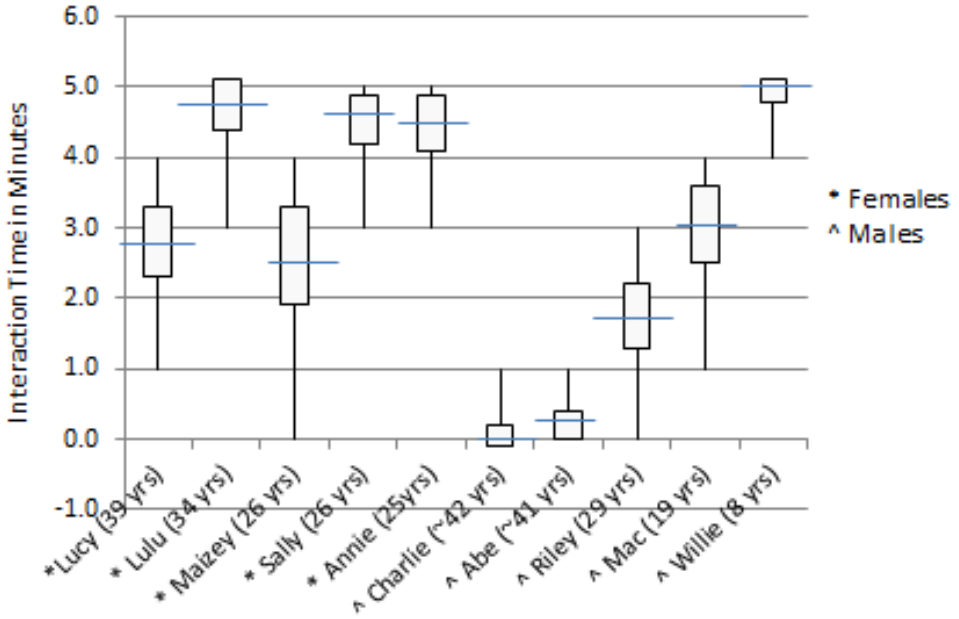
Interaction time with the iPad and a preference for specific application components was not markedly influenced by species. Chimpanzees did show more variation in interaction times across the 6-month study than did orangutans (Fig. 1). For all great apes within the study, the tendency was for a longer interaction time when shown applications featuring an auditory component as well as high level of tactile interaction (Table 1).

Compared to males (across species), females tended to consistently engage in longer iPad interaction times. Female mean interaction time ranged from 2.5 to 4.5 minutes, while male interaction time ranged from 0 to 5 minutes. Both juveniles and adult females had interaction time means that fell on both the high and low ends of the 2.5 to 4.5 minute range. Juvenile males in both species had iPad interaction times that consistently fell between 4 and 5 minutes, while the oldest males in both species consistently had the lowest interaction times of less than a minute (Fig. 1).

	Group type				Criteria			
Application	# group types	Juvenile	Adult Female	Adult Male	Sensory (V=visual, A=audio)	Tactile Interaction	Screen Usage	Goal Oriented
GT Zoo	3	+	+	+	V, A	intermittent	low	no
Music Sparkles	2	+	+		V, A	high	high	no
Painting Sparkles	2	+	+		V, A	high	high	no
Koi Pond Light	2	+	+		V, A	high	low	no
Sound Touch	2	+		+	V, A	high	low	no
Video	1			+	V, A	none	low	no
Farm Sounds	1			+	A	high	low	no
Cat Fishing	1		+		V	high	high	yes
Games for Cats	1		+		V	high	high	yes

Table 1. Recommended ipad applications based on criteria. Specific applications are listed in order of the appeal to the largest number of group types (juvenile, adult female, adult male).

A. CHIMPANZEES



B. ORANGUTANS

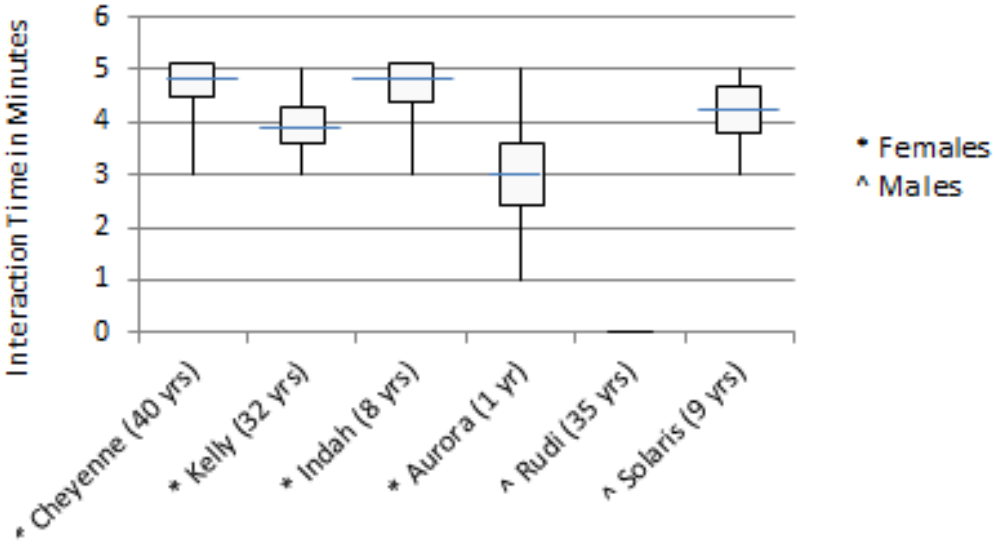


Figure 1. Interaction time of (a) chimpanzees and (b) orangutans. The mean interaction time for individual chimpanzees for twelve iPad sessions over a six month time period. Each iPad session occurred for five minutes regardless of individual's interaction.

In regard to interaction time for specific applications, juveniles had higher interaction times when presented with applications with high screen usage, a high level of tactile interaction and an auditory component. Most juveniles had lower interaction times when presented with problem solvingapplications with the exception of the juvenile male chimpanzee, Willie. All juveniles showed the lowest interaction time with applications involving no tactile interaction. Adult females had a higher interaction time than other groups for problem solving applications (Table 1).

DISCUSSION

The differences in iPad interaction time based on gender correspond with observations of chimpanzees in the wild and their ability to learn and engage in tool use. Female chimpanzees have a higher frequency, efficiency, and duration of tool use for termite fishing than male chimpanzees in Gombe (Lonsdorf, 2005). Other enrichment studies have also found that juveniles spend more time interacting with different enrichment devices than adults (Pruetz and Bloomsmith, 1992).

The results from this study were based on sixteen individuals and many other factors may have come into play that could affected interaction time with the iPad and specific applications. Factors for further study include individual personality, individual history, and genetic predisposition. In particular, the data from this study suggests that interaction times with the iPad may follow family lines with mothers and their offspring having similar interaction times . For the chimpanzees, Lulu and her offspring Annie, Sally, and Willie have mean interaction times above 4.5 minutes with small confidence intervals, while Lucy and her

offspring Maizey, Mac, and Riley have mean interaction times between 1.5 and 3 minutes with much larger confidence intervals and outliers (Fig. 1). Another potential topic of future study would be the change in interaction time with the iPad of the juvenile males as they age. Will males introduced to the iPad at a young age maintain interest as they grow older or will their interaction time decrease as they reach adulthood?

The main purpose of the study was to determine if the iPad was a suitable enrichment device that provided stimulation to the chimpanzees and the orangutans. The interaction times of both orangutans and chimpanzees with the iPad indicate that it is a potentially suitable enrichment option when using the S.P.I.D.E.R. model for evaluation. The information gathered from the study is being used to improve the use of the iPad as an enrichment device at the Houston Zoo corresponding with the readjusting step within the S.P.I.D.E.R. model. iPad sessions are now primarily being offered to juveniles and adult females as enrichment opportunities. Adult females are most often presented with specific applications featuring problem solving components, while juveniles are presented with a variety of applications with a focus on those that contain auditory stimulation and high tactile interaction.

The iPad does appear to provide mental stimulation to several chimpanzees and orangutans at the Houston Zoo. It is an especially useful enrichment option for providing mental stimulation in situations when animals are unable to be on exhibit due to inclement weather, group management, or injury. Since, it was introduced at the Houston Zoo without the use of food rewards in is also a non-food based enrichment option.

CONCLUSIONS

1. iPad interaction time varied among individuals.
2. Females and juvenile males maintained high interaction times with the iPad throughout the 6-month time period, while adult males maintained low interaction times.
3. Applications with auditory and visual components along with high tactile interaction had the highest interaction times overall.

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