ELSEVIER

A quasi-experiment examining the impact of educational cartoons on Tanzanian children

Dina L.G. Borzekowski*

School of Public Health, University of Maryland, College Park, MD, United States

ARTICLE INFO

ABSTRACT

Educational media can positively impact young children; however, few studies have been conducted in developing countries. Researchers investigated the impact of an animated educational series, where participants were randomized to see *Akili and Me* versus other popular programs. In interviews with children, researchers assessed measures before and after four weeks of exposure. From Morogoro, Tanzania, 568 children (mean age - 4.8 years) participated. Controlling for the child's sex, age, and baseline skills in the assessed follow up outcome, exposure to *Akili and Me* significantly improved drawing skills, shape knowledge, number recognition, counting, and English skills. Young and vulnerable children can benefit from a locally-produced educational program. Media interventions should be encouraged as they effectively and efficiently alter school readiness.

1. Introduction

Pre-primary and primary school children need foundational literacy, numeracy, and cognitive skills in order to achieve advanced educational and economic opportunities (Ball, Paris, & Govinda, 2014). Furthermore, education is significantly associated with many health outcomes, especially for the following generation, with increases in maternal education leading to significantly reduced child mortality and improved health outcomes (Gakidou, Cowling, Lozano, & Murray, 2010). While great progress has occurred in the last decade in terms of educational access and equity, many Tanzanians lack a strong base necessary for later success. Though Tanzania has achieved the Millennium Development goal of universal primary education (TMEVT, 2014), the quality of education remains extremely low with half of Tanzanian children aged 10–16 years unable to pass basic literacy and numeracy tests set to the level of an 8 year old (Uwezo, 2013).

Several reasons explain why Tanzanian children fail to thrive in primary and secondary school. To begin, many lack an educational foundation to build upon. Only 42.4% of Tanzanian children are enrolled in pre-primary education (ACEI, 2016). While in very recent years boys and girls have had the same level of access to pre-primary school, there are great attendance disparities in terms of geography (urban vs. rural) and wealth. Urban children are more likely than rural children to attend pre-primary schools; 84% of pre-primary school age children (5–6 years) who were out of school lived in rural areas. Of those children attending school, 62% came from "rich" and "very rich" households, compared to 23% of those from "poor" and "very poor"

households (Uwezo, 2016). Even children who do attend pre-primary school face challenges gaining a solid base. Cosmas (2010) described pre-primary education in Tanzania as inadequate, having an absence of instructional materials, lacking chairs, tables, or desks, having very high enrollment, and a having a scarcity of trained pre-primary education teachers.

The path of child development is similar across populations, however, in countries and communities where resources are limited, age-related milestones exist but can be slightly delayed (WHO, 2007). Despite poverty, malnutrition and poor infrastructure, the typical Tanzanian preschool child remains eager to learn (TMEVT, 2014). Essential to learning about the world around them, play and leisure activities are critical to the 3 to 6 year old. During this early childhood period, receptive and expressive language skills advance, with the young child gaining an ever-increasing vocabulary and having the ability to engage in conversations. By age 5 years, children become aware of literacy, finding their worlds are filled with letters; some children can recognize familiar words in print and most are enthusiastic about acquiring reading skills (Zhao, Zhao, Weng, & Li, 2014). A critical and learned skill developing around this age is the ability to recognize and use language to describe emotions; it is important that young children be able to use appropriate words to convey when they are feeling happiness, sadness, anger, and fear (Denham & Couchoud, 1990). Also during this period, preschool children are learning essential math skills (i.e., counting, addition and subtraction, estimation, patterns, classification, and measurement), which will form a foundation of both concrete and abstract thinking (Fisher, Hirsh-Pasek, Golinkoff, Singer, & Berk, 2011).

* Department of Behavioral and Community Health, School of Public Health, University of Maryland, 1234B SPH Building, College Park, MD 20742, United States.
E-mail address: dborzeko@umd.edu.

Developmentally, this age is when children come to understand dimensional structures; symbols, such as letters or numbers, represent other things and can be connected (Case, 1992; Fischer, 1980). A child who is more adept early literacy tasks, emotional expression, and basic numeracy will 'ready to learn' in a formal school environment than one with fewer of these skills (National Education Goals Panel, 1998).

While not a replacement for a solid and enriching pre-school experience, educational media can serve as a stand-in by stimulating and supplementing learning. Around the world, well-produced television programming can engage hard-to-reach audiences by offering a source of informal education and enrichment (Mares & Pan, 2013). The theorist Albert Bandura was one of the first to explore media effects, especially among young children (Bandura, 2001; Bandura & Walters, 1963). Bandura noted that message components could be manipulated to impact attention, motivational processes, as well as self-efficacy. Attractive and relevant models, which can be examined through constructs like perceived similarity, increase the likelihood of successful observational learning (Bandura, 2004). Described in Fisch's Capacity Model (Fisch, 2000), successful educational programs narrow the distance between the educational content and the narrative, so that facts and lessons are tightly woven into the storyline. Additional factors that can increase children's learning include bold and bright images and simple, melodic music (Yazejian & Peisner-Feinberg, 2009). Finally, familiarity with content, either through repetition, recognizable artifacts, or known subjects, results in children's greater learning from media (Crawley, Anderson, Wilder, Williams, & Santomero, 1999; Fisch, 2000).

The most well-studied children's television show has been *Sesame Street* (Cole & Lee, 2016). Longitudinal research conducted in the United States shows that children's early educational viewing can lead to positive trajectories, lasting well into secondary school (Anderson, Huston, Schmitt, & Linebarger, 2001; Fisch, 2014). Preschool children exposed to the various international versions of *Sesame Street* have made significant gains in knowledge about letters, numbers, shapes, science, environment, one's culture, and health and safety-related practices (Borzekowski & Henry, 2011; Borzekowski & Macha, 2010; Cole et al., 2003; Mares & Pan, 2013). In a study of 223 Tanzanian preschool children, significant gains in literacy, numeracy, social development, and emotional development were associated children's receptivity of *Kilimani Sesame*, as assessed through the accurate naming of the program's characters (Borzekowski & Macha, 2010).

Besides the literature on *Sesame Street's* international productions, no published research, to date, exists on the impact of children's media created in low and middle income countries (LMICs). The fact is, very little educational media is produced, and in turn evaluated, in LMICs. In such countries, most children's programming is comprised of entertainment and is imported from developed, northern-hemisphere countries (Bryant, 2007; Hendriyani, Hollander, d'Haenens, & Beentjes, 2011; Osei-Hwere, 2011). A study conducted in six LMICs found that young children were most familiar with the globally-distributed characters of Tom & Jerry, Mickey Mouse, Ben 10, and SpongeBob Squarepants (Borzekowski & Pires, in press). The research presented in this paper is unique in that it examines the impact of a locally-made educational program produced in Dar es Salaam, Tanzania. Using a carefully designed study, we expected that young, peri-urban children exposed to several episodes of the educational cartoon *Akili and Me* compared to a similar cohort watching episodes of other contemporary and popular TV programs would show greater gains in various educational outcomes.

2. Method

2.1. Setting

This study occurred in early 2016 and participants came from Morogoro. This location is in the eastern part of Tanzania, around

200 km west of Dar es Salaam, at the base of the Uluguru Mountains. Approximately 300,000 people live in Morogoro and the prominent industry is agriculture (National Bureau of Statistics, 2012). In this region, 20.7% and 15.9% of women and men, aged 15 to 49 years, respectively, have a secondary education (MoHCDGEC et al., 2016).

2.2. Procedures and sample

The intervention began at school year's start, and involved children aged 3 to 6 years who had not yet attended any formal pre-primary school. At initial school year in-person meetings, parents were told about the study and informed that the purpose was to examine how controlled viewing of videos might affect children. Parents were provided with an overall list of videos that children might see during the study, without specific attention to *Akili and Me*. While viewing was incorporated into the regular school day, the protocol required active parental consent and active participant assent for partaking in the interviews and assessments. After the consent procedure, parents were interviewed, so demographic information could be obtained. Researchers assessed participating children at baseline and immediately following the intervention, which lasted four weeks. Interviews were in the local dialect of Kiswahili.

The baseline sample included 595 preschool children drawn from 9 randomly selected schools in peri-urban areas of Morogoro. This post intervention sample consisted of 568 children and this group served as our primary analysis sample. These children were on average 4.8 years (SD = 1.1) and 51.3% were female. Slightly more than half (57.2%) of the parents reported that the child lived in a household with an adult who had higher than a secondary education. According to parents, the children lived in households where 69.4% had a radio, 54.9% a television, 25.4% a refrigerator, and 74.6% piped water. Most (89.6%) households had a mobile phone; 27% of these phones were "smart phones." No significant differences were observed between the treatment and control children in terms of demographics or household resources.

Protocols were developed and reviewed by U.S. and East African child development experts, then pilot-tested with a sample of preschool children in Dar es Salaam. Instruments are available upon request. A team of 24 Tanzanian researchers were recruited and underwent extensive training, an initial two week course and then continuous in-person supervision so that protocols were delivered in an ethical, reliable, and valid manner. As part of this training, the researchers heard lectures on child development and research practices with young children. They practiced conducting research with young children and were very familiar with the different assessment tools. Additionally, approval for conducting research was obtained from the Tanzanian Commission for Science and Technology (COSTECH) and the University of Maryland's Institutional Review Board.

One-on-one interviews were done in Kiswahili before and after children were exposed to the intervention. It should be noted that the researchers were blind to the study's purpose and were not told if the child was in the treatment or control group. The interviews with the children took, on average, 40–45 min. Many questions allowed children to point to their answers on picture cards. Other questions were open-ended or involved scoring a response. For example, the researchers had a code scheme for how well the child drew his or her triangle. Researchers would give a score of 0, 1, 2, or 3 for the number of closed corners without gaps and a 0 (no) or 1 (yes) for whether the child's triangle resembled a triangle with diagonal, relatively straight lines.

Researchers also interviewed parents also in Kiswahili, for around 35 min, focusing questions on the child's demographics, household resources, and media use. These questions were all close-ended with structured responses.

After the baseline survey, researchers randomized children at each school setting for the intervention. Children were assigned to watch 30 min of *Akili and Me* (the treatment group) or popular children's

programming (the control group), five days a week for four weeks. At each school, viewing occurred concurrently in two separate locations to reduce the possibility of contamination between groups. An implementation team, distinct from the research team, implemented the intervention and took attendance; schoolteachers assisted with attendance taking and then were asked to wait outside so as to avoid viewing of either group's intervention videos. Four research leads made unscheduled visits during the intervention to verify adherence to protocols.

No attention measures were collected. A child could be in the exposure location, but no attention measures were collected (such as monitoring of eyes-on-screen). Anecdotal reports indicate that the intervention was very popular, encouraging school attention and drawing interest of children not yet even enrolled in the school.

2.3. The treatment videos

Akili and Me is a Tanzanian produced animated series teaching school readiness skills, in both Kiswahili and English. A character-driven approach is used to convey educational material, where East African characters (a young African girl and her animal friends) encounter challenges and solve problems. The first 12 min of every 30 min episode presents a Kiswahili speaking narrator to guide children along as 2–3 English vocabulary words are introduced through the characters' adventures. The remaining 18 min consists of 63 min segments teaching, in the following order: Kiswahili letter learning songs, English letter learning songs, drawing and fine motor skills (described in Kiswahili), story time (in Kiswahili), numeracy (in Kiswahili) and numeracy (in English). Fig. 1 shows a screenshot, displaying how content appears bold and clearly. Audiences see and hear the alphabet song where each letter is sung with a recognizable object, start with that letter ("K" is for "kuku"). In a given episode, educational material is developed such that viewers' learning is scaffolded. Material is shown in different ways, so that concepts are reinforced and complemented with similar components. *Akili and Me* commenced its broadcast in April 2016, so no study participants had prior exposure to the content, except for the small possibility of seeing promotional trailers broadcast on national television prior to the series launch.

In this study, five different episodes were shown over four weeks, with children watching each episode for four days in succession. This repetitive design was used since repeated exposures to episodes, as done with the children's educational program *Blue's Clues*, results in enhanced learning and program involvement (Crawley et al., 1999).

2.4. The control videos

Those children randomized into the control group watched age-appropriate children's television currently available on DVD or online in Tanzania. The selection of the control shows was based on an inquiry of non-study participants (40 children and 20 adults), where researchers asked subjects to "name five to seven of the most popular educational shows watched by Tanzanian children." Most of these programs were in Kiswahili, with limited dialog, and while perceived as education, it is not clear that this was a goal of these shows. The control programming mimicked the format of the treatment episodes, beginning with a 12-minute episode of *Tinga Tinga Tales* in Kiswahili, followed by 5–7 shorter videos of 2–5 min each, including programs such as *Pingu*, *Shaun the Sheep*, and *Longhorn Kiswahili Stories*. Like *Akili and Me*, these shows used bright and bold images to convey simple narratives. *Tinga Tinga Tales* and *Longhorn Kiswahili Stories* are produced in Kenya, *Pingu* and *Shaun the Sheep* are produced in the U.K. All shows used animal characters; those in *Tinga Tinga Tales* and *Longhorn Kiswahili Stories* were animals that inhabit the East Africa region, while *Pingu* used animals of the Antarctic and *Shaun the Sheep* features domesticated farm animals typical of Europe, North America, and Australia.

2.5. Measures

Researchers used culturally and age appropriate instruments, mainly the Save the Children International Development and Early Learning Assessment (IDELA) tool. IDELA successfully captures early learning of children from developing countries using a "rigorous, holistic yet feasible and reliable instrument" (Pisani, Borisova, & Dowd, 2015; Raikes, 2016). IDELA's validity has been tested with over 5300 children from 11 countries with data collected between 2013 and 2014 (Pisani et al., 2015). IDELA covers multiple dimensions of early childhood development, with a focus on early academic and behavioral skills, social-emotional developments, and aspects of physical health (Wolf et al., 2017). Using this tool, this research could assess outcomes that reflect skills and domains necessary for the success in primary grades (Pisani et al., 2015). Children with better knowledge and stronger skills in fine and gross motor capabilities, language and early literacy, math and problem solving, and socio-emotional awareness are more ready for school. Around the world, improving the early learning experience is a crucial step in preventing school dropout, reducing later learning difficulties, and enabling long-term school success (Engle et al., 2011). We assessed and describe in the following paragraphs how our research team used the IDELA tool to measure the drawing skills,

Fig. 1. A screen shot from Akili and Me, showing that "K" is for "kuku", the Kiswahili word for chicken.

shape knowledge, number recognition, counting, letter identification, emotion identification, and English skills. We omitted most of the IDELA's social-emotional and motor development question batteries from this study as they were less relevant to the content presented in either the treatment or control video programs.

2.5.1. Drawing skills

At both assessments, children were asked to copy a triangle form as well as draw a picture of a person. Additional items measured the child's concentration on each of these tasks. Scoring rubrics noted how close to accurate were the illustrations. The baseline and follow up Cronbach's alphas was 0.80 (11 items).

2.5.2. Shape knowledge

Researchers presented a page of shapes and instructed children to identify a circle, rectangle, triangle, and square, first in Kiswahili, and then again in English. Researchers also asked children to name an object in their environment that was shaped like a circle. These items had extremely poor internal consistency (Cronbach's alpha was very low, 0.21 at baseline and 0.15 at follow-up), suggesting that children may be familiar with some shapes but not others.

2.5.3. Number recognition

Researchers showed a grid including numbers ranging from 1 to 20, randomly placed, and asked participating children to identify each in Kiswahili or English. The baseline Cronbach's alpha was 0.91, and follow-up was 0.93.

2.5.4. Counting

Children answered 17 questions to assess their counting skills (Baseline Cronbach's alpha of 0.94, follow up of 0.95). Children were asked to recite the numbers from 1 to 10 in English, as well do different manipulations with beans instructed first in Kiswahili, and then in English (i.e., count out eight beans).

2.5.5. Letter identification

As done with numbers, letters were presented randomly placed in a grid. Researchers pointed to and asked children to name 20 different letters. Also, children were asked about the starting sound of three different words ("kaka," "toto," and "dada.") The baseline Cronbach's alpha was 0.92 at baseline as well as at follow-up (23 items).

2.5.6. Emotion identification

Seven questions were used to assess the children's ability to recognize and name emotions. Children are asked about a moment that made them feel sad and want to cry. They are also questioned about things that made them feel happy. Lastly, children are shown a line drawing of a child crying. They are asked to identify the depicted emotion and potential strategies to change how the child is feeling. Researchers coded the responses as appropriate or inappropriate. At baseline the Cronbach's alpha was 0.75 and at follow up it was 0.78.

2.5.7. English skills

Throughout the assessment, researchers asked 30 different questions in English. A scale was created from the child reciting to ten (ten items), naming six body parts (six items), noting shape names (four items) counting groups of beans (three items), identifying action words (four items), and noting letter sounds (three items). The baseline Cronbach's alpha was 0.85 and follow up was 0.88.

2.6. Analytic approach

We began by conducting a descriptive analysis of the sample and the outcomes, comparing our treatment and control groups at baseline and follow-up. Chi-square tests were used to consider the demographics, as these were categorical variables. Our outcome measures were the child's post-intervention scores; these were all continuous, with normal distributions. Linear regression models were estimated to consider the impact of group assignment (treatment versus control) on the outcome scores, while entering just a parsimonious group of variables. We estimated models similar to those used in other research, so that comparisons could be made across studies of educational television (Borzekowski & Henry, 2011; Borzekowski & Macha, 2010). We included a child's sex and age in the models, but based on other research we expected that the former would not be predictive while the later would significantly predict construct performance. The regression models were quite rigorous, as we included the child's baseline score into the model; we would expect that a great deal of variation would be explained on a child's earlier knowledge of a construct. As a result we are detecting only the impact of exposure to the treatment versus control on change over a four week intervention period.

In the regression analyses, we tested for moderating effects by including interactions in the regression models. While we expected that treatment condition would predict follow-up scores, we also considered if different factors affected the strength between the independent and dependent variable. For example, we explored if the relationship between treatment condition and performance on construct at follow up depended on a child's sex, age, and how a child did on that construct at baseline.

3. Results

3.1. Intervention participation

The 568 children in the sample attended an average of 16.6 ($SD = 4.4$) out of the 20 sessions. There was no significant difference in attendance between the treatment and control groups. At baseline, children knew none of the *Akili and Me*; following the intervention, children in the treatment group could name on average 1.8 (out of 5) characters while those in the control group could name 0.1 characters (t (561) = 16.17, $p < 0.001$). Neither the child's sex nor age was associated with attendance or ability to name characters at follow-up.

3.2. Baseline and follow-up scores

Table 1 provides data on the different outcomes for each group, at baseline and follow-up. It should be noted that for three variables children in the control group began with significantly higher scores than those in the treatment group (number recognition (t (561) = 3.3, $p < 0.001$); counting (t (561) = 2.2, $p < 0.05$); letter identification (t (561) = 3.0, $p < 0.01$)).

3.3. Regression models

Table 2 offers information on the regression models. All models were significant, but the range of variation explained by this set of variables ranged from the low Adjusted R^2 of 0.08 (shape knowledge) to

Table 1
Mean scores at baseline and follow-up for the different outcomes.

Variable	Scale	Treatment group		Control group	
		Baseline M (SD)	Follow-up M (SD)	Baseline M (SD)	Follow-up M (SD)
Drawing skills	0–12	5.2 (3.3)	6.5 (3.3)	5.4 (3.6)	6.2 (3.5)
Shape knowledge	0–7	2.2 (1.4)	2.6 (1.3)	2.1 (1.4)	2.3 (1.4)
Number recognition	0–20	3.1 (3.9)	5.5 (5.3)	4.4 (5.5)	6.1 (6.3)
Counting	0–17	3.6 (4.1)	5.5 (5.5)	4.4 (5.1)	5.0 (5.4)
Letter identification	0–22	1.5 (2.7)	2.8 (3.9)	2.4 (4.3)	3.4 (5.0)
Emotion identification	0–7	3.1 (2.2)	3.6 (2.3)	3.0 (2.3)	3.5 (2.4)
English skills	0–22	4.7 (4.4)	6.7 (5.6)	5.2 (5.1)	6.3 (5.3)

Table 2
Regression models predicting follow-up scores on various assessments.

Variable	Drawing skills	Shape knowledge	Number recognition	Counting	Letter identification	Emotion identification	English skills
Constant	1.26	1.26	− 1.42	0.85	0.75	0.67	1.59
Baseline score	0.62***	0.23***	0.93***	0.79***	0.96***	0.51***	0.68***
Sex (girls = 0, boys = 1)	− 0.35‾	0.06	0.42	− 0.20	0.03	− 0.06	− 0.08
Age	0.46***	0.16**	0.79***	0.40*	0.12	0.29***	0.42*
Condition (control = 0, intervention = 1)	0.50*	0.23*	0.64*	1.13***	0.29	0.08	0.77*
Adjusted R^2	0.48	0.08	0.67	0.47	0.59	0.29	0.36
F stat (df)	131.67***	13.30***	279.83***	125.63***	200.69***	57.39***	79.53***
	(4, 556)	(4, 556)	(4, 556)	(4, 556)	(4, 556)	(4, 556)	(4, 456)
Effect of intervention	8.2%	9.7%	11.7%	24.0%	9.7%	2.3%	12.5%

‾ $p < 0.10$.
* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.

the high Adjusted R^2 of 0.67 (number recognition). Not surprisingly, a child's baseline score was a significant predictor for every model; a child's knowledge at the study's start was associated with his or her performance on the same construct four weeks later. A child's sex was never a significant predictor, suggesting that at this developmental stage, boys and girls are similar with respect their performance on these types of outcomes. Age was significant in all models except letter identification; children who were a little older in the sample did better than those who were younger on the assessments.

Exposure to the treatment program significantly improved children's scores, compared to those in the control group, for five of the seven outcomes (drawing skills, shape knowledge, number recognition, counting, and English skills). The effect of the intervention was greatest for counting skills, where those who had seen the treatment show performed on average 24% better on the follow-up assessment than those watching the control shows, controlling for the child's baseline score, sex, and age. The remaining effect sizes range from 2.3% to 12.5%.

Additional models were estimated which included highest parent education, access to different household resources, and attendance during the intervention period. None of these variables were consistently significant, so we offer these more parsimonious models - only controlling for baseline score, sex, and age. Moderating effects were not observed among these variables with the scores at follow up, so no interactions are included in the regression models.

4. Discussion

This study offers solid evidence that exposure to the Tanzanian-produced children's program *Akili and Me* can boost school readiness. Children who watched *Akili and Me*, as confirmed by their ability to recognize and name characters, gained valuable and foundational educational content above and beyond other factors associated with achievement like existing knowledge and greater maturity. We document that among those children who already knew some content at baseline or were slightly older, there was an additional benefit from watching *Akili and Me* on most of the outcomes. In this work, we also observed that regardless of demographics, parents' education, household resources, and attendance during the intervention period, just four weeks of minimal, albeit controlled, exposure to *Akili and Me* could lead to higher scores in a variety of educational outcomes.

The greatest effects of exposure were observed for the outcome of counting, a measure that was featured and repeated often in the *Akili and Me* videos. The next greatest effect was seen with English skills, which is not surprising as it is a stated goal of the program. Interestingly, watching *Akili and Me* was not associated with either letter or emotion identification. The former finding is odd, as the program does presents and name letters; the latter finding is more understandable, as this content is less frequently emphasized. These various

results have already been reported to the production team and efforts are underway to revise how content with weaker and non-significant findings can be improved to better reach the target audience.

To date, the published international educational media research has considered *Sesame Street* productions. (Our team is aware of studies of other television programs; however, these are not available as they are privately owned by either the production companies or foundations.) The results of this study of *Akili and Me* greatly resemble the findings observed in other *Sesame* studies (Borzekowski & Macha, 2010; Mares & Pan, 2013). For example, in this and other research examining the impact preschool media, a child's sex is hardly ever a significant predictor of outcomes. It seems that boys and girls under age 6 or 7 years benefit from programming in similar ways. In contrast, age and baseline knowledge of a topic are usually significant and positive in estimated models (Borzekowski & Henry, 2011; Borzekowski & Macha, 2010). Children who are slightly older and have some background related to the assessed constructs seem to do better than those who are younger and new to the presented material. This small study of *Akili and Me* provides additional evidence to the children and media literature, presenting that exposure to an educational program can have beneficial effects on vulnerable children, even in low and middle income countries.

Drawing on Fisch's Capacity Model (Fisch, 2000) which theorizes on how educational media affect their audiences, we can assume that *Akili and Me* lessened the distance between the presented narrative and the educational content. *Akili and Me* uses character-driven stories to highlight learning outcomes. In the English language learning segments, the four main characters encounter problems that require the character to learn and repeat the target word in order to complete his/her challenge or adventure. In one episode, a circle, square, and triangle run away from the Shape Train, stalling the train's movement. The main character must find and identify by name the shapes in order to get the train back on course. The educational media literature recommends that salient formal features like bright colors and music be used, as these increase young children's attention to media (Anderson & Pempek, 2005). *Akili and Me* incorporates bold visuals (see again Fig. 1) and catchy melodies to present content. As well, media researchers have found that young children benefit and learn more when material is moderately repeated (Crawley et al., 1999). In *Akili and Me*, each target English word is built into the story and repeated a minimum of three times in the initial 12-minute segment, followed by reinforcement in various ways throughout the rest of the episode.

A strength of *Akili and Me* is that it uses scaffolding to convey a lesson or topic; that is, a variety of instructional techniques are employed to teach an objective. For example, a show whose goal was to teach about the body opened with a one 12-minute segment where the characters learn about body part names (head, body, legs, arms) by building a doll which then comes alive (subgoal – teaching body terms in English). This was followed by a 3-minute song calling out to viewers

to 'touch your head', 'touch your arms', 'touch your body', 'touch your legs' (subgoal – teaching body terms in local language). Next, audiences saw a 3-minute drawing segment in which a narrator modeled and encouraged viewers to draw a simple body form (subgoal – developing fine motor skills). The episode closed with a 3-minute story entitled 'Good Food to Make You Strong' which incorporates the words presented in the episode (subgoal – using English and local language vocabulary).

While *Akili and Me* employs many critical factors necessary for effective educational media, its most distinctive feature likely contributing to the program's success, especially for this young and vulnerable audience, is the inclusion of culturally relevant elements. To date, practically all media reaching Tanzanian children comes from other regions of the world and include references that might be unfamiliar to this audience. For example, the popular children's show *Shaun the Sheep* is produced in the U.K. and its protagonist makes allusions to cultural items like da Vinci's painting *Mona Lisa* and movies such as *Star Wars*, *The Matrix*, and *Pulp Fiction*. In contrast, *Akili and Me* is a locally-produced educational program, that presents the music, characters, and culture of East African children. *Akili and Me's* episodes center around four themes of early childhood: 1) all about me, 2) my environment, 3) my home and neighborhood, and 4) school readiness. These themes draw on and reflect the lives of young African children. The show's main character, Akili, is a four year old Tanzanian girl, living in a modest village home surrounded by chickens and other livestock. Her fictional friends, Little Lion, Happy Hippo, and Bush Baby, are animals with which many rural African children may know. Local details, such as fabric styles and foods eaten, are embedded in Akili's adventures. If children are more familiar with a program's features, then they are better able to devote more energy to processing the novel content (Fisch, 2000), such as new words, numbers, and letters. Furthermore and adhering to Articles 29 and 30 of the United Nations Convention on the Rights of the Child (United Nations, 1989), *Akili and Me* recognizes and conveys aspects of East Africa's identity, values, and language and uses them effectively to advance educational and entertaining content. This is not a surprising finding. Almost forty years ago, researchers found that children learned more from a televised narrative when their ethnic and social class background matched that of the program's characters and situation (Newcomb & Collins, 1979).

Despite the challenges of the study setting, this work was well-designed, closely monitored, and employed rigorous measures. Quality control was notable. For example, the local research team was well-trained to best conduct this research, and assessment tools considered the limited attention spans and literacy skills of the participating children. Supervisors double-checked attendance records. Collected data had high reliability and resembled data collected from similar samples (Pisani et al., 2015). The estimated regressions models were quite restrictive, as we included the baseline measure which picked up a great amount of the variation in the outcomes. It is remarkable that exposure over just four weeks was significantly and positively associated with most of the outcomes.

Still, limitations remain. This work occurred in a remote location of Tanzania, and it is unknown if the impact of *Akili and Me* can generalize to additional samples in Tanzania or other SubSaharan African countries. The results here were observed after a four week intervention. We do not know the long-term impact of this exposure, nor do we know if effects are sustained after viewing. Lastly, an odd finding was observed in this data and may suggest a problem. For three variables, our control group had significantly greater skills at baseline compared to the treatment group. The research and implementation teams have been consulted, and we can confirm that true randomization occurred to assign children to groups. The observed differences suggest that there may be an irregularity with the groups bring some reservation into interpreting the findings from this study.

This study has exciting implications. Exposure to a television show that can be delivered through broadcast is egalitarian; especially in low and middle income countries, where access to preschool education may be limited, the reach of television is practically universal (Mares & Pan, 2013).

There is a moral imperative to create economically efficient and equitable investments in childhood education (Heckman, 2011). Developmentally, children between the ages of three to six years are ready to learn. They are becoming aware of and excited to make sense of the various symbols in their environments. Early childhood is a critical time, and enriched environments and quality stimulation are of utmost importance (WHO, 2007). The preschool child eager to learn, and educational media is just one platform that can be used to convey and model information (Kirkorian, Wartella, & Anderson, 2008). Broadcast television in developing countries can serve as a cost effective way to influence and affect learning, especially through educational programming designed to increase school readiness and social competence in young viewers (Baydar, Kağitçibaşi, Küntay, & Gökşen, 2008; Engle et al., 2011; Huston & Wright, 1996). In locations where pre-primary education may be less than adequate, well-produced educational media can assist in readying children to enter grade 1 of primary school. This study of *Akili and Me*, along with the literature on the international Sesame Workshop productions, offers promising support that media can have positive effects, even among some of the world's most vulnerable children (Kirkorian et al., 2008; Mares & Pan, 2013).

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