Science learning in early years: Effects of the Chinese television series Big Bird Looks at the World

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Abstract

Big Bird Looks at the World, a Chinese co-production with Sesame Workshop, the producer of Sesame Street, uses science as a vehicle to promote curiosity, observation, and hands-on investigation among 3- to 7-year-old children. This study assessed the educational impact of Big Bird Looks at the World in a sample of 1860 children. Preschool and Grade 1–2 classrooms in Central and Southwestern China were randomized within schools to the experimental group (watched 42 11-minute episodes of Big Bird Looks at the World over a 7-week period) or the control group (engaged in normal class activities). Children’s Big Bird Looks at the World content knowledge, in terms of science vocabulary and science facts, was assessed through interviews at baseline and post-test; children’s responses were coded for quantitative analyses. Consistent with our assumptions based on cultural script theory, relatively brief exposure to Big Bird Looks...
at the World had significant benefits. Rural and urban children, children in preschool (ages 3–5) and Grades 1–2 (ages 6–7), and boys and girls all gained equally from exposure to the show. The results suggest that entertaining educational television has great potential for helping Chinese young children expand their science learning experiences.

**Keywords**
Big Bird, early science learning, educational television, experimental study, Sesame Street

By all accounts, the television series *Sesame Street* has been a success in the United States. As one of the first educational television programs for young children, it is now the most popular show among preschoolers (Sesame Workshop, 2010) and the longest running children’s show in the world (Encyclopaedia Britannica, 2014). It was originally designed to prepare poor inner-city preschoolers for school (Lovelace, 1990) and help them learn about health, emotional competence, and respect (Sesame Workshop, 2012c), in addition to literacy and numeracy. The earliest large-scale evaluations of *Sesame Street* (Ball & Bogatz, 1970; Bogatz & Ball, 1971) demonstrated that preschoolers who regularly viewed the show had significant gains in vocabulary. A follow-up study reanalyzed the early data of 695 children from five US regions and found that advantaged and disadvantaged children gained similarly from the show’s educational content (Anderson, Greenberg, & Mark, 1979). Decades later, studies continued to find academic benefits for disadvantaged children, who were the show’s target audience (Penuel et al., 2009; Wright et al., 2001).

Research documenting the benefits of *Sesame Street* is consistent with the larger literature showing that educational television benefits young children’s vocabulary (Penuel et al., 2009). Research has also revealed that content is key to these benefits (Fisch, 2015; Schmidt & Vandewater, 2008; Thakkar, Garrison, & Christakis, 2006). The carefully designed educational content that is typical of *Sesame Street* can go a long way. One large-scale longitudinal study (Anderson, Huston, Schmitt, Linebarger, & Wright, 2001) found that high-school students who had viewed *Sesame Street* as preschoolers, compared to those who had not, read more books and had significantly higher scores in vocabulary, math, and science. These effects were still apparent after controlling for family size, parents’ education, and gender. Interestingly, high-school boys’ retrospective reports of having watched *Sesame Street* at age 5 were correlated with their English grades and overall achievement, whereas the same was not true for girls; however, no other studies in the United States have reported gender differences in preschoolers’ learning from educational television.

*Sesame Street* now has a global audience. Translated versions of the original show are seen in more than 150 countries (Sesame Workshop, 2012a). A meta-analysis of the results of 24 studies involving 10,000 children in 15 countries showed significant positive effects of exposure to the program (Mares & Pan, 2013). International co-productions are currently viewed in around 20 countries as diverse as Brazil, Bangladesh, Poland, Turkey, Jordan, and China (Sesame Workshop, 2012b). Unlike translated versions of *Sesame Street*, co-productions are shaped by the cultural context in which the shows are aired. The year 2010 saw a new large-scale co-production in China, called *daniao kan shijie* (*Big Bird Looks at the World*, or *BBLW*), a show for 3- to 7-year-olds (Sesame Workshop, 2014).

*BBLW* was a series of 52 11-minute episodes that focused on science education for young children. With this singular focus on science, *BBLW* was able to cover a topic in more depth than would usually be possible in the brief segments typical of *Sesame Street’s* magazine format. The series’
production team chose content based on young children’s natural interests (e.g., the moon and sun) and contemporary curricular interests (e.g., preventing colds from spreading and protecting the environment). In the first 2 months of airing in Shanghai, BBLW outperformed all key children’s programs, with 400,000 preschoolers (referring to children of ages 3–5 in China) and nearly 1 million mothers with young children watching. It also continued drawing educators, grandparents, and other caregivers into the audience (Sesame Workshop, 2012d).

Television education programs like BBLW for young children have had an important utility in China. TV is omnipresent in China with over 95% of households owning one or more TV sets (Cable and Satellite Broadcasters Association of Asia, 2010). Public television is a free educational tool for informal learning, particularly for rural children. BBLW was designed to offer children a science learning opportunity without requiring the involvement of teachers, parents, or other caregivers. The series educated children through entertainment, using an approach very different from those commonly used in school or other organized learning activities.

As a Chinese co-production with Sesame Workshop, BBLW was developed in the Chinese cultural context and had a uniquely Chinese flavor. Instead of using content produced by Sesame Workshop in New York, the show used freshly created studio and live action scenes produced in Shanghai, and in addition to Big Bird and Elmo, the show featured a new Chinese character named Lily, a tenacious girl tiger who likes martial arts. Each episode was structured in a way that was a familiar form of discourse in Chinese culture. Inspired by the 80-year-old Chinese children’s popular science series, One Hundred Thousand Why’s, the producers structured each episode according to three pedagogical steps. Take the wind episode for example. First, Big Bird and Elmo posed questions based on their experiences: Where does wind come from? What does it do? Second, children were provided explanations using real-life examples or live action videos, and Big Bird and Elmo verbalized their understanding of these explanations and then raised more questions. Third, there were studio shots of children engaged in science activities. This format presented a discourse that was commonly observable in the Chinese culture. In this shared cultural context, children could mobilize this familiar experience toward a learning goal.

BBLW is also characteristically Chinese in that the producers aligned the science content with China’s national guidelines for preschool education, which promote a preschool curriculum with five mutually integrated educational domains, including health, language, society, science, and art (Ministry of Education, 2001, 2007). The national guidelines were rooted in a century-old preschool curriculum tradition that emphasizes these educational domains as being connected in children’s life experiences (Hsueh, Tobin, & Karasawa, 2004). BBLW followed this tradition by placing science content at once in young children’s experiences and in their societal context, that is, the cultural expectations of Chinese society.

The idea that a culturally sensitive program would be more effective than a simple translation of a US program is consistent with the notion of “cultural script,” a theoretical concept advanced by theorists in cognitive development, linguistic anthropology, and cultural psychology (for a review, see Cole, 1996, pp. 124–130). By definition, “a cultural script is an event schema that specifies the people who participate appropriately in an event, the social roles they play, the objects they use, and the sequence of actions and causal relations that applies” (Cole, 1996, p. 126). Put another way, a cultural script is an action sequence children begin developing for a highly contextualized and socially coordinated activity, for example, science learning. By virtue of participating in the same culture, the producers and viewers of a co-production share a cultural script that informs the content of the program as well as children’s experience of the program.

Attention to the cultural context of China must include a focus on the considerable differences in rural and urban life. Relative to urban children, rural children have a lack of preschool facilities,
poorly equipped facilities, low quantity and quality of teachers, and a lack of children-centered learning and teaching (Li, 2008; Zhang, Tian, & Wang, 2011). Research suggests that disadvantaged children are likely to gain more than advantaged children from viewing educational television (Baydar, Kağıtçıbaşı, Küntay, & Gökşen, 2008; Fisch, 2002). Therefore, although BBLW was designed for a general audience, it is reasonable to assume that the show would have greater impact on rural children than on urban children in China.

**Current study**

The current study examined the impact of children’s exposure to BBLW’s science content, assessed in terms of science vocabulary and science facts. The focus on vocabulary and facts is appropriate for two reasons. First, the literature shows that one important function of educational television is to effectively increase children’s academic performance, particularly vocabulary. Second, in early childhood, a knowledge base composed of vocabulary and facts is viewed as an important part of emergent literacy, as these components are essential to providing cultural tools for the young to participate in a culture (Neuman & Wright, 2014). As defined below, science vocabulary and facts are cultural constructions of knowledge; they are passed on through contextualized experiences in which the young become science community members.

Science vocabulary is considered to be an important foundation for deeper understanding and reasoning about science, and it is the means of communicating about investigations and explanations (National Research Council, 1996). Preschool children’s chronological age is associated with their gains in general vocabulary (Skibbe, Connor, Morrison, & Jewkes, 2010). These vocabulary gains also pave ways for learning science vocabulary, especially with appropriate stimulation and input. However, the importance of gaining science vocabulary does not merely lie in the need for linguistic input and tools for doing science. Rather, as Gelman and Brenneman (2004) observed of the need to think, work, and talk scientifically in preschool years, “Observe, predict, and check are more than terms; they are skills that are introduced and used throughout the year and across a variety of settings” (p. 153). In the current study, science vocabulary presented as part of BBLW’s content included terms such as telescope, heart, and feather.

Science facts refer to a range of information that is observable and recognizable by people who share a common interest in investigating certain phenomena. To borrow Latour’s (1987) words, science facts are constructed by human beings, or by the community of scientists. The established facts are essential to the community of scientists who practice under the same paradigm (Kuhn, 1962), thus crucial to preparing younger generations to enter the same paradigmatic practice or scientific cultural tradition. In the current study, we use the term science facts to refer to facts presented as part of BBLW’s content such as facts about day and night, the fact of being alive, facts about animal classifications, and facts about teeth.

This study is the first large-scale experimental study of the impact of an educational television series on the learning of Chinese young children of ages 3–7. In a large and diverse sample of schools from both urban and rural communities in two regions of China, early childhood classrooms were randomized within each school to an experimental group (children watched the series BBLW in school) or a control group (children engaged in normal class activities). Children’s science vocabulary and science facts were assessed across the three main content areas in BBLW: Science and Discovery (astronomy, science tools), Health and the Human Body (hygiene, anatomy), and Nature and the Environment (animal classification, the life cycle), both at baseline and again 7 weeks later at the end of the study. We tested two hypotheses: one, that by the end of the
study, children in the experimental group would show a significantly better command of science vocabulary and science facts than children in the control group; and two, that this science educational series would be especially beneficial for rural children. For exploratory purposes, we also tested whether the effects of the BBLW series were moderated by children’s age and gender.

Method

Participants

Children (N = 1951) were from nine preschools and five elementary schools in the central (67%) and southwest (33%) regions of China. Across both regions, 64% of the children were from urban areas and 36% from rural areas. About three-quarters were at the preschool level, and about one-quarter were in first and second grade. Most were between 3 and 7 years old, although 2.8% were 8 years old and one child was 10 years old. Because they came from the same classes as the other participants, and because they represented a small percentage of the overall sample, the older children were included in the sample along with their classmates. The gender ratio was 53% boys and 47% girls. Among the mothers of these children, 4% had completed elementary school, 34% middle or high school, 52% 2- or 4-year college programs, and 8% a graduate degree; there were 2% who did not report their education level.

Chi-square analyses showed no significant differences between the experimental and control groups in terms of living in a rural versus urban area, percentage of children who were in preschool versus first/second grade, percentage of boys versus girls, or percentage of children whose mothers had versus had not attended college. Consistent with the results based on level in school, a t-test indicated no significant difference between study groups in children’s average age.

Due to absences and changing schools, 91 children (5% of the sample) did not participate in post-test data collection, resulting in a post-test sample size of 1860. Almost all of the students who did not participate at post-test (96%) were from preschool classes where attendance was not mandatory. Chi-square analysis showed that attrition had no systematic effect on the number of children remaining in the experimental and control groups overall. However, children who attrited were more likely than completers to be from urban areas, χ²(1, N = 1951) = 7.86, p < .01. For the current study, only those children who had data at both Time 1 and Time 2 were included in the analyses (N = 1860).

Measures

Interview. A 20-minute interview was used at pre-test and post-test to assess science knowledge (science vocabulary and science facts) related specifically to the content of the 42 BBLW episodes. This content reflected three themes: (1) Science and Discovery (e.g. astronomy concerning the sun and the moon; science tools such as magnets and microscopes), (2) Health and the Human Body (e.g. human anatomy, the location and functions of body parts and organs, hygiene such as preventing a cold spreading, and keeping teeth clean), and (3) Nature and the Environment (e.g. animals’ fur and feathers, classification of birds and insects, animal life such as how fish breathe, what seeds do, and what is alive).

An overall BBLW Science Content Knowledge score was the mean of 66 scores generated from the interview. These items are described below under the two subscales of Science Vocabulary (14 items) and Science Facts (52 items). The internal consistency of this overall scale was α = .89.
On the 14 Science Vocabulary items, children were asked to generate a verbal (typically one-word) answer or to identify a body part or a science tool by giving it a name, for example, “What is this [showing the thumb] called?” All but one of these items assessed expressive vocabulary when the child was shown a picture and asked to offer a name for what was in the picture. The one exception was the question “Can you show me the heart?” On this item, the child was asked to point to the heart in an array of images. A coding system was designed based on the vocabulary in the viewed episodes to score these items. Children who gave no response, who said “I don’t know,” and who gave an incorrect response were assigned a score of 0; children who gave a correct response were assigned a score of 1. An overall score was calculated as the mean of all items. The internal consistency of this measure was \( \alpha = .70 \).

The 52 Science Facts items were of two types. Some questions involved asking the child to point to pictures in an array, for example, “Can you show me which of these are birds?” On such questions, the child’s response to each item in the array was scored as Correct = 1 (correctly pointing, or correctly not pointing) or Incorrect = 0 (incorrectly pointing, or incorrectly not pointing). Answers to other questions such as “Where does the sun go at night?” were recorded verbatim and transcribed for further coding for quantitative analysis. The researchers identified examples of responses that were incorrect or irrelevant as well as those that reflected understanding of concepts presented on the television series. For example, in response to the question, “What are teeth for?” children’s answers were classified as Incorrect = 0 (no response; I don’t know; incorrect/irrelevant, for example, “my sister lost one tooth”), Relevant but Not Fully Correct = 0.5 (usually personal answers such as “for eating candies” or “for chewing bones”), or Fully Correct = 1 (usually abstract answers such as “for helping us eat food”). Using the coding system, inter-rater agreement was 98%. For quantitative analyses in the present study, scores of 0 and 0.5 were combined as Incorrect = 0, and scores of 1 were considered Fully Correct. The internal consistency of these 52 items was \( \alpha = .86 \).

**Procedure**

Directors and principals of participating schools gave permission for student participation. Within each school, classrooms were randomly assigned to the experimental group or the control group. Over the course of 7 weeks, children in the experimental group were exposed to 42 of the 52 episodes of *BBLW* during the regular school day. During each exposure week, the researchers showed one episode per day from Monday through Thursday and two episodes on Fridays. Throughout the treatment period, teachers did not play any role in facilitating or mediating children’s viewing experience. Teachers would bring their children to either a computer lab or a multifunctional room in the school that had been dedicated for viewing the series. There, the researchers would take over until it was time for children to return to their classroom. Children in the control group classrooms engaged in regular school activities but no attempt was made to prevent the two groups from talking to one another about the show during recess or after school.

Two teams of university-based researchers collected data at pre- and post-test. Most interviewers were female graduate students who traveled in small groups to the schools. These interviewers were not told whether the children they interviewed were in the experimental or control group.

**Results**

We had two questions: First, did the experimental group make more gains than the control group? Second, was this treatment effect moderated by geographic area (urban or rural), age
(preschool or first/second grade), or gender (boys or girls)? To answer these questions, we conducted three 2 (Time) × 2 (Group) × 2 (Area) × 2 (Age) × 2 (Gender) repeated measures multivariate analyses of variance (MANOVAs), for each of the three dependent measures: BBLW Overall Science Content Knowledge, Science Vocabulary, and Science Facts. In the following sections, we highlight the specific findings that are relevant to our research questions. Because of the large sample size and large number of analyses, we used $p < .001$ as the standard for statistical significance.

**Treatment effects**

Because classrooms were assigned randomly to the experimental and control groups, and because there were no demographic differences between the two groups, we expected there to be no significant group differences in BBLW science content knowledge at pre-test. We also expected that both groups might make gains over time, for reasons unrelated to the treatment. However, if the treatment had an impact, we would expect greater gains in the experimental group than the control group; that is, we would expect to find a significant Time × Group interaction.

Indeed, there was a significant Time × Group interaction for all three dependent measures (Tables 1 to 3). For Overall BBLW Science Content Knowledge scores, $F(1, 1844) = 73.35, p < .001$, and partial $\eta^2 = .04$. For Science Vocabulary scores, $F(1, 1844) = 401.38, p < .001$, and partial $\eta^2 = .03$. For Science Facts scores, $F(1, 1844) = 57.38, p < .001$, and partial $\eta^2 = .03$.

**Table 1.** Means and standard deviations of the overall BBLW Science Content Knowledge Scores for the experimental group and control group at Time 1 and Time 2.

|                      | Experimental group, $n = 994$ | Control group, $n = 866$ |
|----------------------|-------------------------------|--------------------------|
|                      | $M$ (SD)                      | $M$ (SD)                 |
| Time 1               | .60 (.14)                     | .60 (.14)                |
| Time 2               | .69 (.14)                     | .64 (.13)                |

BBLW: Big Bird Looks at the World; SD: standard deviation; M: mean.

**Table 2.** Means and standard deviations of Science Vocabulary Scores for the experimental group and control group at Time 1 and Time 2.

|                      | Experimental group, $n = 994$ | Control group, $n = 866$ |
|----------------------|-------------------------------|--------------------------|
|                      | $M$ (SD)                      | $M$ (SD)                 |
| Time 1               | 0.62 (0.18)                   | 0.62 (0.19)              |
| Time 2               | 0.72 (0.17)                   | 0.67 (0.16)              |

SD: standard deviation; M: mean.
Unlike the treatment effect analyses, in which random assignment would mean no group differences at Time 1, here we might expect to see urban-rural differences at Time 1 and perhaps at Time 2 as well. In fact, the urban children significantly outperformed the rural children at both Time 1 and Time 2, for all three dependent measures. For Overall BBLW Science Content Knowledge scores, the main effect of Area was $F(1, 1844)=67.05, p<.001$, partial $\eta^2 = .04$; for Vocabulary Science scores, $F(1, 1844)=45.84, p<.001$, partial $\eta^2 = .02$; and for Science Facts, $F(1, 1844)=64.74, p<.001$, partial $\eta^2 = .03$. There was an urban advantage for both the treatment and control groups.

To address the main question of whether BBLW had a bigger impact on rural or urban children, we also report the Time × Group × Area three-way interaction. This interaction was not significant for any of the dependent measures. For Overall Knowledge Base scores, the three-way interaction was $F(1, 1844)=0.16, ns$; for Science Vocabulary, $F(1, 1844)=0.60, ns$; and for Science Facts, $F(1, 1844)=0.01, ns$. The overall treatment effect was not moderated by geographical area.

### Age differences

We would expect that older children would fare better than younger children, both at Time 1 and at Time 2. In fact, the main effect of age was significant for all three dependent measures. First and second graders had higher scores than preschoolers on Overall BBLW Science Content Knowledge, $F(1, 1844)=426.98, p<.001$, partial $\eta^2 = .19$; Science Vocabulary, $F(1, 1844)=335.73, p<.001$, partial $\eta^2 = .15$; and Science Facts, $F(1, 1844)=396.96, p<.001$, partial $\eta^2 = .18$.

To examine the question of whether age moderated the overall treatment effect, we looked at the Time × Group × Age three-way interaction. This interaction was non-significant for the Overall BBLW Science Content Knowledge score, $F(1, 1844)=0.99, ns$; the Science Vocabulary score, $F(1, 1844)=6.34, p<.02$, partial $\eta^2 = .00$; and the Science Facts score, $F(1, 1844)=0.05, ns$. Preschool children and first/second graders benefited equally from watching the BBLW series.

### Gender differences

We had no reason to expect gender differences at either Time 1 or Time 2. However, there was a significant main effect for gender, with boys outperforming girls at both time points, for all three dependent measures. For Overall BBLW Science Content Knowledge, $F(1, 1844)=17.02, p<.001$, Table 3. Means and standard deviations of Science Facts Scores for the experimental group and control group at Time 1 and Time 2.

|                  | Experimental group, $n=994$ |          | Control group, $n=866$ |          |
|------------------|-----------------------------|----------|------------------------|----------|
|                  | $M$  | (SD) | $M$  | (SD) |
| Time 1           | .60 | (.14) | .60 | (.14) |
| Time 2           | .68 | (.14) | .63 | (.13) |

SD: standard deviation; M: mean.
The Time × Group × Gender interactions showed that gender did not moderate the treatment effect. That is, **BBLW** was equally effective for boys and girls. For Overall **BBLW** Science Content Knowledge, \( F(1, 1844) = 1.67, \text{ns} \); for Science Vocabulary, \( F(1, 1844) = 1.19, \text{ns} \); and for Science Facts, \( F(1, 1844) = 1.30, \text{ns} \).

**Discussion**

**BBLW** was a recent collaborative effort between Sesame Workshop and Chinese partners\(^1\) to create an entertaining science education program for Chinese children of ages 3–7. The series received an unprecedented high viewership (Sesame Workshop, 2012d), and children reported that the special Chinese character, Lily, the girl tiger who practiced martial arts, was their favorite among all the characters (Hsueh, Hao, & Cheng, 2015). The current study on **BBLW** was the largest experimental study to date in China to evaluate young viewers’ gains in watching an educational television program. As hypothesized, children in the experimental group showed significantly better knowledge of science vocabulary and science facts than children in the control group. Both urban and rural children, both preschoolers and first/second graders, and both boys and girls significantly benefited from this entertaining educational program. The significant learning effects, as a result of a very brief exposure to the science content, suggest that an entertaining educational television program for young children has great potential to meet some of their educational needs. These findings are the basis of a number of observations related to future program development and research.

**Treatment effects**

The foremost finding appeared in the overall gains across the board by the experimental group. The general result shows that the experimental group gained in science vocabulary and science facts significantly more than the control group after the 7-week exposure to the television series. This overall gain was remarkable for two reasons. First, the experimental group viewed each episode only once during the 7-week treatment period. Information presented in the early episodes had to be retained for nearly 2 months before children were asked to retrieve from memory what they had learned. Second, 42 episodes on different science topics were presented to children in the same format. Thus, there could be plenty of visual and auditory interference with children’s memory of the contents and the details they watched on the television screen. However, the experimental group demonstrated retention of many episodes’ contents.

How did the **BBLW** television series as an informal science education program effectively engage children in learning science vocabulary and facts? In keeping with the cultural script theory, we suggest that children likely benefited from a cultural script that facilitated their learning, in addition to factors such as developmental change and post-viewing peer interaction. The **BBLW** format fitted with the script children were mastering daily in the educational setting, particularly in the three pedagogical steps that formed the structure of each episode: raising questions, getting explanations, and trying out activities. To know the script is to know how to go about a task and coordinate with others in doing the task, thus enhancing retention.

It is interesting to consider the role of classmates and teachers in the learning experience. There was not any teaching or intervention effort other than children watching each daily episode. For the

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experimental group, there is reason to believe that the within-class peer interaction could have enhanced the learning effect because children would talk about their viewing experience, as some teachers reported informally. However, because there was a new episode every day, children likely had little time to talk about each episode extensively; thus, the general learning effect is attributable more to the one-time viewing experience and a cultural script that facilitated learning.

**Science vocabulary and science facts**

It is worth emphasizing that the television series was not designed to foster children’s memorization of science vocabulary and science facts. Both science vocabulary and science facts are artifacts that the community of scientists constructs, and they can and should be shared with children as symbolic cultural tools so that “children can begin to learn the actual terms that refer to the concepts they explore” (Gelman & Brenneman, 2004:152). If children can acquire these tools, namely, vocabulary and facts, they can further their script for learning science and respond with more sophisticated learning. In this process, they can become active users of the science vocabulary (Leung, 2008).

Embedded in any science fact is a conceptual scheme that involves science vocabulary. For example, “telescope” is the name of a science tool, but at the same time, this name carries with it a definition of its structure and function, and further, it is an artifact, a concrete expression of ideas about its purpose, use, and potentials. As the child’s mind grows, “telescope” may gradually evoke a historical figure, an invention, or a scientific paradigm shift. No matter how rudimentary science vocabulary and facts appear, their presence in young children’s minds will facilitate the self-regulation of thoughts and actions (Vallotton & Ayoub, 2011). Compared to other non-educational cartoon programs, *Sesame Street* has long been effective in supporting preschool-aged children’s general vocabulary growth (Bogatz & Ball, 1971; Penuel et al., 2009; Rice, Huston, Truglio, & Wright, 1990; Wright et al., 2001), and *BBLW* seems to have brought this educational strength to Chinese young viewers by helping them learn science vocabulary and facts.

**Small but significant differences**

Careful readers may have noticed the small but significant differences in our findings between the two groups in the post-test, reflected in the partial $\eta^2$ values. Effect sizes of this magnitude, typically described as in the small to medium range (Cohen, 1988), are common in educational research (corresponding, for example, to correlation values of 0.2 or less), and especially in intervention research. For example, a recently published meta-analysis that synthesized more than 60 treatment-control studies of interventions designed to teach alphabet learning to young children found effect sizes similar to those in the current report (Piasta & Wagner, 2010), with standardized mean effect sizes ranging from $d=0.14$ to $d=0.65$, in the small to medium range. However, as the authors of the meta-analysis note, these relatively small statistical effects nevertheless represent meaningful advancements beyond the status quo in instruction.

An even more relevant comparison is provided by a recent meta-analysis of the effects of Sesame Workshop co-productions as reported in 24 studies conducted in 15 countries (Mares & Pan, 2013). For overall outcomes, the average effect size was $d=0.29$; this value varied depending on type of outcome, with 0.19 for social reasoning/attitudes, 0.28 for cognitive outcomes, and 0.34 for learning about the world. It is important to note that in the current study, comparable effects
were obtained even when children watched the *BBLW* series without the viewing being mediated by teachers. Research on co-viewing and joint media engagement suggests that the effects should be even greater when teachers or parents join young children in viewing and discussing the program contents (Takeuchi & Stevens, 2011).

**Urban-rural differences**

As expected, rural children were at a significant disadvantage compared to their urban counterparts at Time 1 in this study, and this disadvantage was still apparent at Time 2. However, their gains after watching *BBLW* were similar in size to the urban group’s gains; that is, both groups benefited to the same degree from watching the series, a similar finding to those of US studies comparing the learning of advantaged and disadvantaged children (e.g. Anderson et al., 1979). This suggests that entertaining education television programs like *BBLW* could potentially compensate for shortages of educational resources in rural areas. Such programs can provide badly needed informal education for millions of young children who have been left in villages without parents due to labor migration to cities. This is in line with China’s national policy, which sets a high priority on developing rural preschool education in the era of rapid urbanization (State Council of China, 2010).

**Children’s age and gender**

Our analyses regarding age and gender were exploratory. The results regarding age were not surprising, in that older children had better scores than younger children at both time points. Age did not moderate treatment effectiveness, suggesting that the series’ content was appropriate for the full range of children in this age group. An interesting finding, however, emerged about gender. Our results showed that boys did better than girls on all three measures at both Time 1 and Time 2, although gender did not moderate the overall treatment effect; that is, boys and girls on average gained equally on the test items. This result was surprising because it runs against the extensive observation in a growing body of literature across Western societies that preschool girls do better scholastically than preschool boys (e.g. Epstein, Elwood, & Hey, 2011; Fortin, Oreopoulos, & Phipps, 2015; Francis, 2000), a pattern seen also in a meta-analysis of studies of children throughout formal schooling (Voyer & Voyer, 2014). However, one longitudinal study in the United States showed that preschool and early elementary school boys’ interest in science was on average higher than girls’ even though this early interest did not predict boys’ later science achievement, as it did girls’ (Leibham, Alexander, & Johnson, 2013). This finding seems to account developmentally for our result, but new research is needed to examine whether there are culturally appropriate interpretations of the boy advantage as shown in the present study.

**Conclusion**

The series *BBLW* had a clear positive impact on Chinese children of 3–7 years, particularly considering that children watched each episode only once without mediation from the teacher on the subject matter. The gains in children’s science vocabulary and facts documented in the current study, together with evidence of their eagerness to watch more episodes (Hsueh et al., 2012), show that the series was effectively educational and entertaining for the target audience. Conceptually, this success of *BBLW* benefited from the cultural script that Chinese children develop in their early
years, their educational settings, and their social life at large. There appears to be a great potential for similar future science education series to play an important educational role in young Chinese children’s lives. In the digital age, a range of new media may be equally effective in conveying this content; these media can educate through entertainment as well as through interaction, although public television has the advantage of being free and widely available in China (Lee et al., 2016). This potential can be realized with persistent effort to understand Chinese children’s learning needs and contexts. It can be possibly realized more extensively if this informal series is implemented in a formal setting, with special attention paid to the needs of Chinese teachers who provide science instruction.

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**References**

Anderson, B. D., Greenberg, E., & Mark, J. (1979). The educational technology mix: Production functions from “Sesame Street.” *Instructional Science, 8*, 67–79. doi:10.1007/BF00054982

Anderson, D. R., Huston, A. C., Schmitt, K. L., Linebarger, D. L., & Wright, J. C. (2001). Early childhood television viewing and adolescent behavior: The recontact study. *Monographs of the Society for Research in Child Development, 66*, I-VIII, 1–147.

Ball, S., & Bogatz, G. A. (1970). *The first year of Sesame Street: An evaluation*. Princeton, NJ: Educational Testing Service.

Baydar, N., Kağıtçibaşi, Ç., Küntay, A. C., & Gökşen, F. (2008). Effects of an educational television program on preschoolers: Variability in benefits. *Journal of Applied Developmental Psychology, 29*, 349–360. doi:10.1016/j.appdev.2008.06.005

Bogatz, G. A., & Ball, S. (1971). *The second year of “Sesame Street”: A continuing evaluation*. Princeton, NJ: Educational Testing Service.

Cable and Satellite Broadcasters Association of Asia. (2010). *China*. Retrieved from http://www.casbaaa.com/advertising/contries/china

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Lawrence Erlbaum.

Cole, M. (1996). *Cultural psychology: A once and future discipline*. Cambridge, MA: Harvard University Press.

Encyclopaedia Britannica. (2014). *Sesame Street*. Retrieved from http://www.britannica.com/EBchecked/topic/536050/Sesame-Street

Epstein, D., Elwood, J., & Hey, V. (Eds.). (2011). *Failing boys? Issues in gender and achievement*. London, England: McGraw-Hill International.

Fisch, S. M. (2002). Vast wasteland or vast opportunity? Effects of educational television on children’s academic knowledge, skills, and attitudes. In J. Bryant, & D. Zillmann (Eds.), *Media effects: Advances in theory and research* (2nd ed., pp. 397-426). Mahwah, NJ: Lawrence Erlbaum.

Fisch, S. M. (2015). Children’s learning from television. *Televizion, 18*, 10–14.

Fortin, N. M., Oreopoulos, P., & Phipps, S. (2015). Leaving boys behind: Gender disparities in high academic achievement. *Journal of Human Resources, 50*, 549-579. doi:10.3368/jhr.50.3.549
Francis, B. (2000). *Boys, girls and achievement: Addressing the classroom issues*. London, England: Routledge.

Gelman, R., & Brenneman, K. (2004). Science learning pathways for young children. *Early Childhood Research Quarterly, 19*, 150-158. doi:10.1016/j.ecresq.2004.01.009

Hsueh, Y., Hao, J., & Cheng, M. (2015, June). Chinese preschoolers’ preferences for the images of Sesame Street’s Muppets. In Hsueh, Y. (Chair), *Education media from young children’s perspectives*. Symposium conducted at the meeting of the Jean Piaget Society, Toronto, Ontario, Canada.

Hsueh, Y., Tobin, J., & Karasawa, M. (2004). The Chinese kindergarten in its adolescence. *Prospects: Quarterly Review of Comparative Education, 34*, 457–469.

Hsueh, Y., Zhou, Z., Su, G., Tian, Y., Sun, X., & Fan, C. (2012). *Big Bird Looks at the World Season I evaluation report*. New York, NY: Sesame Workshop.

Kuhn, T. S. (1962). *The structure of scientific revolutions* (2nd ed.). Chicago, IL: The University of Chicago Press.

Latour, B. (1987). *Laboratory life: The construction of scientific facts*. Princeton, NJ: Princeton University Press.

Lee, J., Hsueh, Y., Zuhdi, M., Chakma, S., Hashimi, S. F., & Dollard, L. (2015). How Sesame Workshop promotes early childhood education around the world. In C. Cole, & J. Lee (Eds.), *The Sesame Effect: The global impact of the longest street in the world* (pp. 92–117). New York, NY: Routledge.

Leibham, M. B., Alexander, J. M., & Johnson, K. E. (2013). Science interests in preschool boys and girls: Relations to later self-concept and science achievement. *Science Education, 97*, 574–493. doi:10.1002/sce.21066

Leung, C. B. (2008). Preschoolers’ acquisition of scientific vocabulary through repeated read-aloud events, retellings, and hands-on science activities. *Reading Psychology, 29*, 165–193. doi:10.1080/02702710801964090

Li, K. (2008). *Under-development in rural early childhood education: Responsibilities and reconstruction of the system*. China National Society of Early Childhood Education. Retrieved from http://www.cnsece.com/KindTemplate(MsgDetail/27214 (in Chinese)

Lovelace, V. (1990). “Sesame Street” as a continuing experiment. *Educational Technology Research and Development, 38*(4), 17–24. doi:10.1007/BF02314641

Mares, M. L., & Pan, Z. (2013). Effects of Sesame Street: A meta-analysis of children’s learning in 15 countries. *Journal of Applied Developmental Psychology, 34*, 140-151. doi:10.1016/j.appdev.2013.01.001

Ministry of Education. (2001). *The guidelines for the kindergarten education (trial version)*. Beijing, China: Author. (in Chinese)

Ministry of Education. (2007). *The guidelines for the kindergarten education (final version)*. Beijing, China: Author. (in Chinese)

National Research Council. (1996). *National science education standards*. Washington, DC: National Academies Press.

Neuman, S. B., & Wright, T. S. (2014). The magic of words: Teaching vocabulary in the early childhood classroom. *American Educator, 38*(2), 4–11.

Penuel, W. R., Pasnik, S., Bates, L., Townsend, E., Gallagher, L. P., Llorente, C., & Hupert, N. (2009). Preschool teachers can use a media-rich curriculum to prepare low-income children for school success: Results of a randomized controlled trial. New York, NY: Education Development Center.

Piasta, S. B., & Wagner, R. K. (2010). Developing early literacy skills: A meta-analysis of alphabet learning and instruction. *Reading Research Quarterly, 45*, 8–38. doi:10.1598/RQR.45.1.2

Rice, M. L., Huston, A. C., Truglio, R., & Wright, J. C. (1990). Words from “Sesame Street”: Learning vocabulary while viewing. *Developmental Psychology, 26*, 421–428. doi:10.1037/0012-1649.26.3.421

Sesame Workshop. (2010). *Sesame Workshop annual report*. New York, NY: Author.

Sesame Workshop. (2012a). *Opening the world of China’s youngest learners*. Retrieved from http://www.sesameworkshop.org/where-work/index.html

Sesame Workshop. (2012b). *Around the world*. Retrieved from http://www.sesameworkshop.org/what-we-do/ourinitiatives/china.html?o=83&c=featured
Sesame Workshop. (2012c). *Workshop at a glance*. Retrieved from http://www.sesameworkshop.org/about-us/workshop-at-a-glance.html

Sesame Workshop. (2012d). *Zhima Jie*. Retrieved from http://www.sesameworkshop.org/what-we-do/our-initiatives/china/

Sesame Workshop. (2014). *Big Bird Looks at the World*. Retrieved from http://www.sesamестreetchina.com.cn/

Skibbe, L. E., Connor, C. M., Morrison, F. J., & Jewkes, A. M. (2010). Schooling effects on preschoolers’ self-regulation, early literacy, and language growth. *Early Childhood Research Quarterly, 26*, 42–49. doi:10.1016/j.ecresq.2010.05.001

State Council of China. (2010). *China national medium and long-term plan for education reform and development (2010–2020)*. Retrieved from http://www.gov.cn/jrzg/2010-07/29/content_1667143.htm (in Chinese)

Takeuchi, L., & Stevens, R. (2011). *The new coviewing: Designing for learning through joint media engagement*. New York, NY: The Joan Ganz Cooney Center at Sesame Workshop and LIFE Center. Retrieved from http://www.joanganzcooneycenter.org/wpcontent/uploads/2011/12/jgc_coviewing_desktop.pdf

Thakkar, R. R., Garrison, M. M., & Christakis, D. A. (2006). A systematic review for the effects of television viewing by infants and preschoolers. *Pediatrics, 118*, 2025–2031. doi:10.1542/peds.2006-1307

Vallotton, C., & Ayoub, C. (2011). Use your words: The role of language in the development of toddlers’ self-regulation. *Early Childhood Research Quarterly, 26*, 169–181. doi:10.1016/j.ecresq.2010.09.002

Voyer, D., & Voyer, S. D. (2014). Gender differences in scholastic achievement: A meta-analysis. *Psychological Bulletin, 140*, 1174–1204. doi:10.1037/a0036620

Wright, J. C., Huston, A. C., Murphy, K. C., St.Peters, M., Pinon, M., Scantlin, R., & Kotler, J. (2001). The relations of early television viewing to school readiness and vocabulary of children from low-income families: The early window project. *Child Development, 72*, 1347–1366. doi:10.1111/1467-8624.t01-1-00352

Zhang, W., Tian, M., & Wang, Y. (2011). Gaps in preschool education between the rural and urban area in China. *Journal of Heilongjiang College of Education, 30*(8), 36–38. (in Chinese)

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