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# From Story to Science: The Contribution of Reading Fiction and Hybrid Stories to Conceptual Change with Young Children

Dilek Altun
Department of Early Childhood Education, Ahi Evran University, Kırşehir, Turkey

*This quasi-experimental study with 34 preschoolers explores how fictional and hybrid storybooks contribute to conceptual changes in preschoolers' understanding of lunar concepts. Interviews and children's drawings before and after reading sessions provided the data. Findings revealed that (i) young children have intuitive knowledge and alternative explanations from their experiences and lay culture, (ii) storybook messages and illustrations cause misconceptions and (iii) hybrid stories increase protoscientific explanations among children of both genders. Combining accurate scientific information and enjoyable context makes hybrid storybooks effective edutainment for preschoolers. © 2019 John Wiley & Sons Ltd and National Children's Bureau*

**Keywords:** conceptual change, fiction story, hybrid story, preschoolers, the moon.

## Introduction

Children begin their formal science education with an intuitive knowledge and understanding of the physical world based on their everyday experiences and lay culture (Hobson and others, 2010; Samarapungavan and others, 1996; Vosniadou, 2007). Learning science not only involves the simple memorisation of facts but also reconstructs children's intuitive knowledge and understanding by exposing them to systematic instruction; ideally, this instruction will address individual and sociocultural factors in line with constructivist theories (Vosniadou, 2007). There has been a growing consensus that the construction of scientific knowledge is constrained by intuitive knowledge (Barnett and Morran, 2002; Carey, 2000; Hatano and Inagaki, 2000; Posner and others, 1982; Sackes and Trundle, 2017; Vosniadou and Skopeliti, 2014). A variety of terms have been utilised in the literature to describe children's initial conceptions: *naïve theory* (Piaget, 1972), *preconceptions* (Ausubel, 1968), *mental models* (White and Frederiksen, 1986) and *folk theories* (Kempton, 1987). These initial conceptions, which explain facts in a manner largely distinct from scientific explanations, may affect children's ability to assimilate and accommodate new information (Vosniadou and Skopeliti, 2014). Therefore, the elicitation of children's initial conceptions is an important starting point in science education.

A pioneer in the field, Piaget (1929, 1972) examined young children's intuitive understanding of space, day and night cycles as well as time (Zimmerman, 2007). Earth and space science concepts offer convenient domain-specific knowledge because children's everyday experiences provide sufficient information with which they may construct intuitive knowledge of the earth, sun and moon (Vosniadou and Brewer, 1992). A large body of research has focused on children's ideas and mental models related to the earth, sun and moon (Blake, 2005; Gilbert and Watts, 1983; Jones and others, 1987; Panagiotaki and others, 2009; Samarapungavan and others, 1996; Sharp, 1999; Vosniadou and Brewer, 1992; Vosniadou and Skopeliti, 2017). These studies reveal that young children construct

their intuitive knowledge through non-scientific models. Children can offer non-scientific explanations regarding both the causes of lunar phases and observable lunar shapes and the reason the moon can sometimes be observed during the day. Most children accounted for these changes by explaining that the 'shadow of the earth or other objects was blocking the sun's light to the moon' (Hobson and others, 2010, p. 172). The findings of Hobson and others (2010) were in line with previous studies (Barnett and Morran, 2002; Baxter, 1989; Broadstock, 1992; Schoon, 1993).

Vosniadou (2007) asserted that systematic instruction may execute conceptual changes. Studies have often focused on children's elicited, alternative lunar understanding, but only a few (Barnett and Morran, 2002; Hobson and others, 2010; Trundle and others, 2007) have examined the efficacy of intervention on school-aged children's conceptual change. Hobson and others (2010) found that instructional software intervention contributed to conceptual change in the understanding of lunar concepts among elementary school children.

A limited number of studies (Emmons and others, 2018; Shtulman and Checa, 2017) have examined the efficacy of various types of intervention on conceptual change in young children's understanding of scientific concepts. Studies have showed that children's literature may serve as a pedagogical tool to introduce scientific concepts (Fleener and Bucher, 2003; Mantzicopoulos and Patrick, 2011; Monhardt and Monhardt, 2006; Pringle and Lamme, 2005; Sackes and others, 2009). Therefore, this paper presents an investigation into the contribution of fiction and hybrid storybooks towards conceptual change in young children's understanding of lunar concepts.

## Stories and science teaching

Storytelling is an ancient cross-cultural activity (Chauvet and others, 1996; Sugiyama, 2001) that offers a way to transfer thoughts, experiences, desires, intentions and emotions to others. Story context and content facilitate children's language development and learning (Howard and others, 2017; Schickedanz and McGee, 2010), and storytelling exposes children to terms and concepts that are not encountered in daily discourse either at home or in preschool settings (De Temple and Snow, 2003). During story readings, children make connections to their prior knowledge and apply them to the construction of meaning within the story by using cognitive processes, recognising characters, monitoring the plot, making inferences, synthesising and predicting (Mantzicopoulos and Patrick, 2011; Paris and Paris, 2003). Similar to the conceptual change theory, Rosenblatt's (1978) transactional theory asserted that reading a story is a constructivist process through which readers create their own meaning from the text through interactions occurring between themselves and the text. Moreover, the magical and imaginative worlds of the stories attract children's attention; while listening to stories, children become highly engaged and interested, and thus, early childhood teachers and parents commonly use stories to support children's development and learning.

An increasing amount of attention has been paid to the utilisation of children's picture books to both facilitate young children's exposure to science concepts and develop their ability to learn science in meaningful contexts (Banister and Ryan, 2001; Kelemen and others, 2014; Mantzicopoulos and Patrick, 2010; Sackes and others, 2009; Valkanova and Watts, 2007). Stories are capable of fostering an interest to read about science, which in turn promotes positive attitudes towards science (Broemmel and Rearden, 2006; Mantzicopoulos and Patrick, 2011; Stinner, 1995).

However, studies have identified problems in the ways many picture books represent scientific concepts. These problems include texts that contain misconceptions (Kazemek and others, 2004; Sackes and others, 2009), inaccurate visuals (Sackes and others, 2009; Trundle and Troland, 2005; Trundle and others, 2008) and anthropomorphism — the attribution of

 

human characteristics to nonhuman objects (Banister and Ryan, 2001; Gomez-Zweip and Straits, 2006). Researchers have expressed concern that children's picture books give rise to misconceptions about the moon due to illustrations that incorrectly depict the lunar phases as well as explanations that present the earth's shadow as the cause of the lunar shapes (Trundle and Troland, 2005; Trundle and others, 2008). Broemmel and Rearden (2006) suggested that teachers should clarify the distinction between science concepts and aspects of both fantasy and anthropomorphism in storybooks. Other researchers have suggested that anthropomorphism (Banister and Ryan, 2001; Pringle and Lamme, 2005) may encourage children's imaginations and foster their emotional responses to a story, therefore improving their comprehension.

Reading fictional texts improves cognitive and social capabilities (Barnes, 2012; Oatley, 2016). Some researchers have maintained the belief that hybrid texts, which combine fiction and factual information, more effectively facilitate children's science learning (Mantzicopoulos and Patrick, 2011).

### *Picture book reading and gender*

Studies have remarked that science-related children's literature possesses a potential role in science education; however, school-aged children's gender-specific book genre preferences are commonly reported in the literature (Clark, 2011; McGeown, 2015; Topping and others, 2008). Girls more frequently prefer reading fictional and romance stories, while boys more frequently enjoy reading nonfiction and science fiction books (Clark and Foster, 2005; Farris and others, 2009; Topping and others, 2008). Gender socialisation is considered to have a role in children's book genre preferences (Farris and others, 2009; McGeown, 2015; McGeown and others, 2012). A limited number of studies (Mantzicopoulos and Patrick, 2010) have indicated that young children have gender-equivalent interest in science-related picture books, while girls read fewer science-related picture books than do boys both at home and in school. Mantzicopoulos and Patrick (2011) articulated that using science-related stories may support young children's cognitive and affective engagement in science, which may potentially pose incentive for children's future achievements in and positive attitudes towards science. Young children's affective responses to science-related picture books in terms of gender are important research foci that will facilitate the understanding of gender role socialisation along this process.

## The present study

Therefore, the present quasi-experimental study was intended to elicit young children's conceptual understanding of the moon before and after picture book reading sessions with fiction and hybrid books. The study addressed the following research questions:

1. What initial knowledge do preschoolers possess of the moon prior to the story reading sessions?
2. What do preschoolers know about the moon following fiction picture book reading sessions?
3. What do preschoolers know about the moon following hybrid picture book reading sessions?
4. Is there a difference in preschoolers' understanding of lunar concepts following the fiction reading compared to the hybrid reading?
5. Are there gender differences in preschoolers' affective responses to fiction and hybrid picture books?
6. Are there gender differences in preschoolers' picture book preferences?

 

## Method

### *Participants*

Thirty-four preschoolers (M = 67.4 months) participated in the study. The children were recruited from six classrooms of four public preschools in an urban school district in Turkey, and were selected through the implementation of a purposeful sampling method. All children were monolingual Turkish speakers. Based on parents' and teachers' reports, none possessed developmental or learning problems. Half the children were girls (M = 66.05 months, SD = 4.20), while the other half were boys (M = 68.75 months, SD = 3.65). The study included only preschoolers whose parents had signed consent forms. The approximate return rate of the consent forms was 60 per cent. Most parents ($n$ = 20) had graduated university, and the monthly household incomes of families ranged from 1800 TRY to 5200 TRY (M = 3465.58 TRY $\approx$ 718.43 USD, SD = 925.32).

### *Materials*

Storybooks were used to examine how fiction and hybrid stories contribute to conceptual change in preschoolers' understanding of lunar concepts. The aforementioned pre-existing research revealed that many children's picture books have included misconceptions and inaccurate illustrations of the moon. With this in mind, to examine the effect of misconceptions within storybooks on children's understanding of the moon, the fictional story included both misconceptions and inaccurate illustrations. However, the hybrid story presented accurate scientific information and illustrations. From an early age, children were exposed to stories earlier than they were to factual information/texts. Thus, in the present study, children were exposed first to the fictional text and then to the hybrid text to examine how they acquire misinformation and then learn/process factual information.

*Who Stole the Moon?* was written by Helen Stratton-Would, illustrated by Vlad Gerasimov and translated into Turkish by Derya Çebi. The fictional story consists of 40 pages with a total of 541 words. A boy named Bertie is the main character, and he likes to look at the moon when he lies in bed. However, one night, the sky is empty and he cannot see the moon anywhere. He becomes worried, thinking someone has stolen the moon, and thus, he sets out to find it. Along the way, he asks, 'Have you stolen the moon?' of a hedgehog, a fox, a badger and a mole. Each animal says, 'It was not me'. The mole directs Bertie to ask the wise owl, who tells Bertie that the moon does not appear when it is hidden by clouds. The next night, Bertie sees the moon again. He sleeps happily, dreaming that he is an astronaut.

I created *Why Does the Moon Appear Different Every Night?* NASA Space Place and NASA Kids' Club were used as auxiliary sources for the story. The story was illustrated with Storybird, a story creation platform, and was supplemented by actual photos of the moon's phases. The hybrid text provides scientific explanations of the moon's rotation and phases, consisting of 41 pages with a total of 460 words. A girl named Ayşe is the main character. She loves to watch the moon as she falls asleep, and she wonders why the moon looks different every night. Her father reads many books, so she decides to take her questions to him. Her father is happy about her questions, and he proposes that they investigate them together. They read books and examine pictures concerning the moon's rotation and the causes of its phases. They also examine NASA's photos of moon phases over one full month. They decide to make observations and record them in a moon observation log. Ayşe's father introduces her to the names of each phase: new moon, crescent, first quarter, last quarter, crescent and full moon. (The waxing crescent and waning crescent phases are each referred to simply as 'crescent' in Turkish.)

 

Three experts in the fields of children's literature, science education and early childhood education, respectively, were asked to judge the plot, content and language of *Why Does the Moon Appear Different Every Night?* After the story was approved, it was read to ten preschoolers as a pilot study. Following the reading session, children answered story comprehension questions (Paris and Paris, 2003). The children reported their affective responses by selecting the smiley face (unhappy, neutral or happy) that best matched their feelings about the story. Eight children selected the happy face, one selected the neutral face and one selected the unhappy face. The story comprehension score average was 6.75 (range 3–10), above the midpoint of 5.00. Paris and Paris (2003) found that pre-reader children's average story comprehension score was 6.63. Thus, the pilot study presents evidence to support the claim that the hybrid picture book is appropriate to read to preschoolers.

### *Instruments*

Data were collected through semi-structured interviews and children's drawings. The children answered three questions to elicit their knowledge of the moon. At the pretest, children were asked three questions to ascertain their knowledge about the moon and determine their level of understanding based on Blake's (2005) framework. The children were not exposed to direct instruction regarding shapes of the moon before the study. Thus, general questions were more appropriate to reveal their initial understanding (e.g. Grandfather Moon). After each book was read, all children were exposed to accurate information and misinformation regarding the Moon. Therefore, the first question was not meaningful (i.e. Have you ever heard of the Moon?). Post-test questions attempt to reveal children's understanding of the stories. Table 1, below, presents the interview questions posed before and after storybook reading sessions. The children's affective responses were determined by the same smiley face selection method as implemented with the pilot study. Children were also encouraged to draw pictures that illustrated the moon following each session.

### *Data collection procedures*

The data were collected during the 2017–2018 fall education term. After the university ethics committee and the Ministry of National Education provided official permission, I administered consent forms to the parents. The study was conducted in three sessions (see Table 2). Before the sessions, pre-interviews and drawings were used to gain a sense of children's initial understanding of the moon. All interviews were audio-recorded.

In the second session, *Who Stole the Moon?* was read aloud to small activity groups consisting of four to five children. Following the reading, children had the opportunity to examine the book and its pictures individually. Each child had a one-on-one interview and was encouraged to draw a picture of the moon. The last section of *Why Does the Moon Appear Different Every Night?* was read to the same small activity groups; following the reading, the

**Table 1:** Interview questions

| Pre-storybook reading | Post-storybook reading |
|---|---|
| 1) Have you ever heard of the Moon? | 1) How do you feel when you listen to the story? Can you show me the card related to your feeling? |
| 2) What do you know about the Moon? Can you draw me what you know about the Moon? | 2) What do you learn about the Moon? Can you draw me what you learn about the Moon? |
| 3) What do you wonder about the Moon? | 3) What do you wonder about the Moon? |

 

**Table 2:** Study sessions

| Session 1 | Session 2 | Session 3 |
|---|---|---|
| Pre-interviews<br>Drawing | Reading fiction story<br>Interviews<br>Drawing | Reading hybrid story<br>Interviews<br>Drawing<br>Book preferences |

children answered the interview questions and drew pictures of the moon. Finally, both books were placed on the table and children were inquired as to which of the two they preferred.

### *Data analyses*

The interview data were transcribed and coded to examine each child's understanding prior to and following each book reading session. Blake's (2005) framework of hierarchical levels of descriptive and causal understanding was used to categorise the children's understanding. Blake (2005) proposed four hierarchical levels to describe children's conceptual understanding. Level 0 refers to children who are unable to give any answers or are able to give only irrelevant answers (e.g. *no response or 'my sister does not enjoy eating the moon'*); Level 1, 'non-scientific', describes children with a vague understanding that differs from a scientific understanding (e.g. *'grandfather moon shines night and sleeps morning'*); Level 2, 'protoscientific', describes the first development of scientific understanding combined with a lack of accuracy concerning details of the scientific concept (e.g. *'the moon shapes change'; how much sun gives its light*); and Level 3, 'scientific', consists of children who have a clear understanding of the scientific concept and use technical vocabulary in their explanations (e.g. *'the moon goes around the world'; 'the moon shapes are changed by how much light it is getting from the sun'; new moon, crescent, first quarter, last quarter, full moon and other shapes*). I coded the data individually; to ensure coding consistency, 50 per cent of the data was randomly selected for an inter-coder reliability check. The second trained rater was blinded and had a master's degree in early childhood education. Cohen's Kappa coefficient was calculated at 0.96. The smiley face method was scored using Saracho and Dayton's (1989) scale, where the unhappy face scored 1, the neutral face scored 2 and the happy face scored 3. Children's drawings were used to triangulate the interview data.

## Findings

### *Children's explanations of the moon*

The following tables depict data collected from interviews regarding second questions (What do you know/learn about the moon?) that identify children's understanding of the moon. Table 3 presents the categorisation of the children's understanding. The majority of children ($n$ = 28) had a non-scientific understanding, and none of the children articulated a scientific explanation prior to the reading sessions; three children gave irrelevant explanations. The majority of children ($n$ = 33) indicated that 'the moon only appears in the night-time' or 'the moon only comes to the sky in the night-time'. One child explained:

> I know the moon grandfather [the moon]. I see it from our balcony. It looks from our balcony. The moon grandfather comes at night. It shines with the stars. It goes in the morning and the sun comes.
>
> (G5)

 

**Table 3:** Levels of children's conceptual understanding of the moon

| | Pre-interview | | After reading fiction story | | After reading hybrid story | |
|---|---|---|---|---|---|---|
| Categories of scientific understanding | Girl, f | Boy, f | Girl, f | Boy, f | Girl, f | Boy, f |
| Level 0 | 1 | 2 | – | – | – | – |
| Level 1 | 15 | 13 | 16 | 15 | 2 | 3 |
| Level 2 | 1 | 2 | 1 | 2 | 15 | 13 |
| Level 3 | 0 | 0 | 0 | 0 | 0 | 1 |
| Total | 17 | 17 | 17 | 17 | 17 | 17 |

After reading the fiction picture book, the majority of children ($n = 31$) had a non-scientific understanding of the moon and explained that the moon does not appear because it is hidden by clouds. One of them said:

> The clouds were in front of the moon as the weather was so close (so rainy). The moon looked dark to Bertie. Bertie could not see the moon.
>
> (B11)

Following the hybrid picture book reading session, there was a notable shift; 28 children articulated protoscientific explanations. As Table 2 indicates, five children still offered non-scientific explanations, and only one child gave a scientific explanation:

> The moon is turning around in the world. The moon is receiving light from the sun. The shape of the moon changes by getting light from the sun.
>
> (G4 – protoscientific)

> Actually, the moon does not have light. The sunlight comes, and the moon becomes shiny. The moon goes around the world. The moon shapes are changed by how much light it is getting from the sun. We looked at them with my father. New moon, crescent, first quarter, last quarter, full moon, and other shapes change how much light it gets from the sun. I love the moon.
>
> (B9 – scientific)

Lastly, the children's interview scores after reading the fiction and hybrid picture books were compared using the Wilcoxon signed-rank test. The test results revealed a statistically significant increase in scientific understanding after the children had read the hybrid storybook ($z = -0.5209$, $P < 0.00$), with a large effect size of $r = 0.63$.

### *The phases of the moon*

Children's interviews and drawings provided data that examined their knowledge of the moon phases. Table 4 shows the number of children who included moon phases in their responses and drawings. The majority of children ($n = 25$) drew a crescent in their pictures during the pre-interview, and 31 children drew a crescent after reading the fiction story. Six children drew irrelevant shapes during the pre-interview. Appendix 1 displays examples of the children's drawings. During the pre-interview and following the fiction story, children called the crescent phase a variety of names, including 'baby moon', 'banana moon', 'thin moon' and 'the moon on our flag'. Only one boy gave the crescent phase its correct name. Three children provided alternative names for the full moon: 'ball', 'melon' and 'plate'.

After the fiction book reading was administered, the children depicted the book's illustrations (see Appendix 2). Following the hybrid picture book reading session, however, children drew a variety of moon phases, but most of them ($n = 22$) drew the crescent, ten drew the full

 

**Table 4:** Frequencies of children's drawing of the moon phases

| | Pre-interview | | After reading fiction story | | After reading hybrid story[a] | |
|---|---|---|---|---|---|---|
| Moon phases | Girl, f | Boy, f | Girl, f | Boy, f | Girl, f | Boy, f |
| New moon | 0 | 0 | 0 | 0 | 0 | 1 |
| Crescent | 14 | 11 | 16 | 15 | 12 | 10 |
| First quarter | 0 | 0 | 0 | 0 | 2 | 4 |
| Last quarter | 0 | 0 | 0 | 0 | 2 | 3 |
| Full moon | 1 | 2 | 0 | 0 | 5 | 5 |
| Irrelevant shapes | 2 | 4 | 1 | 2 | 1 | 1 |

[a]Some children drew more than one moon phase.

moon and only one drew the new moon (see Appendix 3). Seventeen children correctly named the crescent, seven correctly named the full moon and three correctly named the first quarter. Only two accurately identified the last quarter, while one accurately identified the new moon.

### *Children's questions about the moon*

In the last portion of the interviews, children were asked what they would like to know about the moon. Table 5 summarises their questions, which indicate a notable shift from the non-scientific to the protoscientific level. Their questions were dominated by animistic thought during the pre-interview. As illustrated in Table 4, after listening to the books, children focused on the text and illustrations while forming new questions that reflected the storybooks' content.

### *Children's affective responses to the stories*

After the completion of each book reading session, children were asked to share their ideas about the story and report their affective responses to it by selecting a corresponding smiley

**Table 5:** Children's questions about the moon

| Pre-interview | f | After reading fiction story | f | After reading hybrid story | f |
|---|---|---|---|---|---|
| What does the moon do during the day? | 18 | How is the moon hiding behind the clouds? | 10 | How are moon photos taken? | 11 |
| Why is the moon following us? | 4 | Are clouds bigger than the moon? | 5 | How do I go to the moon? | 5 |
| Does the moon have a family/a house? | 3 | Why is the moon sparkling? | 4 | How do people become astronauts?/How do I become an astronaut? | 5 |
| Is the moon alone or bored? | 3 | How big is the moon? | 4 | Why do the stars shine? | 3 |
| Why is Moon running away from the sun? | 1 | How to become an astronaut? | 3 | I wonder about space — what else is there? | 2 |
| How many moons are there in the world? | 1 | How do I go to the moon? | 3 | What does the moon do when the sun does not light? | 2 |
| Are stars friends with the moon? | 1 | What if the moon never comes? | 1 | Why do astronauts always wear white? | 1 |
| What's in the moon holes? | 1 | Is the moon bigger than the world? | 1 | | |
| If I go to the side of the moon, do I burn? | 1 | | | | |
| Total | 33 | | 31 | | 29 |

 

face (unhappy, neutral or happy). Figure 1 demonstrates that the majority of children ($n$ = 31) selected a happy face for the fiction story, while 26 selected a happy face for the hybrid story. A chi-squared 2 × 3 contingency table (with Monte Carlo method for the asymptotic chi-squared distributions) indicated no significant association between gender and affective responses to the fiction story: $\chi^2$ (2, $n$ = 34) = 1.03, $P$ = 0.74. When asked the reasons, they selected a smiling face; twelve children stated that the story was funny and they liked the moon; ten said that animals helped the boy, the boy talked to animals and they liked animals. A substantial minority ($n$ = 9) claimed that they enjoyed the storybook illustrations. One boy stated that he did not enjoy the story because the main character went to the forest alone at night. Two children said that they did not select either happy or unhappy because, although they felt unhappy when the moon was lost, they felt happy when it came back. Examples of the children's explanations are listed below.

> Because the boy went to the forest alone without telling his mother, I did not like the story.
>
> (B12 – unhappy)

> I felt sad when the moon disappeared. Then the wise owl helped. The boy saw the moon again. I felt happy.
>
> (G1 –neutral)

> Because the child in the story was talking to the animals. I loved the owl very much.
>
> (B8 – happy)

With respect to the hybrid story, a chi-squared 2 × 3 contingency table (with Monte Carlo method for the asymptotic chi-squared distributions) indicated no significant association between gender and affective responses to the hybrid story: $\chi^2$ (2, $n$ = 34) = 2.66, $P$ = 0.41. Among them, ten children said that they were happy to learn the different shapes of the moon. Six of them stated that they enjoyed the moon photos, four indicated that they enjoyed the way the father talked and explained things to his daughter and three said that they enjoyed learning the moon rotates and reflects the light of the sun. Two boys claimed that the story was boring and too long, and thus, they selected an unhappy face. Lastly, six children stated that they enjoyed the story, but regretted that there were no animals and that the illustrations in the fiction book were more beautiful than those in the hybrid book; thus, this group selected a neutral face. Three children's explanations are described below.

> It is so long, and it did not end, and the pictures were not so beautiful.
>
> (B3 – unhappy)

> There are a girl and her father in the story. It is good, but I enjoy animal stories.
>
> (B12 – neutral)

> They took very beautiful photos of the moon. I want to take photos, too.
>
> (G17 – happy)

Lastly, children's affective responses to the fiction and hybrid picture books were compared using the Wilcoxon signed-rank test. The test results revealed a statistically significant

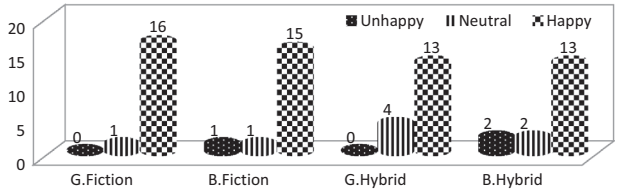


**Figure 1.** Children's affective responses to the picture books

 

decrease in affective responses following the hybrid storybook reading ($z = -0.2449$, $P < 0.05$), with a medium effect size of $r = 0.30$.

### *Children's storybook preferences*

As seen in Table 6, nine girls and seven boys preferred the fiction story, whereas five of the girls and six of the boys preferred the hybrid story. Lastly, three girls and four boys claimed that they enjoyed both picture books equally. A chi-squared $2 \times 3$ contingency table (with Monte Carlo method for the asymptotic chi-squared distributions) indicated no significant association between gender and book preferences: $\chi^2$ (2, $n = 34$) = 0.48, $P = 0.81$. One child explained this last choice, stating:

> Bernie and Ayşe like observing the moon. I like that, too. I also asked my father questions about the moon. I want to take photos of the moon. Bernie wants to be an astronaut. I want to be an astronaut. I love both of the stories.
>
> (G10)

## Discussion

There exists a growing drive to expand children's developmentally appropriate science experiences and foster their scientific thinking skills and attitudes towards science during their early years (Eshach and Fried, 2005; Mantzicopoulos and Patrick, 2010). Previous studies have focused on descriptive aspects of young children's understanding of the moon and have sought to elicit children's alternative understanding of lunar phenomena (Blake, 2005; Panagiotaki and others, 2009; Samarapungavan and others, 1996; Vosniadou and Brewer, 1992). However, this empirical study examines how fiction and hybrid picture books contribute to young children's learning about the moon. The findings revealed that, prior to the interview, young children had intuitive knowledge and alternative explanations based on their experiences and lay culture. These findings are in line with previous research (Samarapungavan and others, 1996; Vosniadou and Brewer, 1992). Children shared their own daily experiences and observations during the pre-interview. For instance, one well-known Turkish children's song uses the lyrics 'Grandfather Moon, Grandfather Moon, where is your home?' Children commonly referred to 'Grandfather Moon' and inquired as to whether the moon has a home or a family. Vosniadou (1994) maintained that children's initial scientific conceptual structures have both universal properties based on their developmental cognitive capabilities and culture-specific properties. Cross-cultural studies provided evidence that, in certain respects, children's mental models of the world vary from the United States, Greece (Vosniadou and Brewer, 1989), India (Samarapungavan and others, 1996) and Samoa (Brewer and others, 1987). Children assimilate folk cosmologies and cultural information that can mediate their constructions of initial conceptual models and understanding. These findings suggest that children's conceptual understanding has ethnographic, linguistic and cognitive aspects. Thus, research on children's scientific conceptions should begin by tracing the roots of

**Table 6:** The distribution of the children's picture book preferences

| Picture book | Girl, f (%) | Boy, f (%) | Total, f (%) |
|---|---|---|---|
| Fiction | 9 (53.0) | 7 (41.2) | 16 (47.0) |
| Hybrid | 5 (29.4) | 6 (35.3) | 11 (32.4) |
| Both | 3 (17.6) | 4 (23.5) | 7 (20.6) |
| Total | 17 (100) | 17 (100) | 34 (100) |

 

sociolinguistic experiences in the dynamic context of social life (Hymes, 1977) and in how children assimilate such experiences.

After the fiction storybook reading session, the majority of children ($n$ = 31) articulated the non-scientific explanation that clouds hide the moon. This is a common misconception about the phases of the moon that the fiction book presented. Children's drawings also focused on the book illustrations in which the moon was hidden by the clouds. These findings present evidence that storybook messages as well as their illustrations may lead children to develop misconceptions. Eye movement monitoring studies showed that, among young children, the majority of eye fixations remain on the illustrations during storybook reading (Evans and Saint-Aubin, 2005; Roy-Charland and others, 2007). Furthermore, multimodality literacy, which is a social semiotic perspective on meaning and communication, states that not only written or spoken words but also visual images, drawings and other graphic representations provide a source for meaning making (Arizpe and Styles, 2003; Painter and others, 2013). These findings suggest that children learn from the illustrations, and therefore, early childhood educators and parents should take care when examining both the text and the illustrations of children's picture books (Sackes and others, 2009; Trundle and Sackes, 2008; Trundle and Troland, 2005). Pringle and Lamme (2005) recommended that teachers take into account the scientific backgrounds of both writers and illustrators.

One contribution of the present study is that young children's explanations before and after reading the hybrid text indicate distinct differences. There was an increase in children's protoscientific explanations, although only one boy articulated scientific explanations. The study findings show that the direction of children's curiosity also notably shifts when they are exposed to hybrid literature and that they ask more detailed questions regarding the moon, space and astronauts. The present study makes a contribution towards the literature concerning the influence of different types of children's picture books on the development of scientific concepts as well as the importance of combining accurate scientific information with an enjoyable story context. Young children are capable of understanding scientific explanations regarding the moon in developmentally appropriate stories.

Reading the hybrid science story is proved to be an effective, meaningful, amusing and interesting activity for young children of both genders. These results revealed that both boys and girls enjoyed and benefitted from the hybrid science story, as has also been supported by previous studies (Broemmel and Rearden, 2006; Mantzicopoulos and Patrick, 2010). Clearly, science stories offer an effective opportunity for bridging the gender gap in science as well as developing more gender egalitarian-focused societies. Children's reading of hybrid books facilitates change regarding their scientific understanding of the moon, although conceptual change involves a further process (Vosniadou and Skopeliti, 2014); additional developmentally appropriate activities are necessary to foster children's scientific conceptions. To reach equilibrium, children need to assimilate or accommodate information that is new to them (Piaget, 1983).

Researchers have also noted that the causes of lunar shapes are a complex issue that covers three dimensions of thinking from two different perspectives: the first perspective is the appearance of the moon from the earth and the second is its inferred appearance from the sun (Suzuki, 2002). More relative research is necessary for the designing and examining of instructional interventions related to children's conceptual changes. Future studies should examine the contribution that the additional features of multimedia hybrid science stories can make towards children's scientific understanding.

Another set of important findings of the present research centres around the children's affective responses to fiction and hybrid stories. Children primarily preferred and enjoyed the fiction story, as some of them emphasised that they like animal characters and enjoy

 

stories that include animals. Children enjoy exploring fantasy and their imaginations, and it seems that they have a particular fondness for anthropomorphism in stories. A possible explanation for this fondness is that anthropomorphism may suit children's animistic thinking, as their drawings also reflect animistic thinking. This finding indicates that anthropomorphism in stories may not present a barrier for children's learning of science concepts; more important for children's learning of science is the plot of the story, its message and the accuracy with which the illustrations convey the related science concepts. I chose to use human protagonists in the hybrid story to compare the effects of anthropomorphism. However, future studies may develop hybrid science stories with animal protagonists and examine the efficacy of this approach on children's conceptual understanding. In the present study, the expository text was lightened in the hybrid text. Future studies could also use the storybook and expository pairings suggested by previous studies (Camp, 2000; Fleener and Bucher, 2003) to introduce children to different types of texts.

Although this study has some limitations regarding the number of storybooks used, the lunar concept and sample size, interview questions and the order of story presentation were not counterbalanced. However, the findings have implications for both science education and children's literature. To support children's science learning within the sphere of early childhood education, accurate scientific information should be presented within the context of developmentally appropriate texts. The study's findings revealed that children enjoy listening to fiction stories more, but they gained misconceptions from the story. However, they learned the most from the story they liked the least — the hybrid story. The inclusion of scientific misconceptions in fictional stories can lead children to embrace those misconceptions. Fictional stories provide amusing and interesting context for children and it should blend accurate information and intriguing plots. These many benefits suggest that hybrid stories serve as a type of edutainment implemented with learning materials that allow children to enjoy the introduction of science concepts that are novel to them.

## Conclusion

Storybook reading is a transcultural activity for children. This study reveals that storybook reading involves more than just listening to stories, comprehending their messages and fun time for children. The small-group quasi-experimental study illustrates that young children process information beyond the story plots and visuals. They apply prior knowledge, cultural information, text and visuals to make their own meaning. The aforementioned studies have found that children from a variety of cultural backgrounds tend to communicating and reflecting cultural dimensions of language experience in storybook reading process. Children play an active role in processing cultural, linguistic and visual information in order to assimilate the new information. This study provides important insights for educators and parents regarding the way information in the text can lead children to gain misconceptions from the story. Storybook reading is an important social learning method because stories usually contain socially constituted conceptual structures and facilitate the process of information exchange from previous to future generations. Thus, we should select storybooks carefully and listen to the perspectives and understandings children derive from them. This study characterises storybook reading as a rich and complex experience for children, which goes beyond extracting themes and an accurate understanding of the text; rather, storybook reading helps children make sense of the world around them.

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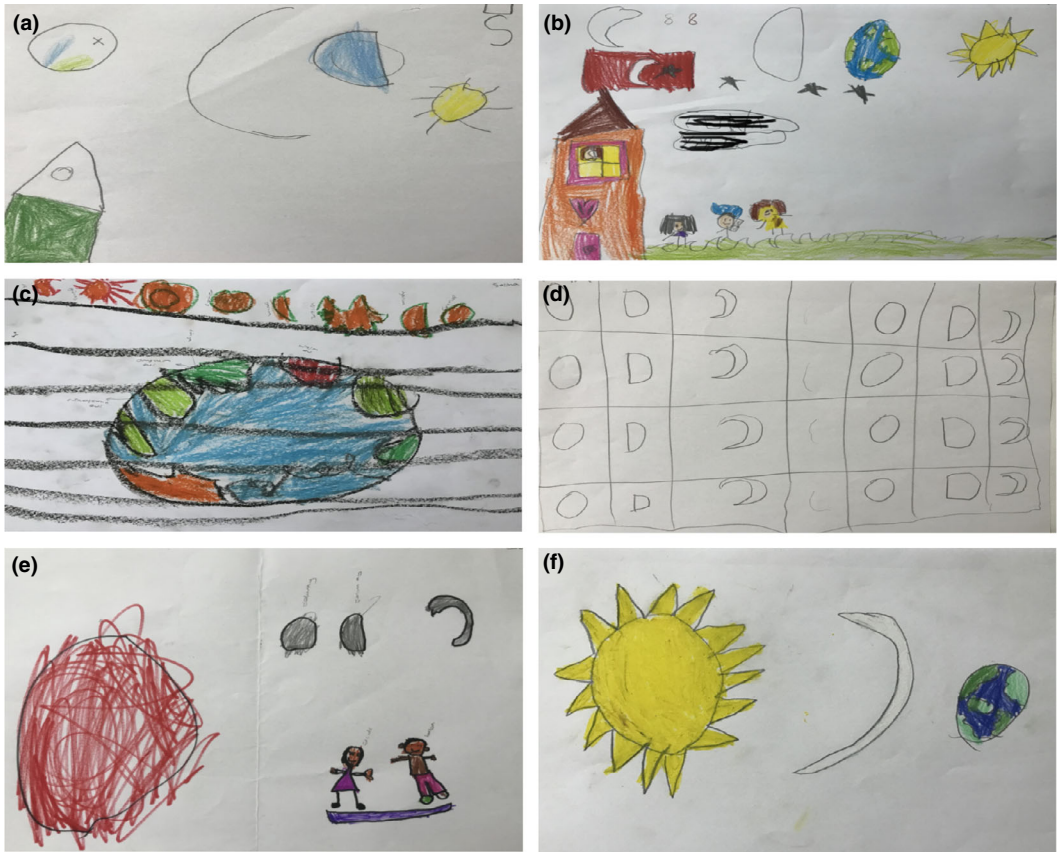
**Appendix 1:** Children's pre-interview drawings related to the moon. [Colour figure can be viewed at wileyonlinelibrary.com]


(a) irrelevant shape (B5), (b) crescent (G3), (c) crescent (G11), (d) crescent (B10), (e) full moon (B2), (f) crescent (G7).

**Appendix 2:** Children's drawings related to the moon after reading Who Stole the Moon? [Colour figure can be viewed at wileyonlinelibrary.com]


Children's depiction of the story illustrations: the moon behind the clouds (a) G1, (b) B7, (c) B8, (d) G6, (e) G8, (f) B13.

**Appendix 3:** Children's drawings related to the moon after reading Why Does the Moon Appear Different Every Night? [Colour figure can be viewed at wileyonlinelibrary.com]




Children depict the moon going around the sun (a) B2, (b) G10, (c) B17, (f) G5; The boy recorded in moon observation journal/log (d) B16; Ayşe and her father learning the lunar shapes: full moon, last quarter, crescent (e) G9.

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Correspondence to: Dilek Altun, Department of Early Childhood Education, Ahi Evran University, Kırşehir 40100, Turkey. E-mail: daltun@ahievran.edu.tr

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