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Effects of an educational television program on preschoolers: Variability in benefits ☆

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ABSTRACT

This study examined the cognitive effects of an educational early childhood television program in Turkey that was designed to enhance basic cognitive skills and socio-emotional development of 5-year-old children. The program targeted children with low socioeconomic status who had limited access to formal preschool education. The program was screened for a period of 13 weeks and was evaluated with an experimental design, with the addition of a natural observation group. Findings indicated that the program functioned as an early educational intervention for those children who had moderate exposure to it. Furthermore, compensatory effects were found, such that those children who had low levels of skills prior to the viewing of the program benefited more than their skilled peers. The policy implications are important for enhancing school readiness among children in socioeconomically deprived contexts.

1. Introduction

Television constitutes an important and influential aspect of young children's developmental environment (Singer & Singer, 1990). The most likely source of positive influence of television on children's development is the educational programming that is specifically designed to increase school readiness and social competence in young viewers. However, most previous studies evaluating the effects of educational programs are correlational, making it difficult to identify program effects because of the confounding effects of factors that might predispose young children to watch such programs (Cole & Cole, 2005). The present paper describes an experimental study that evaluated the cognitive consequences of an educational television program among low socioeconomic status (SES) preschool age children living in Turkey. This study examined sources of variability in the beneficial TV effects due to level of exposure to particular programs, pre-existing socio-demographic characteristics such as maternal education, and pre-existing child characteristics such as pre-screening cognitive skills.

Extensive research on children's television viewing has found that television can serve as a powerful vehicle for informal education. Parent reports indicate that children as young as 2–3 years old spend 11 h or more per week watching television (Jordan & Woodward, 1997; Rideout & Hamel, 2006). The literature points to a broad range of effects that are related to watching television, including well publicized negative effects overall and some positive effects of educational programming.

In order to evaluate previous research on the effects of television on children's school readiness and other achievement outcomes, a distinction must be made between studies on the effects of entertainment viewing and viewing of educational or

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informational programs. Most studies of entertainment programs conducted with school age children have focused on school achievement. Correlational studies show a moderate and consistent negative association between viewing entertainment programs and various indicators of school achievement even when confounding factors such as SES are controlled (Comstock, 1995; Rosengren & Windhal, 1989).

1.1. Effects of television viewing on children

Previous studies have suggested two processes by which exposure to general entertainment programs might lead to deficits in achievement: By replacing other and more beneficial activities, and by directly decreasing the level of intellectual functioning. Researchers have suggested that television viewing displaces more intellectually engaging activities, resulting in lower levels of language and intellectual functioning (Huston, Wright, Marquis, & Green, 1999; Wright & Huston, 1995). For preschool children, viewing entertainment programming also interferes with a child's opportunity to interact with adults (St. Peters, Fitch, Huston, Wright, & Eakins, 1991). Another study proposed that entertainment programs do not encourage mental effort, make few intellectual demands, and as a result develop intellectual laziness and disinterest in learning (Koolstra & van der Voort, 1996). Whereas early viewing of entertainment programming may start a negative cycle predicting more entertainment consumption and lower school grades, there is evidence that early viewing of preschool educational programs starts a positive cycle predicting the viewing of informational programs and higher achievement in school (Wright et al., 2001).

Educational programs for young children are designed to enhance academic and social skills. They contain linguistic and production techniques designed to enhance learning (Huston & Wright, 1994). Academic school readiness has always been one of the important objectives of educational programs targeting preschool children (Huston & Wright, 1994). Most studies evaluating the effects of the educational programs on language and other social and cognitive skills of young children have been conducted with *Sesame Street*. Viewing *Sesame Street* at age 3 has been shown to predict improved receptive vocabulary at age 5 (Rice, Houston, Truglio, & Wright, 1990) and improved grades in high school even when family characteristics are controlled (Anderson, Huston, Schmitt, Linebarger, & Wright, 2001).

1.2. Processes by which educational programs influence children

The effects of viewing educational programs on children of preschool ages may be direct or indirect, and previous studies have documented both of these processes. Direct effects operate via learning specific cognitive or academic skills. Indirect effects operate through motivational processes, or through modeling desirable behaviors that facilitate functioning in academic environments. Furthermore, neither direct nor indirect effects of educational programs are expected to be uniform for children from different developmental ecologies. These effects are expected to vary depending on the extent to which a child's developmental ecology supports cognitive and socio-emotional development. The following paragraphs summarize the extant evidence pertaining to the direct and indirect effects of educational programs.

Direct beneficial effects of educational programs were shown by the studies on *Sesame Street* previously cited. In addition, Wright et al. (2001) found that exposure to educational programs designed for children was associated with subsequent letter–word skills, number skills, receptive vocabulary, and school readiness. Furthermore, individual differences in these skills remained stable through the preschool years.

Regarding indirect effects, previous studies suggested that viewing educational programs increases children's motivation and enables them to organize their home and school environments differently (Wright & Huston, 1995). For example, children exposed to a lot of educational programs tended to devote more time to reading and educational activities. In one longitudinal study, viewing educational programs in early childhood was positively associated with high school grades and it was suggested that these long-term associations could be due to differences in motivation and self concept (Anderson et al., 2001).

In addition to overall direct and indirect effects of educational television, the degree and sources of variability of these effects are issues of great policy significance. Viewing educational programs will not benefit all children similarly. Such variations are often referred to as non-linear effects. In the present study two kinds of non-linear effects were considered: (1) supplementary effects of exposure to educational television, which imply more benefits for children who are in advantaged developmental ecologies than disadvantaged developmental ecologies; and (2) compensatory effects, which imply that children who have low levels of skills and unsupportive developmental ecologies would benefit from exposure to educational programs more than others.

Studies have shown that viewing educational television may be more beneficial for children from socioeconomically disadvantaged backgrounds than children from socioeconomically advantaged backgrounds. The variability of the effects of *Sesame Street* and other educational television programs have been documented elsewhere (National Center for Education Statistics, 1999). However, these compensatory effects were not supported by the evaluation of another educational television program targeting literacy development of 5- to 6-year-old children (Linebarger, Kosanic, Greenwood, & Doku, 2004). Children who were at moderate or no risk for later reading difficulties demonstrated significant gains in early literacy skills over their non-viewing counterparts after viewing an educational series, but such gains were not observed among children who were at high risk.

Studies suggest that the relation between watching television and school achievement varies for older children living in different socioeconomic contexts as well (Wright et al., 2001). In one study, for example, reading performance was positively associated with infrequent viewing for children from high SES families, but was associated with frequent viewing for children from low SES families (Searls, Mead, & Ward, 1985). Putting it another way, viewing may interfere with school performance among high SES children, but it may enhance knowledge and/or language ability for low SES children (Wright et al., 2001).

The social-interactive context of viewing television has been suggested as another factor moderating the effects of educational programs. Huston and Wright (1996), for example, proposed that the benefits of viewing could increase when children watch television together with their parents. Because of this, mothers and children in the experimental group were asked to view the program together.

1.3. About the educational program "Will You Play with Me?"

The present study examined the impact of an educational childhood television program "Will You Play with Me?" ("Benimle Oynar mısın?" BOM hereafter) on 5-year-old Turkish children. This program was prepared by the Mother–Child Education Foundation (MOCEF) in Turkey and was focused on improving the developmental trajectories of young children generally, and more specifically, on supporting their school readiness. The television program targeted 4- to 6-year-old low SES children without center-based preschool experience.

"BOM" was a television adaptation of the Mother–Child Education Program (MOCEP) that was implemented by the Mother–Child Education Foundation for over ten years in Turkey, and more recently in Bahrain, Jordan and Lebanon and with ethnic minorities in Belgium, Germany and France. The MOCEP originated from an early intervention study (Bekman, 1998; Kagitcibasi, 1997; Kagitcibasi, Sunar, & Bekman, 2001; Kagitcibasi, Sunar, Bekman, & Cemalcilar, 2005). Its television adaptation, "BOM" was developed by a group of experts at the Mother–Child Education Foundation, some of whom had also taken part in devising the MOCEP, in collaboration with Turkish Radio and the Television Office of Children's Programming. The goal was to expand the MOCEP to reach a large number of children and mothers through distance learning. The experience with the MOCEP had been very positive, as established by longitudinal research (Bekman, 1998; Kagitcibasi et al., 2001; Kagitcibasi et al., 2005). However, because of its in-person instructional curriculum that spanned 25 weeks, the MOCEP was limited in its reach (to around 240,000 mother–child pairs over its 10-year history). Television was considered as the appropriate medium to reach a wider audience, although the intervention would be less intensive than in-person instruction.

The "BOM" program is a 65-part series of half hour television segments that were repeated twice daily during weekdays. It is rather similar to *Sesame Street* in format in that it includes lively and entertaining studio drama shows and games, puppets, animation, live shots, and music. It differs from *Sesame Street*, however, in addressing not only children but also their mothers. "BOM" has six main target topics: Family relations, social development, emotional development, physical development (health), environmental awareness, and cognitive development. Cognitive development is the most emphasized area and it is the focus of the current study. The six main targets of BOM are also among the main targets of the MOCEP, considered by the expert team to be the most relevant for contributing to the overall development and well-being of at-risk children and parents. The target topics were also deemed suitable for a television production with the planned format of a mix of short segments. The special emphasis on cognitive development was appropriate given the lack of access to preschool education in Turkey. Thus, "BOM" was conceived as a compensatory school readiness program.

1.4. The socio-cultural context of the current study and its significance

This study is unique in several aspects. First, it used an experimental design to test the effects of a televised educational program for preschool children. Second, it focused on compensatory and supplementary effects of educational television. Third, it was conducted in a cultural context that may generalize the potential effects of educational television to a more global perspective. Turkish society provides a context in which preschool education is unavailable for a vast majority of children, most mothers are not employed, and television is nearly universally available.

Although official statistics are unavailable, it is estimated that less than 10% of 3- to 6-year-olds attend formal preschools in Turkey. Of the approximately 4.5 million 3- to 6-year-old children who were not yet attending grade school in Turkey in 2004 (Turkish National Statistics Institute, 2003–2004), around 358,500 children were enrolled in preschools in the 2003–2004 academic year. Among the children who do attend preschools more than 80% come from middle and upper–middle income groups (Kagitcibasi et al., 2005). Low and lower–middle income group children do not have access to preschool education. Within this context, "BOM" was conceived as a program to enhance school readiness. The possibility of achieving compensatory effects of educational television is especially significant in this context. Indications from other studies are promising in that exposure to educational television has been associated with gains in cognitive skills (Zill, Davies, & Daly, 1994).

In Turkey, there were about 33 million televisions for a total population of almost 70 million individuals residing in about 20 million households in 2004 (Turkish National Statistics Institute, 2004a). The fact that television is nearly universally available enhances the potential of television as a tool for developing school readiness. Before the introduction of commercial television in 1992, state-owned television held a monopoly on broadcasting. During the period following 1992, Turkish audiences have been exposed to a variety of commercial broadcasters. Today Turkey has 23 network channels, 6 of them publicly owned, more than 50 local channels, and after the recent implementation of deregulatory policies, several digital and cable channels. Commercial channels, cable and digital broadcasting air mostly entertainment programs whereas public channels usually focus on public affairs programming, news, documentaries, educational programs and sports. A majority of the programs both in public and commercial channels are domestically (nationally) produced and attract large audiences. These programs are overwhelmingly entertainment and fiction oriented in their content (Celenk, 2001). A recent study showed that Turkish children between the ages 3–6 watch an average of 4.7 h of television per day (Higher Council of Turkish Radio and Television, 2006).

The daily experiences of low SES children and their mothers are limited to their families and their neighborhoods. They live in a socially restrictive context where they do not have much opportunity to enjoy excursions, contact with individuals from different

social or cultural backgrounds, or access to formal or informal education. Labor force participation of women in urban Turkey is around 16.3%. The average years of schooling for women is 5.0 (Turkish National Statistics Institute, 2004b), which was the level required by compulsory education in Turkey until 1998. In these social contexts, exposure to television programs is an extremely important – and sometimes the only – resource for information other than the home environment. Therefore, television constitutes a particularly important opportunity for educational exposure.

2. Method

2.1. Sample

Mothers who were not employed and their children who were to start school in the following fall were recruited from among low income families in the largest metropolitan area in Turkey. Children ranged in age between 4 years 7 months and 7 years 3 months (mean = 5 years, 3 months). Mothers and their children were randomly assigned to three conditions. Experimental group participants (n = 139) were asked to watch "BOM" every weekday for 13 weeks. Control group participants (n = 127) were asked to watch an entertainment program that was broadcast at the same time as "BOM" on a different channel for 13 weeks. Natural observation group participants (n = 133) were informed about "BOM" and about its potential benefits for children but were not asked to watch it, nor were they contacted during the study time to repeat this information.

2.2. Procedure

The study was conducted during the fall of 2002, when the second, 65-segment cycle of "BOM" was aired (5 days/week for 13 weeks). Participants in all study conditions received an in-person pre-screening assessment and an in-person post-screening assessment. Mothers in the experimental and control conditions also received six telephone follow-up interviews. The purpose of the follow-up interviews was to ensure maximum compliance among the experimental group participants for watching "BOM" and to ensure that the control group participants did not view "BOM". The telephone interviews also collected data on exposure to the program. In order to assure that the control group was not contaminated, the mothers in this group were asked whether they and their children watched any program other than the one requested during the phone interviews. Contamination was indeed minimal: Only six mother–child pairs from the control condition reported having ever watched "BOM".

All participants were also provided with incentive gifts. Attrition rates from the pre-screening assessment to the post-screening assessment were 5% in the experimental group, 9% in the control group, and 29% in the natural observation group.

2.3. Measures

2.3.1. Pre-screening and post-screening measures of child cognitive skills

Given the absence of standardized cognitive tests in Turkey for the age group we tested, the authors developed a test battery. The test battery was not intended as an assessment of a child's general cognitive development, but addressed the types of cognitive outcomes specifically targeted by "BOM". All assessments were pilot tested with 4- to 5-year-old children to ensure that the instructions and the procedures were understood.

All children completed the same battery of five cognitive skills tests (basic arithmetic readiness, categorization, spatial analogies, syllabification, and vocabulary) once prior to the screening of the program and once approximately 15 weeks later. On average, the post-screening assessment occurred 12.7 (SD = 7.1) days after the screening of "BOM" ended for the experimental group.

The basic arithmetic readiness test assessed children's ability in counting and simple addition and subtraction using objects that were manipulated. We asked children to place a given number of beans or buttons on a table and then asked simple arithmetic questions such as "How many beans will there be if I put two more beans here?" or "How many beans will there be if I take two beans away?" The total number of correct answers for 24 questions constituted the score for this test. The internal reliability (α) at pre-screening assessments was .92.

The categorization test assessed whether the child recognized similar objects and grouped them in a category. The child was shown one set of three drawings representing a category. Next, a set of five drawings was presented and the child was asked to identify two drawings from this set of five that would fit with the category represented by the first set of three drawings. For example, the child would be shown a set of five drawings, two of which were dogs, and was asked to identify the two objects that would fit with the first set. The score was the number of accurate drawings chosen. There were seven such items. The internal reliability (α) at pre-screening assessment was .69.

The spatial analogy skills test consisted of seven items that assessed mental representation of shapes. The child was presented with two simple abstract drawings in which the second was a modification of the first. The child was then given a new abstract drawing and asked how it would look like if it were similarly modified. Children were given five potential answers to each question. The score depended on the number of accurate drawings chosen. The internal reliability (α) at pre-screening assessment was .63.

The syllabification test assessed whether a child could break down words into syllables. The Turkish language offers a syllable template that preschool age children can learn to recognize and use in developing their phonological awareness skills. Syllabification activities are often used in Turkish schools to facilitate word decomposition skills, which help development of early literacy. Six words were presented. The test score depended on the accuracy of the syllables pronounced by the child. The internal reliability (α) at pre-screening assessment was .90.

A vocabulary test assessed receptive vocabulary knowledge. The child was asked to name each of 12 drawings. The internal reliability (α) at pre-screening assessment was .69.

The outcome measures used in the analyses in this study were first expressed in terms of percentile scores (0–100). These were age standardized by regressing the pre-screening scores on the children's ages, expressed in months. The regression coefficients were used to create the predicted test scores for each child. These predicted scores were then subtracted from the observed test scores. These residualized test scores represented the test performance of the child relative to his or her peers in this sample.

2.3.2. Measures of exposure to "BOM"

Exposure to "BOM" was assessed on the basis of six structured telephone interviews conducted with the mothers with a mean interval of 13.5 (*SD* = 5.0) days during the 13-week screening of the program. There were major religious holidays during these 13 weeks, and the month preceding these holidays is often a period when the daily household routine is disrupted. In order to encourage the viewing of the assigned television programs in the experimental and control groups during that time, the telephone interviews were scheduled slightly more frequently, with a mean interval of 8 (*SD* = 2.8) days.

The telephone interviews collected information from the mothers on how many times during the past week they watched "BOM". Exposure to "BOM" was coded into three categories. Those who watched "BOM" less than once a week, on average, were considered not having had meaningful exposure to "BOM". Those who watched "BOM" an average of 1–2 times a week were considered to have had moderate exposure. Those who watched "BOM" an average of three times a week or more, on average, were considered to have had a high exposure to "BOM". Mothers also reported whether their children watched "BOM" with them. The responses indicated that almost all children were watching "BOM" with their mothers. Because of the lack of variability in this measure, it was not included in further analysis.

At the post program assessment the natural observation group participants reported their frequency of watching "BOM". This group did not receive telephone interviews during the screening of the program in an effort to avoid influencing their program choices. The exposure of the natural observation group to "BOM" was coded into three categories based on the self reports in post-screening assessment: Those who did not watch "BOM"; those who watched "BOM" on average less than once a week; and those who watched "BOM" once a week or more frequently, on average.

The validity of the retrospective reports from the natural observation group could be estimated because the same retrospective exposure questions were asked of the experimental group mothers who also had telephone interview data. These data supported the validity of the retrospective exposure data. For example, those mothers who retrospectively reported exposure to BOM once a week or more frequently had a weekly exposure rate of .46 (approximately every other day) based on the phone interview data. In comparison, the mothers who reported exposure less than once a week, based on the retrospective data, had an average exposure rate of .22 (approximately once every 5 days) based on the phone interview data.

Pre-experimental TV exposure of the average number of hours per day the child watched TV on week days was measured by maternal report at the pre-screening interview. In addition, the pre-screening interview yielded information on the previous exposure to "BOM". These latter items were used to check the comparability of the experimental, control, and natural observation groups.

2.3.3. Measures of socio-demographic characteristics

The demographic information considered here consisted of the maternal reports on the age and sex of the focal child, the total number of children in the family, and the place of birth of the mother (whether born in the study metropolitan area). Socioeconomic information consisted of the mother's number of years of education, the mother's estimate of the total monthly expenditures of the household, and the ownership of the family residence. It was expected that mothers (almost all of whom were unemployed) would know the total amount of money that would be needed per month for food and all other regular payments, but they might not know their husbands' earnings due to the patriarchal cultural values dominant in the Turkish family. Furthermore, earnings might not be a good estimate of family financial status because they could be highly volatile for many families who had main earners employed in the marginal sector and who might depend on transfers from the extended family. The amount of total expenditures was divided by the total number of people living in the household to obtain an estimated amount of monthly per person expenditures.

2.3.4. Measures of cognitively stimulating activities available to the child

In order to have a measure of the cognitive stimulation available in the home environment of the child prior to the screening of the program, a cognitive stimulation scale score was computed based on six maternally reported items that pertained to the child's learning activities. These items assessed the frequency of reading to the child by the mother or other family members, the number of books that the child had, and whether anyone made an effort to teach the child numbers, the alphabet, and shapes or sizes. A scale score constructed with these six items yielded an internal reliability (α) of .62.

2.4. Analysis methods

The impact of "BOM" on children's cognitive development was assessed using regression analyses. Post-screening scores were regressed on pre-screening scores and indicator (dummy) variables that denoted the study group (experimental or natural observation groups) and the degree of exposure to the program. This approach allowed the estimation of the program impact controlling for pre-screening differences between groups. This approach also allowed the estimation of the expected trajectories of test scores for different groups of children. For example, changes in the scores of the children in the control group could be

compared to the children in the experimental group who watched "BOM" less than once a week or the children in the experimental group who watched "BOM" three or more times a week.

In order to address questions regarding variability of program effects, the same approach was extended to include interaction effects. For example, to assess the variability of program impact based on initial levels of skill (the hypothesis of compensatory effects), the following procedure was followed: For each outcome of interest, an indicator was constructed that distinguished the children who had scored below average in that assessment prior to the screening of the program from those who had scored above average. This indicator was then used to create an interaction term quantifying the effects of at least once a week of exposure to "BOM" for those children who had below average pre-screening scores.

3. Results

3.1. Characteristics of the sample and the three groups

Table 1 presents information about relevant characteristics of the three groups. Children in the sample averaged slightly over 5 years of age. Children in Turkey start formal schooling after their 6th birthday and before their 8th birthday. The mean number of children in the household was close to the total fertility rate in Turkey, about 2.7 children. A minority of the sample families lived in extended family households. This indicated that the main caregivers of the children were probably their mothers, although it is common for Turkish metropolitan low SES families to be "functionally" extended (i.e., to share resources other than residence with the extended family). Most mothers were born outside of the metropolitan area where the study was conducted and had immigrated into the area. Such immigrations tend to occur for economic reasons. As indicated before, the study sample consisted of low SES families, with average educational attainment of the participant mothers slightly over five years, the level of compulsory education in Turkey until 1998. The per person monthly expenditures of the households also evidenced the modest budgets of the participating families, averaging about $56 per person per month. Nevertheless, about one half of the families reported owning their own residences, which were often small flats in 4–5 story apartment buildings.

The last three data rows of Table 1 describe the child rearing environments of the participating families. Almost 60% of the study children had no books of their own, and about one-quarter watched more than 5 h of television on weekdays. About one half of the mothers had never heard of "BOM", even though its first cycle was screened during the previous broadcast season.

The comparability of the experimental, control, and the natural observation groups was tested using F tests for means and χ^2 tests for percentages. As indicated in Table 1, the randomization process led to comparability of the three groups for all but two of the characteristics considered. The experimental group had a higher proportion of families owning their residence than the control group. In addition, the experimental group had a lower proportion of children with no books than both the control and the natural observation groups. Thus, the experimental group might have been somewhat less disadvantaged than the other two groups, which could be associated with school readiness. In order to investigate this issue further, the pre-screening test scores of children were compared among the experimental, control, and natural observation groups. There were no significant differences in any of the pre-screening test scores between the experimental and control groups. However, the natural observation group differed significantly from the other two groups in their mathematics test scores (higher than the other two groups) and vocabulary test scores (lower than the other two groups; results available from the authors upon request). Analyses presented in the current study included pre-screening test scores as controls in estimating the effects of educational television viewing on post-screening test scores.

3.2. Variability in the test scores

Almost all of the test scores varied with the age of the children. Because most of the skills assessed by these tests are usually acquired during the preschool ages, it was expected that age would be associated with performance. Indeed, the data in Table 2 generally support this expectation. There were, however, two anomalous scores for the children 6+ years, namely, 72.7 for

Table 1
Characteristics of each group at pretest

	Randomized study groups		
	Experimental	Control	Natural observation
Mean age of the child in months	63.1[a]	63.7	64.1[b]
Percent of male children	50.4%	52.0%	58.1%
Mean number of children in the household	2.6	2.7	2.7
Percent of extended family households	14.3%	16.0%	22.5%
Percent of mothers who were born outside Istanbul Metropolitan Area	70.7%	72.0%	80.6%
Mean maternal education in years	5.5	5.1	4.9
Estimated mean monthly per person expenditures of the household	$55.30	$56.00	$56.67
Percent who owned their residence	58.6%[a]	46.4%[b]	51.2%
Percent of children who had no books	49.2%[a]	61.6%[b]	66.4%[b]
Percent of children who watched more than 5 h of television on weekdays	24.8%	21.6%[a]	32.6%[b]
Percent of mothers who had never heard of BOM	46.6%	58.4%	52.7%

Note. Superscripts that differ indicate that the differences between the two groups with distinct superscripts are significant ($p < .05$) based on F tests for mean differences and chi-square tests for percentage differences.

Table 2
Mean test scores (possible ranges) by age of children (N = 393)

Test	Child age group			
	4.5 years	5 years	5.5 years	6+ years
Basic arithmetic readiness (0–24)	12.9	14.1	15.3	17.3
Categorization (0–100)	51.3	50.5	54.9	60.3
Spatial analogy skills (0–100)	36.9	36	40.7	52.8
Syllabification (0–100)	77.1	78.1	81.1	72.7
Vocabulary (0–100)	75.7	78.4	79.7	75.0

Syllabification (a drop from 81.1 when compared to the 5.5-year-old children) and 75.0 for Vocabulary (a drop from 79.7 when compared to the 5.5-year-old children). This might be due to self-selection. Six year-old children who were ready for school were probably sent to school. The fact that these children were not yet in school might indicate that their parents may have observed that they did not yet possess the skills required for school. Because of the age differences in test scores, in the following analyses all scores were age standardized.

The non-standardized test scores of the children in Table 2 show that these scores were not close to the minimum or maximum possible scores at the time of the pre-screening assessments for any age. Therefore, measurement problems due to floor or ceiling effects were not suspected.

Many studies using samples from the U.S. have suggested sex differences favoring girls in cognitive test scores of preschool age children (Coley, 2001). In this sample, there were no significant sex differences in the pre-screening test scores except for vocabulary scores, where girls had a statistically significant advantage over boys.

3.3. Characteristics associated with exposure to BOM

In any intervention study, the selectivity of intervention exposure is a concern. Prior to assessing the effects of exposure to "BOM" on the children's cognitive skills, the selectivity of "BOM" exposure was checked. Selectivity could operate such that the mothers who were highly educated, concerned with their children's cognitive development and school readiness, could be more compliant with the requests or suggestions to watch "BOM". These mothers were also expected to have children who were more skilled than children of less compliant mothers. Empirical evidence did not suggest such selectivity (Table 3). There was no consistent indication of statistically significant advantage of the group of children who were highly exposed to "BOM". In addition ANOVA analyses were conducted to test if pre-screening test scores of children significantly differed by exposure to "BOM". There was only one test score among the five considered here (the syllabification test) that indicated a relative pre-screening disadvantage of the group of children who had low exposure to "BOM" in the experimental group. In sum, exposure to the educational program was probably driven by mothers' schedules, but not by systematic differences in their educational or their children's skill levels. This was also indicated in telephone follow-up interviews when mothers were asked why they had been unable to watch the program as requested.

3.4. Effects of "BOM" and the variability in those effects

The effects of viewing "BOM" on cognitive outcomes are presented in Table 4. Two models were estimated for each of the five outcomes of interest. Model I included the effects of different levels of exposure to "BOM" for the experimental and natural observation groups, compared to the control group. Model II included the interaction effects that addressed the hypothesis of variability of the effects of "BOM" on children with differing levels of skill prior to exposure to the program. Both models I and II

Table 3
Comparison of pre-screening characteristics of the experimental group and natural observation group participants by levels of exposure to BOM

Characteristic	Experimental group			Natural observation group		
	Watched less than once a week	Watched 1–2 times a week	Watched 3+ times a week	Did not watch	Watched less than once a week	Watched 1+ times a week
Mean age of the child in months	62.8	63.6	62.4	64.1	65.3	63.2
Mean number of children in the household	2.6	2.7	2.4	2.9	2.3	2.6
Mean maternal education in years	5.6	5.2	5.7	4.6	5.2	5.6
Estimated mean monthly per person expenditures of the household	$49.79	$51.13	$57.61	$57.42	$57.34	$53.34
Percent of children who had no books	44.4%	57.4%	32.3%	70.4%	55.2%	67.9%
Percent of children who watched more than 5 h of television per week	22.2%	24.6%	29.0%	33.8%	24.1%	37.9%
Percent of mothers who had never heard of BOM	51.9%	47.8%	41.9%	60.6%	51.7%	34.5%
Percent distribution of exposure within group	21.3%	54.3%	24.4%	55.0%	22.5%	22.5%
N	27	69	35	71	29	29

Note. Differences between exposure levels were tested separately for the experimental and natural observation groups; none were significant.

Table 4
Summary of results of regression models for non-linear effects of exposure to the educational television program BOM (unstandardized coefficients and standardized coefficients in parentheses)

Outcome	Model	Pre-screening measure	Experimental group			Natural observation group		Indicator for below average pretest score	Experimental group: Medium or high exposure* below average pretest score	Natural observation group: Medium or high exposure* below average pretest score
			High Exposure (3 + times/wk)	Medium Exposure (1–2 times/wk)	Low Exposure (<1 time/wk)	Medium and High Exposure (> 1 time/wk)	Low or No Exposure (< 1 time/wk)			
Basic arithmetic readiness	I	0.636**	2.820*	1.990*	0.192	0.043	−3.205**			
		(0.540)	(0.110)	(0.107)	(0.006)	(0.002)	(− 0.167)			
	II	0.541**	1.683	0.805	0.600	−2.284+	−3.100**	−2.795*	2.687*	7.375**
		(0.460)	(0.066)	(0.043)	(0.020)	(−0.087)	(− 0.162)	(−0.184)	(0.129)	(0.161)
Categorization	I	0.201**	2.152	3.590	3.539	−2.831	−2.006			
		(0.153)	(0.022)	(0.052)	(0.031)	(−0.029)	(−0.028)			
	II	0.071	−4.969	−4.842	6.717	−1.098	−2.572	−12.401*	17.879**	−5.017
		(0.054)	(−0.052)	(−0.070)	(0.060)	(−0.011)	(−0.036)	(−0.218)	(0.218)	(−0.032)
Spatial Analogy Skills	I	0.146*	7.705	7.350+	2.821	10.382+	−2.136			
		(0.113)	(0.068)	(0.090)	(0.021)	(0.089)	(−0.025)			
	II	0.118	1.063	0.339	3.078	12.678+	−2.136	−5.709	16.246*	−6.146
		(0.091)	(0.009)	(0.004)	(0.023)	(0.109)	(−0.025)	(−0.085)	(0.161)	(−0.035)
Syllabification	I	0.092+	14.560*	4.865	−10.907+	8.685	−5.667			
		(0.082)	(0.122)	(0.056)	(−0.078)	(0.070)	(−0.063)			
	II	−0.019	10.026+	1.023	−8.162	9.101	−5.384	−14.521*	14.868+	−0.584
		(−0.017)	(0.084)	(0.012)	(−0.058)	(0.074)	(−0.060)	(−0.187)	(0.124)	(−0.003)
Vocabulary	I	0.386**	4.290*	5.439**	3.974+	5.928**	2.054			
		(0.418)	(0.106)	(0.186)	(0.084)	(0.143)	(0.068)			
	II	0.382**	3.657+	4.666**	4.053+	7.974**	2.152	−0.484	2.034	−3.302
		(0.413)	(0.091)	(0.160)	(0.086)	(0.192)	(0.071)	(−0.020)	(0.054)	(−0.062)

+$p < .10$. *$p < .05$. **$p < .01$.

investigated variability in the effects of "BOM": Variability due to differing levels of exposure, and variability due to the pre-existing differences in children's cognitive skills.

It was expected that children with higher levels of exposure to the program would benefit more strongly. It was also expected that a low level of exposure to the program might not result in improvements in cognitive skills that could be detected. These hypotheses were supported by the data (Model I). The group of children who were in the experimental group and who had three or more times a week of exposure to "BOM" exhibited significant gains in their basic arithmetic readiness, syllabification, and vocabulary, compared to the control group children. The group of children in the experimental group who watched "BOM" on average once or twice a week, exhibited significant gains in their basic arithmetic readiness, spatial analogy, and vocabulary skills. Experimental group children with low levels of exposure to "BOM" had significant gains only in their vocabulary.

The effects of different levels of "BOM" exposure were not as anticipated for all outcomes. Spatial analogy skills and vocabulary were similarly improved for the high and medium exposure groups, and syllabification was not significantly improved for the medium exposure group.

The positive effects of exposure to "BOM" were less pronounced in the natural observation group, as compared with the experimental group. Effects were detected for spatial analogy and vocabulary skills only. This may be partly due to the effects of self-selection due to unobserved characteristics, and partly due to the lack of substantial numbers of children in that group who had high levels of exposure. Furthermore, children in the natural observation group who had low or no exposure to "BOM" had significant losses in basic arithmetic readiness skills compared to their peers in the control group. These effects may be due to self-selection for no exposure. The mothers in this group were informed about the screening of the educational program but they chose not to have their children watch it.

Model II addressed the compensatory effect hypothesis that the beneficial effects of exposure to "BOM" are stronger for children who lacked school readiness skills prior to the screening of the program than children who possessed these skills. The estimated interaction effects capturing the compensatory effects are shown in the last two data columns of Table 4, for the experimental and natural observation groups, respectively.

For most outcomes in which there were main effects of exposure to "BOM", compensatory effects were detected, such that exposure had stronger beneficial effects for those children who had below average pre-screening skills and who watched the program at a meaningful frequency (once a week or more often). For medium and high levels of exposure to "BOM", basic arithmetic, syllabification and spatial analogy were the areas where interaction effects indicated higher benefits for the children who had below average pre-screening scores than other children. For categorization scores there were no overall "BOM" exposure effects, but there was an interaction such that children who had below average level of categorization skills prior to the screening of the program and who had medium or high levels of exposure showed strong beneficial effects.

Compensatory effects of "BOM" were less evident for the natural observation group than for the experimental group. Those children in the natural observation group who had below average scores prior to the screening of the program, and who had a medium or high level of exposure enjoyed significant gains only in basic arithmetic skills.

Figs. 1–3 display the results of the regression analyses for basic arithmetic (Model II), categorization (Model II), and vocabulary (Model I) scores, respectively. These figures plot the predicted trajectories in age-standardized scores of children, where the predictions were based on the regression models displayed in Table 4. Fig. 1 shows the expected sharp gains in basic arithmetic skills for those children who had below average skills prior to the screening of BOM and who watched the program at least once a week, both in the experimental and in the natural observation groups. While the children in the control group with a low level of initial skills also gained skills during this period of about three months, they did not gain as much as those who watched BOM at least once a week.

Fig. 2 shows similar trends for categorization skills. When the initial scores in categorization were low, children in the experimental group gained sharply, if they had high levels of exposure. Children in the natural observation group who had low

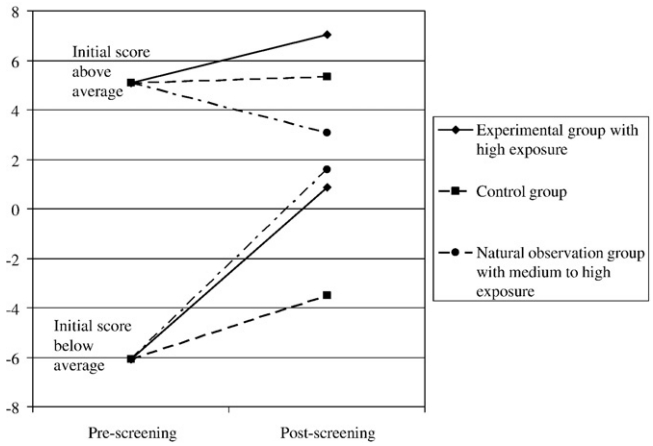

Fig. 1. Predicted gains in basic arithmetic readiness for children with low and high initial level of skills in experimental, control, and natural observation groups.

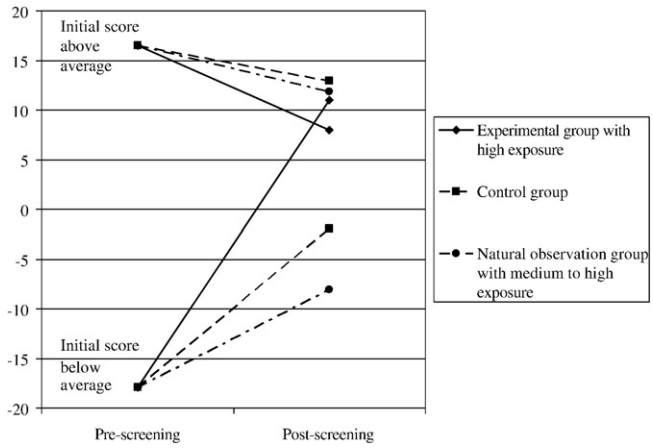

Fig. 2. Predicted gains in categorization skills for children with low and high initial level of skills in experimental, control, and natural observation groups.

initial scores of categorization did not gain even as much as the children in the control group (although this difference is not significant), probably because higher levels of exposure were needed to improve categorization skills than that experienced by the average child in the natural observation group.

Fig. 3 displays the expected vocabulary gains for all children in the three groups regardless of their initial levels of skill, because variability in the effects of BOM by the initial skill level was not significant for vocabulary skills. Again, the children in the experimental and natural observation groups who had medium or high levels of exposure to BOM gained vocabulary skills more rapidly than their peers in the control group.

To test the supplementary effects hypothesis of (i.e., greater effects for relatively advantaged children), interaction effects that quantified differential effects of exposure to BOM for the children whose mothers provided them with a high level of cognitive stimulation were introduced in Model I previously described. High cognitive stimulation was defined as the upper 30 percentile of the distribution of cognitive stimulation scores. There was no evidence that the children of these mothers benefited from exposure to BOM more than the other children. Similarly, differential effects of exposure to BOM were tested for children whose mothers had more than five years of education versus those who had five or fewer years of education. Only one of those interaction effects was statistically significant, indicating that vocabulary scores of the children who had less educated mothers had improved more after exposure to BOM compared to the children of highly educated mothers. This finding was contrary to the hypothesis of supplementary effects and was suggestive of the hypothesis of compensatory effects (results available upon request).

In sum, the regression analyses revealed that exposure to BOM had significant effects on all five types of cognitive skills that were assessed. These effects were especially consistent for children who had comparatively low levels of skills prior to watching BOM. Specifically, exposure to BOM significantly enhanced basic arithmetic readiness, spatial analogy, syllabification, and vocabulary in the experimental group with medium and/or high exposure. The program also had compensatory effects for medium or highly exposed children in the experimental group on basic arithmetic, categorization, spatial analogy, and syllabification skills. The beneficial main or compensatory effects of BOM in the natural observation group were fewer, limited to the spatial analogy and vocabulary skills.

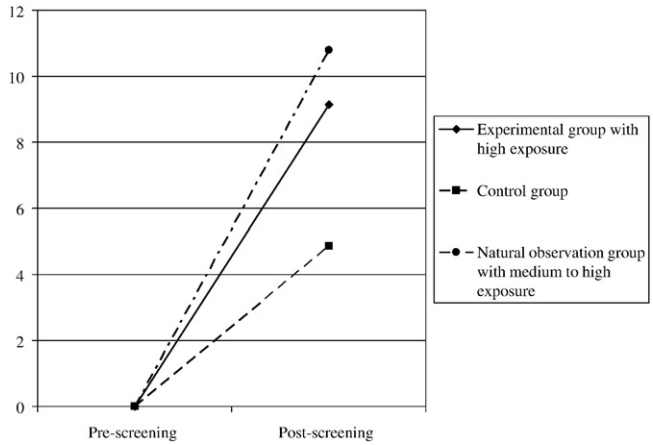

Fig. 3. Predicted gains in vocabulary scores for children in experimental, control, and natural observation groups.

4. Discussion and conclusions

The findings indicate that educational television programs targeting children at preschool ages could indeed have significant benefits for cognitive skills related to school readiness as long as children frequently watch such programs. These results extend the extant body of research with correlational designs by employing an experimental design with random assignment to intervention and control conditions and pre- and post-screening assessments to estimate the association between exposure to educational television and child outcomes.

The effects of the televised educational program for preschool children, "BOM", depended on the level of exposure to the program, akin to a dose–response. Whereas some cognitive skills could be significantly enhanced even at medium levels of exposure to the program (e.g., arithmetic and vocabulary), some others required a high level of exposure for significant gains (e.g., syllabification). Exposure enhanced spatial analogy skills and categorization skills among children whose skills in those areas were below average. The benefits in these areas are noteworthy alongside the more specific school readiness skills because these are general cognitive skills that were not specifically taught in the program. This finding suggests that the specific skills acquired through BOM may generalize to enhance cognitive development more generally.

Three sources of variability in the effectiveness of BOM on cognitive outcomes were investigated: Variability due to differing levels of exposure, variability due to the pre-existing differences in children's cognitive skills, and variability due to some family characteristics. The children who were exposed three or more times a week showed significant gains in their arithmetic readiness, syllabification, and vocabulary. The children with low levels of exposure, on the other hand, had significant gains only in their vocabulary. The beneficial effects of BOM were stronger for the children with lower school readiness skills prior to screening of the program than the children who had higher levels of these skills. The children who had low pre-screening scores gained significantly more in the areas of basic arithmetic, syllabification, spatial analogy, and vocabulary indicating the compensatory effects of educational television. There was a lack of empirical support for the supplementary effects of BOM. In other words, the beneficial effects of BOM were not stronger for the children who had high levels of skills or favorable family characteristics than other children.

The presence of the compensatory effects of educational television is important for countries like Turkey where preschool education for younger children is not widely available. Low SES children who do not attend preschool and who may be at risk in terms of school readiness constitute a potential audience for educational television. Educational programs can provide benefits to children at all ages, but it may be especially important to provide such programs for young children for two reasons: First, young children are less likely to be exposed to educational activities than older children who receive formal schooling; and second, viewing educational programs may lead to developing a preference for such programs throughout childhood with associated accrued benefits (Wright et al., 2001).

SES differences in emergent literacy and numeracy are well established (Kagitcibasi, 2002; Kagitcibasi et al., 2001; Myers, 1992). Preschool age children from low income families are less likely than those from more affluent families to display signs of emergent literacy and numeracy (Zill et al., 1994). The results of this study suggest that educational television programs targeting preschool children may accelerate the acquisition of cognitive skills. Although children with low levels of skills are not expected to catch up with their peers with initially higher levels of skills from a three-month long exposure to programming, (Zill et al, 1994), exposure to educational programming does lead to positive accelerated gains in cognitive skills. Given that television is nearly universally available and it has a great potential to reach underprivileged children, encouraging children to view a program like BOM may help a significant proportion of preschoolers by reinforcing and motivating their school readiness.

Educational programs must compete with entertainment programs that have attractive advertising campaigns. Children's programs that are designed only to entertain attract children away from the educational programs that are specifically designed to benefit their social and cognitive development (Mitroff, 2003). The results of the present study pertaining to the natural observation group underscore the effort that was needed to reach the intended audience. BOM reached fewer than one-quarter of the children it targeted at the frequency that could potentially be beneficial, despite mothers' personally receiving information about the program and its schedule. These findings suggest that even among a group of children who have many hours of exposure to television during the day, the exposure to beneficial programs may be relatively rare. Thus, the benefits of educational programs need to be better disseminated in order to motivate parents to encourage their children's viewing of such programs. Furthermore, such programs should be broadcast at times when preschool children are likely to view them.

The high production costs and the limited audience age range for educational programs steer the producers away from investing in educational programs. However, Calvert and Kotler's (2003) study revealed that most U.S. children watch two or three educational programs per week, and that only a few (6%) watch none at all. Studies show that educational programs do reach children in real-world settings when supported by public policy, public awareness and legislation such as the Children's Television Act (Calvert & Kotler, 2003; Kunkel, 2003). Similar policies may benefit children in developing countries where preschool education is not available and educational television programs are scarce. Such policies, together with the dissemination of information regarding the benefits of educational programs, can help young children from disadvantaged environments by enhancing their cognitive capacities.

In sum, there is a dire need for a well-thought out public policy that requires broadcasters to serve the educational and informational needs of preschool children, especially those of socioeconomically disadvantaged groups. At the same time, there is a continuing need for age-specific programming that will interest and teach children in preschool ages and beyond. The findings of the present study provide support for the potential powerful role of nonformal education, in particular television, in promoting cognitive development. Television can have far-reaching influence. When used effectively, it can increase the educational exposure

of disadvantaged populations. Children, especially those who do not yet receive formal schooling, can be prime targets for such educational exposure with a likely outcome of cognitive gains and enhanced school readiness. Good educational programming, similar to any other intervention, cannot compensate for social inequalities (Brooks-Gunn, 2003), but it can provide enhanced opportunities to those who need them the most.

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