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Home media and science performance: a cross-national study

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This study examines the effects of media resources in the parental home on the science performance of 15-year-old students. It employs data from the 2006 Programme for International Student Assessment (PISA) containing information on 345,967 respondents from 53 countries. Results show that media assets in the family home are indeed meaningful for children's science performance, as a beneficial resource but also as a disadvantage. A positive reading climate in the parental home and the availability of computers benefits science performance. However, a television-rich home seems to hinder children's school success. Furthermore, results indicate that, compared to less developed countries, in more modernized societies parental reading investments are even more beneficial to their children's science performance, whereas a television-rich parental home is even more disadvantageous.

Keywords: home media; parental media resources; science performance; cross-national research

Introduction

A large body of research indicates that children's educational performance partly depends upon parental resources and socialization activities (Coleman, 1988; Farkas, 1996; Lareau, 1987). Parental cultural socialization may particularly enhance children's educational success, since parents nurture and equip their children with cultural skills and competencies that could give their offspring a lead start in school (Bourdieu & Passeron, 1977; De Graaf, 1986; DiMaggio, 1982; Dumais, 2005). Scholars from various disciplines have established the important role of parental media socialization activities, such as reading and television viewing in the home, in cultural socialization and reproduction (De Graaf, 1986; Elchardus & Siongers, 2003; Schieffelin & Ochs, 1986; Sullivan, 2001). Parents can actually enhance their children's school success by fostering certain media activities, for instance, by creating a positive reading climate in the home (Bus, Van IJzendoorn, & Pelligrini, 1995; De Graaf, De Graaf, & Kraaykamp, 2000). However, other media consumption patterns, like excessive television exposure, are disadvantageous for a child's cognitive and educational development (Notten, Kraaykamp, & Ultee, 2008; Schmidt, Pempek, Kirkorian, Lund, & Anderson, 2008). The current study

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elaborates on previous research on the reproduction of educational inequality by studying the effect on children's science performance of parental media resources. More specifically, it studies the impact of the availability of books, television sets, and personal computers in the family household. Our first research question reads: *To what extent can parental media resources explain differences in children's science performance?*

Comparative research shows that countries differ with respect to educational inequality, and children's school performance varies according to the national level of economic and cultural development (Chiu & McBride-Chang, 2006; Heyneman & Loxley, 1983; Levels, Dronkers, & Kraaykamp, 2008). In explaining these cross-national differences, parental media resources may play a relevant role. Therefore, our second research question reads: *To what extent does a country's level of development affect the relation between parental media resources and children's science performance?*

In our study, we contribute to cultural reproduction research in several manners. First, we make a theoretical contribution by distinguishing between a "beneficial" and "disadvantageous" parental cultural socialization. We hypothesize that certain parental media resources (e.g., books) enhance a child's science performance, whereas other media resources in the parental home (e.g., television) harm a child's school career. The second major contribution is our inclusion of 53 countries. Previous research on media access in the parental home largely targeted a single country or one specific media resource (Attewel & Battle, 1999; Kraaykamp, 2003; Park, 2008; Roe, 2000). Our international study of the effects of media resources in the family home on children's science performance thus provides broader insight into the cultural socialization process. Third, we apply multilevel modelling to test our expectations, which enables us to distinguish between country-level and individual-level effects. By estimating cross-level interactions in multilevel models, we study whether the relation between parental media resources and children's science performance is affected by a country's stage of economic and cultural development (i.e., modernization). We employ data from the Organisation for Economic Co-operation and Development (OECD) Programme for International Student Assessment (PISA) conducted in 2006 (OECD, 2008). The PISA 2006 database contains information on 15-year-old students' science performance (knowledge and skills) but also on family background and media access in the parental home.

Theory and hypotheses

Cultural reproduction and media socialization

Scholars generally agree that children from higher status families perform better at school and experience a more successful educational career than children with a less privileged background (e.g., De Graaf, 1986). According to Bourdieu and Passeron (1977), it is the intergenerational transmission of cultural capital that mediates the influence of parental socioeconomic background on children's educational performance. Cultural reproduction theory explains differences in educational success between social groups by differences in parental cultural capital, traditionally measured by direct indicators of parental cultural behaviour. According to cultural reproduction theory, parents socialize or nurture their children within a specific cultural habitus, and this set of attitudes and skills acquired during childhood is assumed to persist into adult life and to affect educational performance.

From Bourdieu's theory, it follows that in particular highbrow cultural resources are transmitted over generations, and this process takes place mainly through education and the educational system. First, the school curriculum reflects the dominant (highbrow) culture in society and, perhaps even more important, presupposes equality in possession of cultural assets at the beginning of a person's educational career. Consequently, children from culturally competent backgrounds are more in sync with school culture and thus are better equipped to follow the school curriculum. In this way, *selection* takes place by the school system itself: children from less culturally proficient families are less likely to enter higher levels of education. Also, children whose parents have less cultural capital might feel that they do not really fit in with school culture, especially at the higher levels of education. This lack of familiarity with the school culture and curriculum may result in *self-selection*, for instance, with these children dropping out or entering lower levels of education. In this case, one might speak of a cultural conflict or clash between a child's family-specific traditions and the school culture (Bourdieu & Passeron, 1977; Dumais, 2005; Kalmijn & Kraaykamp, 1996).

Attention in cultural reproduction research has recently shifted from cultural capital as a means of intergenerational transmission of social status to cultural capital as an indication of cognitive competency (Barone, 2006; De Graaf et al., 2000; Farkas, 1996). The current study recognizes both status and cognitive aspects of parental cultural socialization activities. Thus, parental media resources may differ in the social status they are associated with as well as in the cognitive stimulation they offer. In line with the cultural reproduction theory, we expect parental media resources to directly affect children's educational performance and thereby to mediate the influence of the parental socioeconomic background.

Investing in media resources in the home is a meaningful part of parents' cultural socialization practices. When it comes to leisure time and cultural participation, media consumption takes up by far the most time and is the most frequent cultural in-home activity. According to socialization theories, children imitate their parents' (media) behaviour, especially when it is performed frequently (Bandura & Walters, 1963; Kraaykamp, 2003; McLeod & Brown, 1976). We argue that the media resources available in the parental home indicate the parents' own media preferences (Chiu & McBride-Chang, 2006; D'Haenens, 2001). Consequently, they represent the media habits and values that parents stress intentionally or unintentionally in their children's upbringing. This study analyses parental media socialization by focusing on the number of books, television sets, and personal computers available in the family home.

Books

In pedagogical research and sociology, many studies discuss the effects of parental reading on children's cognitive and cultural competency (Bus et al., 1995; Leseman & De Jong 1998; Van Peer, 1991). Results have shown a positive reading climate in the parental home to be especially valuable for acquiring reading, language, and problem-solving skills (Cook-Gumperz, 1973: Kraaykamp, 2003; Schieffelin & Ochs, 1986). Particularly in the higher levels of education, reading competencies are relevant – perhaps even imperative – for success. Parents stimulate their children's interest and skills in reading by setting an example and creating a literary home climate; for instance, by reading themselves and investing in reading materials in the home. Hence, children from literature-rich homes are better equipped to succeed at school.

Next to cognitive stimulus, book reading reflects a habitus that is socially rewarded and highly appreciated at school. Parents from higher social status groups are particularly likely to foster their children's school career by providing a positive literary environment at home (Barone, 2006; Notten & Kraaykamp, 2009). Parents who invest in literature and spend a substantial amount of their leisure time reading books are found to stimulate their children to read (Kraaykamp, 2003). The intergenerational transmission of this beneficial habit enhances the children's school performance (De Graaf et al., 2000; Sullivan, 2001). Since parental reading socialization is a socially rewarded and cognitively stimulating activity, we expect that *a literature-rich parental home enhances a child's science performance*.

Television

Unlike reading, television viewing is largely associated with entertainment, passivity, low-cognitive stimulation, reduced concentration, and noncreativity (e.g., Hancox, Milne, & Poulton, 2005; Schmidt et al., 2008). Consequently, the medium itself is accorded a low status. Although equivocal, scholars have found significant correlation between a family's social status and the number of television sets in the home. In Western countries, it appears that the higher a family's social status, the fewer additional television sets are found in the home. Also, in higher status households a television set in a child's bedroom is less common, and children spend fewer hours in front of the television screen than in lower status households (Beentjes, Koolstra, Marseille, & Van der Voort, 2001; Livingstone, 2002; Roe, 2000).

Research indicates that time spent watching television displaces and disturbs educational activities like reading and doing homework. It is therefore likely to have a long-lasting negative effect on a child's school success (Notten et al., 2008; Sharif & Sargent, 2006; Verboord & Van Rees, 2003). A television set in the bedroom seems to especially increase children's television consumption and consequently harms their educational performance (Borzekowski & Robinson, 2005; Bovill & Livingstone, 2001). On the other hand, some scholars have found that watching educational programmes such as "Sesame Street" may enhance a child's language skills (Wright et al., 2001).

Nonetheless, this study assumes a negative effect of the availability of television sets in the parental home on children's school performance for several reasons. A greater number of television sets is an indication of (a) higher odds of a parental example of excessive viewing, (b) more opportunity for television consumption for all family members, (c) a higher probability that children have a television set in their own bedroom, and (d) less parental supervision of children's television consumption both in time and content. Easy access to television consumption in the parental home would probably hinder or replace school-related activities and therefore does not match school culture and curriculum. We thus expect that *a television-rich parental home harms a child's science performance*.

Computers

When it comes to the spread of digital applications, the availability of personal computers and Internet access is more common in households with children than in those without (D'Haenens, 2001; Drotner, 2000; Livingstone, 2002). Though

parents are ambivalent about the effects of computer use for their children's well-being, the leading argument for parents to invest in home computers is its use in an educational setting (Livingstone, 2007; Subrahmanyam, Kraut, Greenfield, & Gross, 2000). Indeed, having and using a home computer is associated with better reading and academic achievement (Attewel & Battle, 1999; Borzekowski & Robinson, 2005).

Computer use also seems to be a socially valued activity matching school culture relatively well, at least better than passive television viewing. A large body of research reveals a positive correlation between parental socioeconomic background and the availability of a computer in the family home and in a child's bedroom (D'Haenens, 2001; Livingstone, 2007). Higher status and higher educated parents are more experienced with digital media themselves, they have a more positive attitude towards computer and Internet use, and they understand better that children need digital and ICT competencies in school (Clark, Demont-Heinrich, & Webber, 2005; Notten, Peter, Kraaykamp, & Valkenburg, in press; Pasquier, 2001). As a consequence, high-status parents will likely provide computer access in the home.

Recently, in countries where digital applications are widespread, recreational computer use such as (excessive) time spent gaming has been associated with negative effects on a child's development. However, such research findings are still scarce and equivocal. In general, access to personal computers in the family home is socially rewarded, matches school culture and curricula, and provides a means to enhance a child's educational performance. Therefore we expect that *a computer-rich parental home enhances a child's science performance*.

Cross-national differences in media effects

Previous research established that in wealthier countries children perform better at school than their counterparts in less developed nations (Baker, Goesling, & Letendre, 2002; Chiu & McBride-Chang, 2006). Also, in wealthier and more culturally developed countries, the diffusion of literacy and the spread of relatively new media, like television and computer, are more common than in less modern countries (D'Haenens, 2001; Notten et al., in press). This gives reason to expect the effect of home media on children's science performance may vary according to a country's level of modernization. However, up until now, scant research has been done in this domain. Consequently, our hypotheses in this regard are explorative and represent two contrasting viewpoints, that is, the effect of media availability in the parental home on children's science performance may be reduced or enlarged by a country's level of development.

First, we argue that in the more developed countries home media is universal and therefore not as much of a distinctive cultural asset as in less developed societies. In less modernized countries, media goods are not easily accessible to all social strata. There is a clear distinction between a small segment of ''haves'' and the majority of ''have-nots'' (i.e., the ''information-rich'' and ''information-poor''). However, when looking at countries with higher levels of development, social mobility is larger, the general level of knowledge is higher, and, due to the diffusion of innovations, the cost of the initially elite cultural products is rather low (Beck, 1992; Rogers, 1995). According to this notion, media access becomes more widespread and less distinctive in modern countries. The negative effect of television and the positive effect of literature and computers is then likely lower. We therefore expect that *a media-rich*

parental home is less relevant for children's science performance in countries with a higher level of economic and cultural development.

Second, in all countries, social class and parental cultural and media socialization activities are relevant predictors of a child's educational success (Barone, 2006; Levels et al., 2008). This is in line with cultural reproduction theory (Bourdieu & Passeron, 1977), which holds that in contemporary societies the intergenerational transmission of family wealth is no longer sufficient for the higher social groups to maintain their elite status. Cultural reproduction theory states that these high-status parents apply compensating strategies. Indeed, research shows that in modern countries, where society is more egalitarian and meritocratic schooling systems are universal, the impact of family resources on a child's educational success is equally high or even higher than in less developed nations (Heyneman & Loxley, 1983; Park, 2008).

In modern or highly developed countries, also labelled "information-rich" and "knowledge-based" societies, cultural competencies are highly relevant for success in life (Norris, 2001; Pasquier, 2001; Van Eijck & Bargeman, 2004). We therefore might expect home media, as a form of cultural capital, to become more crucial in the reproduction of social inequality. Consequently, in more developed countries, the availability of media resources in the parental home plays a more distinctive role in a child's educational career than in less developed countries. We thus expect that *a media-rich parental home is more relevant for children's science performance in countries with a higher level of economic and cultural development*. Note that this means we expect increases in both the positive effect of literature and computers and the negative impact of a television-rich parental home.

Data, measurements, and methods

Data

The data we employ originate from the OECD Programme for International Student Assessment (PISA), conducted in 2006 (OECD, 2008). The target population of the survey was 15-year-old students enrolled in secondary education. Participating students completed a 2-hr test with open and multiple-choice tasks and a half-hour questionnaire about themselves. The selection of students was based on two-stage random sampling: first schools were extracted, then respondents were selected. Nationally representative samples of 15-year-old students were drawn. A drawback of our data is that enrolment rates in secondary school as well as drop-out rates are not equally distributed over all counties included in our study. Therefore, the students in our dataset might not be an accurate representation of the general population of 15-year-olds in a specific country when it comes to background characteristics and abilities. Our dataset omits 4 of the 57 countries included in the PISA 2006 study because of incomplete or incomparable data on relevant country characteristics.[1] We further removed all students with missing values on one of the relevant variables in our models. These selections resulted in a hierarchical dataset containing 345,967 students at the individual (lower) level and 53 countries at the national (higher) level.

Measurements

The dependent variable *science performance* is measured by scores on 108 science-related tasks. PISA 2006 defines scientific literacy as "[s]cientific knowledge and use

of that knowledge to identify questions, to acquire new knowledge, to explain scientific phenomena, and to draw evidence-based conclusions about science-related issues'' (OECD, 2007). PISA 2006 used 108 items of varying levels of difficulty to assess respondents' knowledge of and about science and three broad areas of science competency (identifying scientific issues, explaining phenomena scientifically, using scientific evidence).[2] Respondents were presented a selection of these items, and item response modelling was used to construct plausible values. Each student was awarded a score indicating both the performance of the student and the difficulty of the question. Five values were reported measuring different aspects of respondents' science competency and knowledge. PISA 2006 also created five plausible values combining the questions from all scales, indicating students' overall performance in science. We used the mean score of these last five values to measure students' science performance.[3] The OECD constructed the science performance scales such that the average student score in OECD countries was 500 points, with a standard deviation of 100 points (OECD, 2007). Because our dataset also contains non-OECD countries, our dependent variable ''science performance'' ranges from 23.7 to 912.8 points with a mean score of 482.9 points.

The *sex* of the respondents is coded (0) male and (1) female. Although we refer to our respondents as 15-year-olds, respondent *age* ranges between 15 and 16 years.[4] Parental socioeconomic background is measured by parental educational level (in years) and occupational status. *Parental educational level* is classified using the International Standard Classification of Education (ISCED), ranging from (0) none to (6) ISCED 5A and 6, theoretically oriented tertiary and postgraduate education. The score of the parent with the highest education is recoded into estimated years of schooling (OECD, 2009), ranging from 3 to 18 years. OECD (2009) uses the highest score on the International Socio-Economic Index of Occupational Status (ISEI) (Ganzeboom, Treiman, & De Graaf, 1992) of both parents to measure *parental occupational status*, here ranging from 16 to 90. For use in the multilevel models, we centred parental educational level (in years) and occupational status to the mean.

Parental media resources are measured by three specific types of media in the family home: books, television sets, and computers. For each media resource, we constructed a dichotomous variable, indicating whether the specific media asset is present. Additionally, we created linear variables for all media resources, representing the accumulation of media assets in the family household. The simultaneous inclusion of the dichotomous and linear media variables in our models enables us to analyse the effect of mere media availability as well as the effect of an increasing number of media resources in the parental home. Moreover, in this manner we solve existing problems of nonlinearity, since the initial variables measuring the number of computers and televisions in the parental home show an off-shift in their (linear) relation with science performance for those who own television sets and computers (one television and one computer, respectively) and those who do not.

The variable *number of books in the parental home* measures the reading climate at home. Students were asked to indicate the number of books in their home. Answer categories were (0) 0–10 books, (1) 11–25 books, (2) 26–100 books, (3) 101–200 books, (4) 201–500 books, and (5) more than 500 books. The dichotomous variable *home library* indicates whether there were (0) hardly any books (10 books or less) or (1) more than 10 books in the parental home. The *number of television sets in the parental home* is measured by the following question: How many television sets are

there in your home? Students could answer with (0) none, (1) one, (2) two, or (3) three or more. We also constructed a dichotomous variable *home television access*, indicating whether there was (0) no television set or (1) at least one television set in the parental home. Students were also asked the number of computers at home. The variable *number of computers in the parental home* measures whether there were (0) none, (1) one, (2) two, or (3) three or more computers available at home. The variable *home computer access* indicates whether there was (0) no computer or (1) at least one computer present in the parental home.

Two variables at the country level represent the country's level of development. A country's stage of economic development or wealth is measured by *gross domestic product (GDP) per capita* at purchasing power parity (PPP) in 2006, in international dollars (World Bank, 2009). A country's cultural development is measured by the percentage of gross *enrolment in tertiary education* (ISCED 5 and 6) in 2006, representing the general level of participation in tertiary education in a given country (United Nations Educational, Scientific and Cultural Organization [UNESCO] Institute for Statistics, 2009).[5] All country-level variables are centred to the mean. Appendix 1 presents more detailed information on country characteristics. Table 1 presents descriptive statistics of all the variables.

Methods

To study cross-national differences in the effect of parental media resources, we used multilevel modelling. With this method, we simultaneously estimate differences between countries and between individual respondents (Snijders & Bosker, 1999). Multilevel modelling enables us to model heterogeneity and obtain more correct estimations of country effects. In Model 1 and 2, we apply multivariate multilevel modelling with a random intercept and fixed slopes. These models assume students' mean science performance to vary across countries, whereas the individual effects (covariates) are fixed among countries. Model 3 adds the country-level variables.

Table 1. Descriptive statistics of all variables.

	Minimum	Maximum	*M*	*SD*
Individual level (Level 1)				
Science performance	23.67	912.84	482.94	99.04
Sex	0.00	1.00	0.51	0.50
Age	15.17	16.33	15.78	0.29
Parental educational level (yrs)	3.00	18.00	12.75	3.40
Parental occupational status	16.00	90.00	47.73	17.03
Home library	0.00	1.00	0.85	0.36
Number of books in parental home	0.00	5.00	2.14	1.44
Home television access	0.00	1.00	0.99	0.11
Number of TVs in parental home	0.00	3.00	2.18	0.81
Home computer access	0.00	1.00	0.78	0.41
Number of PCs in parental home	0.00	3.00	1.20	0.91
Country level (Level 2)				
GDP per capita ($)	1813.00	51862.00	23614.52	12085.71
Enrolment tertiary education (%)	15.00	95.00	55.47	19.22

Source: PISA 2006 (N Level 1 = 345,967; N Level 2 = 53).

Model 4 estimates interactions between the individual-level media-related variables and country-level characteristics. Estimating these cross-level interactions means that we assume the effects of parental media resources vary over countries (i.e., random effects).

Results of multivariate multilevel modelling

Individual-level effects

Table 2 shows the results of the multilevel models. Our analyses began with the estimation of a baseline model with a random intercept and without predictors to assess the variance component at the country level. The significant random country-level intercept in the baseline model indicates that children's science performance varies significantly among countries. Calculating the intra-class correlation (ICC), it appears that 26% of the variance in science performance of children (15-year-old students) is due to differentiation between countries.[6]

Next, in Model 1 we include the control variables sex and age, as well as the parental socioeconomic background characteristics. The results show that girls perform less successfully in science than boys (b = −2.34). Age has a significant positive impact on science performance (b = 15.43), with older students performing better. This may reflect a difference between the students' grade levels. In line with previous research on reproduction of educational inequality, the model shows children whose parents have a higher educational level (b = 3.54) and occupational status (b = 1.32) perform better in science-related domains. Surprisingly, the magnitude of the effect of parental occupational status (1.32*17.03) is larger than that of parental educational level (3.54*3.40). This might be due to the more dominant effect of parental occupational status for children's educational performance in less modern countries.

In Model 2, we add parental media resources. Results show that a more positive parental attitude towards literature and reading, represented by an increasing number of books in the family home, is associated with better performance of their children in science (b = 16.63). Our results also show that television access in the parental home is more beneficial for a child's science performance than having no television at all (b = 19.90). This seems to indicate that television functions as a gateway to information and (general) knowledge of science. However, in family homes where the odds of television exposure are higher, that is, in households with more than one television set, children perform less well in science-related domains. Once access is accomplished with the presence of one television set, children's science performance decreases with every additional television set present in their home (b = −7.84). The number of computers in the parental home is positively related to school performance. Children growing up in a household with computer access have a lead start in school compared to their peers growing up in homes without computer access (b = 18.73). Furthermore, every extra computer in the parental home increases a child's science score (b = 7.59). It appears that investments in digital applications at home are indeed a contemporary means for parents to enhance their children's science performance. However, we must be careful in our conclusions because of the possibility of reverse causality. It is likely that parents invest in home computers because (or when) their children enter the higher levels of education.[7]

Investing in reading materials in the home seems to have the largest impact on children's educational performance (16.63*1.44). By showing a preference for

Table 2. Multilevel regression models estimating the effect of parental media resources on children's science performance, unstandardized coefficients.

	Baseline Model		Model 1		Model 2		Model 3		Model 4	
	b	se	b	se	b	se	b	se	b	se
Individual level (Level 1)										
Control variables										
Sex (0/1)			−2.34***	0.28	−4.04***	0.26	−4.04***	0.26	−4.40***	0.26
Age			15.43***	0.48	14.47***	0.46	14.47***	0.46	14.39***	0.46
Parental socioeconomic background										
Parental educational level (13 = 0)			3.54***	0.05	1.54***	0.05	1.54***	0.05	1.56***	0.05
Parental occupational status (48 = 0)			1.32***	0.01	0.88***	0.01	0.88***	0.01	0.85***	0.01
Parental media resources										
Home library (0/1)					0.66	0.48	0.66	0.48	10.53***	1.11
Number of books in parental home (0–5)					16.63***	0.13	16.63***	0.13	15.00***	0.61
Home television access (0/1)					19.90***	1.23	19.91***	1.23	14.46***	3.03
Number of TVs in parental home (0–3)					−7.84***	0.20	−7.85***	0.20	−6.89***	0.68
Home computer access (0/1)					18.73***	0.50	18.73***	0.50	21.36***	1.39
Number of PCs in parental home (0–3)					7.59***	0.23	7.58***	0.23	6.08***	0.73
Country level (Level 2)										
GDP per capita/1000 ($) (23780 = 0)							1.76***	0.35	2.08***	0.34
Enrolment tertiary education (%) (55 = 0)							0.33	0.23	0.18	0.22
Cross-level interactions										
Home library*GDP									0.32***	0.08
Number of books in parental home*GDP									0.11*	0.05
Number of TVs in parental home*GDP									−0.36***	0.05
Number of books in parental home*									0.12***	0.03

(*continued*)

Table 2. (*Continued*).

	Baseline Model		Model 1		Model 2		Model 3		Model 4	
	b	se	b	se	b	se	b	se	b	se
Tertiary education										
Intercept	480.86***	7.00	237.99***	10.03	191.52***	9.00	192.90***	8.27	190.89***	8.68
Variance										
Individual (Level 1)	7392.97***	17.78	6534.44***	15.71	5961.82***	14.34	5961.82***	14.34	5845.37***	14.06
Country (Level 2)	2593.82***	504.16	2247.19***	436.80	1404.08***	273.08	716.64***	139.48	1036.89***	254.30
ICC	0.26									
Deviance (–2LL)	4064185.91		4021477.75		3989728.67		3989693.07		3983467.24	

Significance ***$p < 0.001$, **$p < 0.01$, *$p < 0.05$.

Source: PISA 2006 (N Level 1 = 345,967; N Level 2 = 53).

literature, parents are most successful in fostering their children's science performance. Furthermore, including parental media resources in our model explains about half of the effect of parental socioeconomic background. The effect of parental educational level decreases from 3.54 in Model 1 to 1.54 in Model 2, the effect of parental occupational status declines from 1.32 to 0.88. This might be interpreted as a partial corroboration of Bourdieu's cultural reproduction theory. Parental media resources have a direct effect on a child's science performance and significantly mediate the effect of parental socioeconomic background. Note that including the individual characteristics reduced both the individual and country-level variance.

Country-level effects

In Model 3, we add two country-level variables. We learn that a country's level of economic development (in terms of its GDP) is influential when it comes to children's science performance (b = 1.76). Our results corroborate previous findings that children in more economically developed countries perform better in science than their peers in less developed nations. Tertiary education participation in a country (the percentage enrolled in tertiary education) seems to have no significant impact on science performance, after controlling for a country's level of wealth. However, this seems to be at least partially a result of the correlation ($r = 0.60$) between GDP and level of educational expansion: we do find a direct and significant effect of tertiary education participation in a country on children's science performance when we exclude GDP from our models. In line with previous research, we find that various aspects of a nation's development are highly correlated (Weakliem, 2002). Including country characteristics reduces the country-level variance by almost 50%.

Variation in media effects across countries

To answer our research question on whether the influence of parental media resources on children's science performance varies across countries, we include in Model 4 all possible cross-level interactions of parental media resources with a country's GDP and tertiary education participation. Through a stepwise procedure, we excluded nonsignificant interactions; therefore, Table 2 presents only the significant cross-level interaction effects.[8] Estimating interactions with GDP and educational participation in two separate models reveals virtually identical results (in both magnitude and direction). Apparently, our indicators of a country's economic and cultural stage of development measure one global concept: a country's level of modernization. Therefore, in interpreting our results distinguishing between the effects of a country's wealth and level of educational expansion may not be useful.

Model 4 shows that a literature-rich parental home becomes even more important in countries with a higher level of development. In modern countries, the availability of books in the parental home is even more beneficial to a child's science performance than in less modern countries. Hence, we might conclude that investing in a positive reading climate at home is a modern tool for reproduction of educational inequality. Next, our findings reveal that a television-rich parental home has an even more disadvantageous effect on children's science performance in more highly developed countries. The cultural cleavage between television consumption

and school culture seems to widen as countries enter higher levels of modernization. Nonetheless, we find that the positive effect of a computer-rich parental home on science performance remains the same along the lines of modernization. Apparently, parental investment in home computers is a key aid to help children perform successfully at school, regardless of the country's level of development.

Discussion and conclusion

This study scrutinized the effect of parental media resources on children's science performance from an international perspective. Previous research has tested Bourdieu's cultural reproduction theory and the significance of parental cultural socialization in several countries (De Graaf et al., 2000; Georg, 2004; Sullivan, 2001). However, with a small number of exceptions (Barone, 2006; Park, 2008), few empirical attempts have been made to conduct cross-country comparisons of the significance of cultural reproduction in a person's educational career. We fill this lacuna in cultural reproduction research by studying cross-national variation in the impact of media resources in the parental home on children's science performance. To answer our research questions, we applied multilevel analyses on the PISA 2006 dataset, containing information on 345,967 15-year-old students in 53 countries.

We found that a positive reading climate at home benefits children's science performance. Also, parental investment in home computers seems to pay off in terms of more successful school performance of children. We thus conclude that in all countries parents can help their children to fit in and perform well at school by creating a literature-rich and computer-rich home environment. On the other hand, although one television set in the parental home contributes to children's school success, every additional television set actually harms a child's science performance. Worldwide, the absence of a television set at home seems to narrow a child's worldview and knowledge of science. However, once this barrier has been overcome, the low social status and meagre cognitive stimulation of (excessive) television viewing actually seems to conflict with school culture. A drawback of our study, however, is the possibility of reverse causality. For instance, parents might invest in (additional) computers in the family home when their children enter the higher levels of education. Remarkably, this study finds that books, often referred to as "old" media, are most effective in enhancing children's science performance. Our results also indicate that, from an international viewpoint, half of the effect of parental social status is mediated by parental media resources. These findings corroborate to some extent Bourdieu's cultural reproduction theory from a global perspective.

We expected the effect of parental media resources on children's science performance to vary across countries. Our results indicate that a literary parental home becomes more important (i.e., advantageous) for a child's science performance in countries with a higher level of modernization. However, a television-rich parental home is even more harmful for a child's school results in more modern countries. The beneficial effect of home computer access on children's school performance remains stable, regardless of a country's level of development. Overall, and with caution, we conclude that both parental reading and television socialization are becoming more important factors in the process of cultural reproduction and social exclusion in modern societies. This finding of an increasing significance of cultural competencies supports the notion of an "elitist rearguard" in contemporary information-based societies (Knulst, 1992; Van Eijck & Bargeman, 2004).

Our study questioned the significance of home media access for a child's science performance from an international perspective. Globally, we found media provision in the parental home to be a significant component of the parental resources relevant for a child's school success. Moreover, the results give reason to believe that parental media resources become even more important in the reproduction of educational inequality in more modern countries. This study suggests that the availability of media in the parental home reflects parental media preferences and media socialization activities. Future research, however, might take into account more direct measures of parental media socialization to further test these hypotheses. Also, because families are not equally equipped with home media assets, policymakers and researchers addressing educational inequality might be advised to pay more attention to programmes providing such access, for instance, at schools or community centres, to compensate for unequal access to media. Moreover, governments might become more aware of the individual-level implications of national-level policies, as national investments, for example, in digital infrastructure, may not equally benefit all children's school and cultural competencies.

Notes

1. Qatar, Luxemburg, and Liechtenstein are excluded because of their extraordinary (banking) economy (GDP) and subsequently poor model fit. Taiwan is excluded because of incomplete data on country characteristics.
2. Example assessment items are available at http://www.pisa.oecd.org/dataoecd/47/23/41943106.pdf
3. We also analysed the five values separately, obtaining virtually identical results.
4. PISA selected students aged between 15 years 3 months and 16 years 2 months at the start of the assessment, regardless of grade, school programme, or type of institution (OECD, 2007).
5. Because of incomplete data on school enrolment in 2006, we use data for Germany from 1997, for Canada from 2004, for Brazil from 2005, and for Serbia from 2001 (World Bank, 2009).
6. We accounted for the nesting of students within schools by adding an extra level (school level) to control for the differentiation between schools. However, this did not affect our results.
7. Reverse causality is less obvious for television: parents probably do not increase the number of television sets in their home after a child performs poorly in school.
8. Simultaneously including all interactions produces virtually identical results.

References

Attewell, P., & Battle, J. (1999). Home computers and school performance. *The information society*, *15*, 1–10.

Baker, D.P., Goesling, B., & Letendre, G.K. (2002). Socioeconomic status, school quality, and national economic development: A cross-national analysis of the "Heyneman-Loxley effect" on mathematics and science achievement. *Comparative Education Review*, *46*, 291–312.

Bandura, A., & Walters, R.H. (1963). *Social learning and personality development*. New York: Holt, Rinehart and Winston.

Barone, C. (2006). Cultural capital, ambition and the explanation of inequalities in learning outcomes. *Sociology*, *40*, 1039–1058.

Beck, U. (1992). *Risk society: Towards a new modernity*. London: Sage.

Beentjes, J.W.J., Koolstra, C.M., Marseille, N., & Van der Voort, T.H.A. (2001). Children's use of different media: For how long and why. In S. Livingstone & M. Bovill (Eds.), *Children and their changing media environment. A European comparative study* (pp. 161–177). Mahwah, NJ: Lawrence Erlbaum Associates.

Borzekowski, D., & Robinson, T. (2005). The remote, the mouse, and the no. 2 pencil. *Archives of pediatrics and adolescent medicine*, *159*, 607–613.
Bourdieu, P., & Passeron, J.C. (1977). *Reproduction in education, society and culture*. London: Sage.
Bovill, M., & Livingstone, S. (2001). Bedroom culture and the privatization of media use. In S. Livingstone & M. Bovill (Eds.), *Children and their changing media environment. A European comparative study* (pp. 179–200). Mahwah, NJ: Lawrence Erlbaum Associates.
Bus, A.G., Van IJzendoorn, M.H., & Pelligrini, A.D. (1995). Joint book reading makes for success in learning to read: A meta-analysis on intergenerational transmission of literacy. *Review of Educational Research*, *65*, 1–21.
Chiu, M., & McBride-Chang, C. (2006). Gender, context, and reading: A comparison of students in 43 countries. *Scientific Studies of Reading*, *10*, 331–362.
Clark, L.S., Demont-Heinrich, C., & Webber, S. (2005). Parents, ICTs, and children's prospects for success: Interviews along the digital "Access rainbow". *Critical Studies in Media Communication*, *22*, 409–426.
Coleman, J.S. (1988). Social capital in the creation of human capital. *The American Journal of Sociology*, *94*, 95–120.
Cook-Gumperz, J. (1973). *Social control and socialization. A study of class difference in the language of maternal control*. London: Routledge & Kegan Paul.
De Graaf, N.D., De Graaf, P.M., & Kraaykamp, G. (2000). Parental cultural capital and educational attainment in the Netherlands: A refinement of the cultural capital perspective. *Sociology of Education*, *73*, 92–111.
De Graaf, P.M. (1986). The impact of financial and cultural resources on educational attainment in the Netherlands. *Sociology of Education*, *59*, 237–246.
D'Haenens, L. (2001). Old and new media: Access and ownership in the home. In S. Livingstone & M. Bovill (Eds.), *Children and their changing media environment: A European comparative study* (pp. 53–84). Mahwah, NJ: Lawrence Erlbaum Associates.
DiMaggio, P. (1982). Cultural capital and social success: The impact of status culture participation on the grades of high school students. *American Sociological Review*, *47*, 189–201.
Drotner, K. (2000). Difference and diversity: Trends in young Danes' media cultures. *Media, Culture and Society*, *22*, 149–166.
Dumais, S.A. (2005). Early childhood cultural capital, parental habitus, and teachers' perceptions. *Poetics*, *34*, 83–107.
Elchardus, M., & Siongers, J. (2003). Cultural practice and educational achievement: The role of parents' media preferences and taste culture. *The Netherlands' Journal of Social Sciences*, *39*, 151–171.
Farkas, G. (1996). *Human capital or cultural capital? Ethnicity and poverty groups in an urban school district*. New York: Aldine de Gruyter.
Ganzeboom, H.B.G., De Graaf, P.M., & Treiman, D.J. (1992). A Standard International Socio-Economic Index of Occupational Status. *Social Science Research*, *21*, 1–56.
Georg, W. (2004). Cultural capital and social inequality in the life course. *European Sociological Review*, *20*, 333–344.
Hancox, R.J., Milne, B.J., & Poulton, R. (2005). Association of television viewing during childhood with poor educational achievement. *Archives of pediatrics and adolescent medicine*, *159*, 614–618.
Heyneman, S.P., & Loxley, W.A. (1983). The effect of primary-school quality on academic achievement across twenty-nine high- and low-income countries. *American Journal of Sociology*, *88*, 1162–1194.
Kalmijn, M., & Kraaykamp, G. (1996). Race, cultural capital and schooling: An analysis of trends in the United States. *Sociology of Education*, *69*, 22–34.
Knulst, W. (1992). An elitist rearguard: An effort to explain changes in the extent and composition of the arts audience in the age of television. *The Netherlands' Journal of Social Science*, *28*, 72–94.
Kraaykamp, G. (2003). Literary socialization and reading preferences. Effects of parents, the library, and the school. *Poetics*, *31*, 235–257.
Lareau, A. (1987). Social class differences in family-school relationships: The importance of cultural capital. *Sociology of Education*, *60*, 73–85.

Leseman, P.P.M., & De Jong, P.F. (1998). Home literacy: Opportunity, instruction, cooperation and social-emotional quality predicting early reading achievement. *Reading Research Quarterly*, *33*, 294–318.
Levels, M., Dronkers, J., & Kraaykamp, G. (2008). Immigrant children's educational achievement in western countries: Origin, destination, and community effects on mathematical performance. *American Sociological Review*, *73*, 835–853.
Livingstone, S. (2002). *Young people and new media. Childhood and the changing media environment*. London: Sage.
Livingstone, S. (2007). Strategies of parental regulation in the media-rich home. *Computers in Human Behavior*, *23*, 920–941.
McLeod, J., & Brown, J.D. (1976). The family environment and adolescent television use. In R. Brown (Ed.), *Children and television* (pp. 199–233). London: Collier Macmillan.
Norris, P. (2001). *Digital divide. Civic engagement, information poverty, and the internet worldwide*. New York: Cambridge University Press.
Notten, N., & Kraaykamp, G. (2009). Parents and the media. A study of social differentiation in parental media socialization. *Poetics*, *37*, 185–200.
Notten, N., Kraaykamp, G., & Ultee, W. (2008). Ouderlijke mediasocialisatie: Hulpbron of handicap? Een studie naar de langetermijneffecten van mediasocialisatie op het onderwijssucces van kinderen [Media socialization: Help or handicap? A study of the long term effects of parental media socialization on children's educational success]. *Mens & Maatschappij*, *83*, 360–375.
Notten, N., Peter, J., Kraaykamp, G., & Valkenburg, P.M. (in press). Research note: Digital divide across borders – A cross-national study of adolescents' use of digital technologies. *European Sociological Review*. Doi: 10.1093/esr/jcn071
Organisation for Economic Co-operation and Development. (2007). *Pisa 2006: Science competencies for tomorrow's world. Executive summary/Volume 1*. Retrieved May 2008, from http://www.pisa.oecd.org/dataoecd/15/13/39725224.pdf
Organisation for Economic Co-operation and Development. (2008). *Programme for International Student Assessment. Database – Pisa 2006* [datafile]. Retrieved January 2008, from http://pisa2006.acer.edu.au/downloads.php
Organisation for Economic Co-operation and Development. (2009). *Pisa 2006 technical report*. Retrieved March 2009, from http://www.pisa.oecd.org/dataoecd/0/47/42025182.pdf
Park, H. (2008). Home literacy environments and children's reading performance: A comparative study of 25 countries. *Educational Research and Evaluation*, *14*, 489–505.
Pasquier, D. (2001). Media at home: Domestic interactions and regulation. In S. Livingstone & M. Bovill (Eds.), *Children and their changing media environment: A European comparative study* (pp. 161–177). Mahwah, NJ: Lawrence Erlbaum Associates.
Roe, K. (2000). Socio-economic status and children's television use. *Communications*, *23*, 3–18.
Rogers, E.M. (1995). *Diffusion of innovations*. New York: The Free Press.
Schieffelin, B.B., & Ochs, E. (1986). Language socialization. *Annual Review of Anthropology*, *15*, 163–191.
Schmidt, M.E., Pempek, T.A., Kirkorian, H.L., Lund, A.F., & Anderson, D.R. (2008). The effect of background television on the toy play behaviour of very young children. *Child Development*, *79*, 1137–1151.
Sharif, I., & Sargent, J.D. (2006). Association between television, movie, and video game exposure and school performance. *Pediatrics*, *118*, 1061–1070.
Snijders, T.A.B., & Bosker, R.J. (1999). *Multilevel analyses. An introduction to basic and advanced multilevel modeling*. London: Sage.
Subrahmanyam, K., Kraut, R., Greenfield, P., & Gross, E. (2000). The impact of home computer use on children's activities and development. *Children and computer technology*, *10*, 123–144.
Sullivan, A. (2001). Cultural capital and educational attainment. *Sociology*, *35*, 893–912.
United Nations Educational, Scientific and Cultural Organization Institute for Statistics. (2009). *Data centre: Public reports – Education*. Retrieved January 2009, from http://stats.uis.unesco.org/unesco/TableViewer/tableView.aspx?ReportId=167
Van Eijck, K., & Bargeman, B. (2004). The changing impact of social background on lifestyle: "Culturalization" instead of individualization? *Poetics*, *32*, 439–461.

Van Peer, W. (1991). Literary socialization in the family: A state of the art. *Poetics*, *20*, 539–558.

Verboord, M., & Van Rees, K. (2003). Do changes in socialization lead to decline in reading levels? How parents, literary education and popular culture affect the level of books read. *Poetics*, *31*, 283–300.

Weakliem, D.L. (2002). The effect of education on political opinions. An international study. *International Journal of Public Opinion Research*, *13*, 141–157.

World Bank. (2009). *World Development Indicators (WDI) Online 2006*. Retrieved January 2009, from http://www.worldbank.org

Wright, J.C., Huston, A.C., Murphy, K.C., St. Peters, M., Pinon, M., Scantlin, R., et al. (2001). The relations of early television viewing to school readiness and vocabulary of children from low-income families: The Early Window Project. *Child Development*, *72*, 1347–1366.

Appendix 1. Country (mean) scores

Country	*N*	Science performance	GDP per capita	Tertiary education (%)
Azerbaijan	3778	392.43	6172	15
Argentina	3849	407.23	11985	64
Australia	13259	529.40	33035	73
Austria	4709	515.79	35523	50
Belgium	8157	524.02	33243	63
Brazil	8025	392.34	8949	25
Bulgaria	4038	448.00	10295	46
Canada	20973	527.25	36687	62
Chile	4852	445.37	12997	47
Colombia	3958	398.93	6381	31
Croatia	4915	497.72	14309	44
Czech Republic	5652	541.67	22004	50
Denmark	4101	499.68	35125	80
Estonia	4729	535.02	19155	65
Finland	4519	565.26	32903	93
France	4212	506.51	31980	56
Germany	4272	525.60	31766	48
Greece	4636	480.35	31290	95
Hong Kong-China	4426	549.02	39146	33
Hungary	4144	512.42	18154	69
Iceland	3635	494.45	35814	73
Indonesia	9033	389.16	3455	17
Ireland	4283	514.45	40823	59
Israel	3444	474.07	24405	58
Italy	20913	489.82	28828	67
Japan	5313	538.79	31951	57
Jordan	5006	441.05	4654	39
Korea	5063	523.38	22985	93
Kyrgyzstan	4494	337.98	1813	43
Latvia	4440	496.49	15389	74
Lithuania	4460	491.25	15739	76
Macao-China	4583	510.98	44114	57
Mexico	28455	426.89	12176	26
Montenegro	3670	416.27	9250	36
Netherlands	4531	534.99	36099	60
New Zealand	4310	542.25	25260	80
Norway	4318	493.50	51862	78
Poland	5261	505.66	14675	66
Portugal	4838	481.53	20845	55
Romania	4606	422.90	9368	52
Russian Federation	5422	485.12	11861	72
Serbia	4503	440.88	9468	36
Slovak Republic	4464	495.76	17837	45
Slovenia	6269	497.85	25021	83
Spain	18512	507.69	29208	67
Sweden	4162	509.49	34056	79
Switzerland	11705	510.62	37396	46
Thailand	5781	433.83	7613	46
Tunisia	3869	390.01	6958	31
Turkey	4412	430.61	11535	35
United Kingdom	11550	524.07	32654	59
United States	5104	495.34	43968	82
Uruguay	4354	444.36	10203	46

Source: PISA 2006 (*N* Level 1 = 345,967; *N* Level 2 = 53).