

Book-rich home environments and academic performance

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Abstract

In the current paper was researched the effect of having books present in a students' household on their academic performance. Academic performance was measured in dimensions of reading performance, mathematic performance and science performance. Of these, reading performance was expected to be most affected by book possession. The expectation was that for all three types of performance, the effect would be mediated by reading engagement (attitudes towards and practices of reading). The study sample consisted out of 4765 Dutch 15-year old students, who were part of the 2018 Program for International Student Assessment (PISA). Linear regression analyses were conducted to test the hypotheses. The relationships were controlled for sex, speaking the language of the PISA test at home, the age of starting primary school, ESCS (similar to SES), subjective wellbeing, and being bullied. The results of the study show that indeed books at home correlate positively with academic results in all three performance dimensions. This effect is mediated by reading engagement, as expected. The found effect is also strongest for reading performance. The study contributes to literature on elements of the home environment that predict academic performance and supplies unique evidence for the value of book access at home and reading engagement for academic performance.

Introduction

Adamson (2016), in his policy brief on public versus private investment in education, emphasizes the importance of investing in equity in order to combat inequalities in education. He states that children's backgrounds in terms of resources, opportunities and achievement influence their academic performance strongly. For the sake of the student, governments and professionals have to mitigate these gaps in resource and opportunity. Within this aim, there exists a manifold of factors that could be focused on: ranging from improvements in school curricula to an improvement of the home environment of a student. The latter is the addressed in the current paper, which researches the benefits of the presence of books in the home in relation to academic performance. The context on which is focused is The Netherlands. Since the last measurement in 2015, The Netherlands has been found to be declining in all three performance areas measured by PISA: reading performance, mathematics performance and science performance (OECD, 2018¹). Furthermore, The Netherlands was one of the ten countries where the decline in reading performance was the most pronounced. Though The Netherlands still performs slightly above or at the OECD average, the declines are worrying. Therefore, unresearched factors that improve academic performance should be welcomed by Dutch officials and stakeholders in student education. If the hypothesis of this study holds up, investing in book ownership at home could be a way to improve scores. Especially the reading performance dimension is expected to benefit.

The paper is revolutionary in its focus on books as an aspect of the home environment, which is unresearched in relation to academic performance. Book-rich home environments in general are found to affect certain learning capabilities in children (Merga, 2015). Evidence also exists that book

access in general (in terms of print exposure) and reading enjoyment contribute to academic results (Mol & Bus, 2011). Despite these findings, researchers have not yet linked the benefit of having a book-rich home environment directly to academic performance. As far as the researcher could find, this study is the first. Home environments are known to affect academic performance (Bradley, Caldwell & Rock, 1988; Schneider & Lee, 1990; Egunsola, 2014), this happens through mechanisms of parental encouragement (Bradley et al., 1988), parental values (Schneider & Lee, 1990) and the location of the home (Muola, 2010), to name some examples. Depending on the results of the study, books at home can be added to that list. The study makes use of PISA 2018 data, which spans 79 countries and over six-hundred-thousand 15 year old students. Of these six-hundred thousand, 4765 students were from The Netherlands. They will form the sample of the study. As stated before, the study may benefit government and educational professionals in their formation of programs for decreasing educational inequalities in students. If book ownership at home matters, programs can focus on increasing this ownership for families of all income strata through funding or alternative methods. Scientifically, the paper contributes to home environment literature, reading and books literature, and literature on academic performance. It does so primarily through its unique focus on books at home, a neglected element in home environment and academic performance literature.

Literature review

Academic performance

There are many different contributors to academic performance. After the granted factor of general intelligence, there are: self-discipline (Duckworth & Seligman, 2005); teaching methods (Ganyaupfu, 2013); studying (Stinebrickner & Stinebrickner, 2008); sleep (Curcio, Ferrera, & De Gennaro, 2006); not using social media (Kirschner & Kapinski, 2010); personality (Duff, Boyle, Dunleavy & Ferguson, 2004); motivation (Afzal, Ali, Khan & Hamid, 2010), and socioeconomic status (White, 1982; Sirin, 2005) to name some. Academic achievement is an important requirement for later opportunity in life and being able to work to the degree of ones' abilities. For this reason the field continues to be of importance to researchers. A relatively under researched predictor of academic performance (AP hereafter) remains the home environment of a student. This environment is found to affect AP (Bradley, Caldwell and Rock, 1988) and does so in various ways. To name a few examples: Gottfried, Fleming and Gottfried (1998) found that the presence of cognitively stimulating experiences at home benefit AP; and Bradley, Caldwell and Rock (1988) found that the availability of toys in stages of infant development related positively to later school results. A mixture of both cognitively stimulating experience and leisure objects would be books. The presence of books at home are an unexplored mechanism in its relation to AP. Does being around books at home influence the performance of a secondary school student? In the current study is argued that the presence of a manifold of books increases the probability for a student to become reading engaged: having positive attitudes towards reading and a regular practice of reading. Reading engagement is proven to benefit academic results (OECD², 2018 on reading performance; Whitten, 2016 and Galik, 1999 on reading enjoyment and academic performance).

Closely tied to the home environment concept is the concept of socioeconomic status (SES). The two are closely related in the literature (White, 1982). SES refers to the status attributed to a single person, which is derived from their education, income and employment. These three elements are the cornerstones of SES, though measurement of the concept varies. The home environment concept can include one or more of these three factors, but also others that are foreign to SES such as parental styles and encouragement. From meta analyses by White (1982) and Sirin (2005) it can be

concluded that SES has moderate to strong correlations with academic performance. This relationship is contingent on a multitude of factors. It matters, for example, whether the unit of analysis is aggregate or individual (schools vs. students) or where the school is located (White, 1982; Sirin, 2005). Also, the way SES is operationalized in studies affects the strength of the relationship with academic performance. According to White (1982), SES has stronger ties with academic performance when the concept is measured in a way more akin to home environment.

The home environment (HE hereafter) concept is broad to say in the least. It considers everything from infant development to toy ownership at home. Despite White's (1982) finding on the importance of HE factors on AP, HE has received much less attention in AP research compared to SES. Leading work on this relationship has been done by Bradley (2010; and peers such as Caldwell and Rock (1984; 1988). Bradley (2010) invented the HOME Inventory, a qualitative measurement instrument for the evaluation of home environments. A summary on HE can be found in Altman & Werner (2013). Some mechanisms of the relation between HE and AP are: mechanisms of parent behavior (Bradley, Caldwell & Rock, 1988); home facilities (Egunsola, 2014); and arguably parental values (Schneider & Lee, 1990). The following section summarizes work on the HE – AP relationship. Afterwards, books, as nested in HE, are related to AP.

Home environment and academic performance

Bradley, Caldwell and Rock (1988) performed a 10 year longitudinal study on HE and AP in 42 fourth- and fifth-grade children. In the study they introduce and test three models through which HE affects performance outcomes. The models were: (1) *primacy of early experience*; (2) *predominance of the contemporary environment*; and (3) *cumulative effects in stable environments*. Model 1, 'the primacy of early experience', is a 2-part model that believes the difference in AP to be explainable through early life differences in the responsiveness and acceptance of the parent towards the child, in addition to the presence and availability of toys in the home. Responsivity instills in the child a sense of trust towards their environment. This would translate to the school environment and produce better results. Also in the early experience of the child are toys. Playing with toys lies at the beginning of skill development and mastery, which benefit the child later in life. Model 1 proved statistically significant for an effect on school factors. Parental responsiveness with the child at 6 months old relates positively to the classroom behavior of the child at 10 years old, irrespective of the child's environment in the intervening time. A nurturing and responsive environment results in a more comfortable and responsive child. Besides a positive relation with AP, teachers also take note of such a child in a positive way. Evidence was also found that playing with toys benefits AP, irrespective of the later home environment. Especially reading performance was impacted by this factor. Model 2 focused on the general emotional climate of the household and the students' partaking in extra-curricular stimulating experiences. The contemporary emotional HE of the students was measured and found to benefit AP. This is evidence that emotionally healthy homes provide better results. Extra-curricular experiences are believed to develop learning models in the child, which lead to better performance. Proof for this claim was supported by the results: Model 2 received the strongest statistical support of the three models. These relations were found to be moderate to strong. Finally, model 3 focuses on parents' encouragement and motivation of the child to perform well. It received some statistical support. Bradley et al. (1988) thus provide three models for improvement in AP due to HE. The models receive statistical support, but, as the researchers note, do not explain all of the data, leaving room for further research. Limitations to the study were the small sample size and inconsistencies in the measurement devices.

A relative of HE which is argued to influence AP is cultural capital. Cultural capital theory from Bourdieu (1976) is a theoretical field apart from HE but often considers home possessions which makes it relevant for the study. Cultural capital refers to the cultural resources an individual

has that will place him in an advantaged position in their society (Bourdieu, 1986). Schools value expression of the top layer of the dominant culture coming from their students. Students who express this layer of culture are rewarded more so than those who don't. They are believed to be more competent. Cultural capital is held to be generationally transferable, meaning it passes from parent unto child. Cultural capital can be measured through parental education or certain home possessions. This is called objective cultural capital. Cultural capital is differentiated into three forms: incorporated; institutionalized; and objective (Bourdieu, 1976, as found in McQueen et al., 2007). Incorporated cultural capital is the capital that an individual has taken onto himself through exposure with his environment (e.g. language or mannerisms). Institutionalized cultural capital lies in status titles and status related esteem. Attending a private school would provide this form of cultural capital. Objective cultural capital is the cultural capital that lies in objects such as books or pieces of art. The argument that cultural capital affects AP positively is to some degree solidified in social science (DiMaggio, 1982; De Graaf, De Graaf & Kraaijkamp, 2000). DiMaggio (1982) measured the impact of cultural capital on school grades of high school students in the United States. He found that cultural capital did indeed affect grades positively, and even to the degree that it almost paralleled the impact of general ability. He stressed the use of a composite versus a single measure of cultural capital and measured the concept in his study by analyzing students' interest and partaking in cultural activities, such as poetry and attending symphonies. Arguably though, this partaking is an extension of a higher intelligence, which accompanies an openness to different experiences. Whether this openness is a result of generationally transferred cultural capital or the cause of it, is debatable. However, the found effects of cultural capital were consistent and highly significant in DiMaggio's study. De Graaf, De Graaf and Kraaijkamp (2000) also analyzed the relationship between cultural capital and AP. They conceptualized cultural capital as parental beaux arts participation and parental reading enjoyment. Results proved that cultural capital in a home did indeed relate to higher performance measures in students.

Finally, HE and AP have also been approached through mechanisms of motivation, cultural values, learning facilities at the home, and more. Gottfried, Fleming and Gottfried (1998) performed a longitudinal study on the relation between HE and academic motivation in children. HE was specified to cognitively stimulating activities in the home. The theory was that such activities would instigate a motivation to learn more in the children, resulting in a higher academic motivation. Academic motivation is a big predictor for academic performance. The results of the study were positive: HE affected academic motivation. Children in cognitively stimulating homes are more academically motivated. SES was included in the study and the researchers make explicit note of the fact that HE superseded SES in significance and strength regarding affectation of academic motivation. Another study on HE and motivation comes from Muola (2010). Opposed to intrinsic motivation from Gottfried et al. (1998), which is the desire to learn, Muola (2010) studied achievement motivation: the desire to achieve well. The study contained 235 pupils between the age of 13 and 17, in the Machakos district in Kenya. It was undertaken to explain variance in study results that could not be attributed to intelligence or quality of education. The home environment meant here: employment of the father; employment of the mother; education of the father; education of the mother; family size; learning facilities at the home; and parental encouragement. Note that SES elements are included in this list. In result, all of these factors proved to correlate with academic achievement motivation. Only parental encouragement had a low to negligible correlation. To conclude with a summary of other HE to AP findings: Forehand, Long, Brody & Fauber (1986) found a positive relationship between a student's bond with their father and their grade point average. This effect might, however, be culturally dependent (Herzog, 1974); Schneider and Lee (1990) found significant effects for parental styles and culture in the home on academic achievement; and

Egunsola (2014) found significant relationships between academic success and parent education, parent occupation and location of the home.

Books in the home

Cognitively stimulating activities at home influence academic motivation, a strong predictor for AP (Gottfried et al., 1998). From this findings a possible new predictor for AP can be derived. Books, synonymous with learning and education, are by definition cognitively stimulating. The current study introduces the amount of books in a students' home as a potential predictor for AP. Although objects such as toys have been studied in the literature, books are curiously disregarded. Being read to as a child (Mol & Bus, 2011), enjoying leisurely reading (Whitten, 2016), and having a reading habit (Fransisco & Madrao, 2019) are all found to benefit academic performance of students. Book access at home should therefore spark the interest of researchers on HE and AP.

The positive effects of books and reading on AP are widely recorded (Mol & Bus, 2011 for a meta analysis). A few examples are mentioned here. A study performed in Australia found that the use of books and libraries was found to positively relate to mathematics and science achievements among a group of randomly selected 12 year old students (Keeves 1972; as found in Bradley et al., 1988). Dave (1963; as found in Bradley et al., 1988) observed that intellectual interests and activities in the home correlated moderately to strongly with IQ and school achievement with fourth graders in the US. Merga (2015) found that access to books at home is related to having motivation to read for recreation, which is in turn related to higher academic performance (Galik, 1999; Whiten, 2016). PISA (OECD², 2018) found that reading engagement, which refers to having positive attitudes towards reading and a regular practice of reading, positively influenced reading performance. Furthermore, book-rich home environments foster avid and competent readers (Gambrell, 1996; Kirsch et al., 2002; Spiegel, 1992; Nieuwenhuizen, 2001; Worhy, Moorman & Turner, 1999; all as found in Merga, 2015). Print exposure, books and reading (engagement) are thus positively related to academic performance. The current paper hypothesizes that a larger amount of books present in the household, increase the probability for a student to become engaged with reading, which translates to the acquirement of better results in school. Reading, mathematic and science performance are all expected to benefit from book ownership and reading engagement, but reading performance is expected to benefit the most given the obvious ties between books and reading. The research question asked in this study is: *How does having a book-rich home environment affect students reading engagement and consequentially their academic performance?* Evidence of the impact of reading engagement on AP is thin spread. If results are positive, the current study strengthens the evidence on this relationship. Furthermore, home environment literature is lacking studies on the effect of single item influencers of AP, such as IT-devices and books. On a societal level, this study seeks to deliver evidence for students that they can improve in their performance by simply picking up a book at home.

Methodology

Sample

All data on the variables is supplied by PISA 2018. PISA conducts international surveys on, among other things, the educational performance of 15 year old students, every three years. PISA 2018 included over six-hundred-thousand (612004) students in its study, with participants from a total of 79 countries and 3 regions (Moscow City, Moscow region, and Tatarstan in Russia). In the current study the 4765 participating Dutch students of the PISA study are selected. PISA 2018 supplies data

on books in the home, reading engagement and academic performance. Additionally, PISA 2018 gathered data on several variables which are used as control variables in the study, for reasons that will be detailed below. These are: sex, language spoken at home, subjective wellbeing, being bullied, the age of starting primary school, and Economic, Social and Cultural Status (ESCS), a variant of socioeconomic status (SES). Linear regression analyses will be performed to answer the research question. All measurements are done in SPSS 29.0.

Books in the home

Books at home (abbreviated to BOOKS) will be a composite measure of several variables that pertain to book ownership at home. The first of these is item ST013 of the main PISA survey, which asks: *"How many books are there in your home?"* With the answer categories being: *0 – 10 books; 11 – 25 books; 26 – 100 books; 101 – 200 books; 201 – 500 books; and More than 500 books.* The survey also asks other questions about what books are in a students' home. ST011 asks: *"How many are in your home of": classic literature; books of poetry; books to help with your school work; technical reference books; a dictionary; and books on art, music, or design.* All of these are included in BOOKS, except for books to help with school work, which were thought to be too directly linked to academic results, and technical reference books. Furthermore, ST012 contains a question about possession of E-book readers. This question was also excluded, because one e-book reader can contain thousands of books which makes the measurement unreliable for the study.

Thus, the included items are: ST013 (how many books...); and, of ST011, the subitems of classical literature; poetry books; a dictionary; and books on art, music and design. A principal components analysis was ran for these book-items, which resulted in one component extracted. The variables were grouped together to create one variable called 'Books in the home (BOOKS)' in SPSS which is used in the study.

Academic performance

The main focus of the study is on reading performance, given the self-evident ties to books and reading. However, since evidence exists that reading (engagement) and print exposure benefit mathematics and science performance (Galik, 1999; OECD², 2018; Whitten, 2016; Keeves, 1972, as found in Bradley et al. 1988), and the Netherlands is declining in these areas also, these dimensions are also included in the study. Academic performance is thus split up into reading performance (READ in SPSS), mathematics performance (MATH) and science performance (SCIE). PISA 2018 performed tests in all three of these fields.

Reading engagement

In the literature, reading engagement is a two part concept existing out of reading practices and attitudes towards reading (OECD², 2018). The current study also measures reading engagement in this manner. Attitudes towards reading is measured as the degree to which a student enjoys reading. For this is used item ST160 of the survey, which measures reading enjoyment. It asks: *"How much do you agree or disagree?"* with answer categories 'strongly agree', 'agree', 'disagree', and 'strongly disagree' to the following statements: *"I read only if I have to"; "Reading is one of my favorite hobbies"; "I like talking about books with other people"; "For me, reading is a waste of time"; and "I read only to get information that I need."* Reading practices are measured through item ST167 which asks: *"How often do you read these materials because you want to?"* with answer categories: 'Never or almost never', 'a few times a year', 'about once a month', 'several times a month' and 'several

times a week.' The materials in questions are: *Magazines; comic books; fiction (novels, narratives, stories); non-fiction (informational, documentary); and newspapers*. A principal component analysis was ran on the items of ST167. From this analysis one component was derived, which means they measure one concept, which is reading practices. Another principal components analysis was ran on reading enjoyment and reading practices together, from which also one component was derived. They were then combined into a single measurement variable for reading engagement (RENG). On an additional note, reading practices were also measured in PISA by ST176 which is about online reading: *Reading emails; chat online (e.g. Whatsapp, Messenger); reading online news; searching for information on a particular topic; taking part in online group discussions or forums; and searching for practical information online (e.g. schedules, events, tips, recipes)*. Seeing that the study is about books at home, this item was not included.

Control variables

The study makes use of several control variables which could potentially influence the outcome variable. The control variables are: *the sex of the student; the language spoken at home; age when starting primary school; ESCS; subjective wellbeing; and the degree to which the student experiences being bullied*. Regarding sex, boys perform slightly better in mathematics and girls perform slightly better in languages (Downey & Vogt Yuan, 2005). Sex is measured by questionnaire item ST004: *"Are you female or male"* with respective answer categories. The variable is recoded in SPSS to provide data on being male versus not being male (i.e. being female).

Speaking the language of the PISA test at home is also expected to affect academic performance. Students who speak the test language at home are expected to have an advantage in relation to students who speak a foreign language. This would especially be the case for language related parts of the test, though not exclusively. A study by Van Laere, Aesaert and Braakon (2014) shows a difference in results in science performance based on language spoken at home. Language spoken at home is measured using survey item ST022: *"Which language do you speak at home most of the time?"*. The answer options are 'Language of the test' and 'other language'. The variable is recoded in SPSS to 'speaks test language at home' versus not speaking the test language at home.

The age at which the student started primary school is also believed to affect results, since students who started at a younger age have had more years of education and are therefore more likely to attain higher results. This concept is measured by item ST126 of the survey: *"How old were you when you started [primary school]?"*. With answer categories: 3 or younger; 4; 5; 6; 7; 8; and 9 or older.

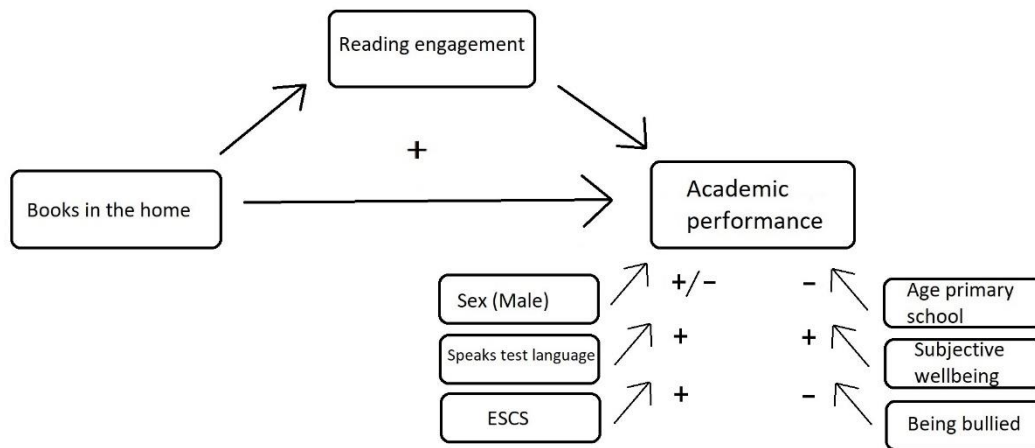
Furthermore, SES is found to affect academic performance although this relationship is not straightforward (White, 1982; Sirin, 2005). ESCS, the variant of SES from PISA 2018, functions in the current study as a control variable. ESCS is comprised of 3 variables: *highest level of education of parents (PARED); parents' highest occupational status (HISEI); and home possessions (HOMEPOS)*. HOMEPOS, though, contains multiple items regarding books which are already part of the BOOKS variable. For that reason ESCS is reconstructed. A new measurement of HOMEPOS is made, using ST011 and ST012 as in the original, but excluding sub-items about books. The excluded sub-items are: Classic literature; books of poetry; books to help with your school work; technical reference books; a dictionary; books on art, music or design; country-specific wealth item 1 to 3; and E-book readers. A factor analysis on the new HOMEPOS (HOMEPOS2) results in 1 extracted component. A principal component analysis on HOMEPOS2, PARED and HISEI also results in 1 component extracted and so a new ESCS variable (ESCS2) is made in SPSS, consisting out of HOMEPOS2, PARED and HISEI.

Bullying is also included as a potential confounding variable. Bullied students perform worse in school (Murillo & Roman, 2011; Strøm, Thoresen, Wentzel-Larsen & Dyb, 2013; and Juvonen, Wang & Espinoza, 2011). In PISA 2018, a students' experience of being bullied is measured by item ST038, where is asked how how often the student has been bullied during the past 12 months. Sub items are: "Other students left me out on purpose; other students made fun of me"; "I was threatened by other students"; "Other students took away or destroyed things that belonged to me"; "I got hit or pushed by other students"; and "Other students spread nasty rumours about me". The answer categories are: "Never or almost never"; "A few times a year"; "A few times a month; and "Once a week or more". Together they form the variable BEINGBULLIED, which was ready-made by PISA and already present in the dataset.

Lastly, subjective well-being is found to affect academic achievement (Berger, Alcalay, Torretti & Milicic, 2011; Bücken, Nuraydin, Simonsmeier, Schneider & Luhmann, 2018; and Gräbel, 2017). The current study takes subjective affective (emotional state) wellbeing as a control variable. For this, PISA provides the variable SWBP (Subjective wellbeing positive affect). SWBP is comprised of measures of health, confidence in skills and capabilities, body-image and a psychological dimension about emotional states and interpersonal relationships (OECD³, 2018)

Conceptual model

Figure 1



H1: *The amount of books present in a house predicts reading engagement, which predicts academic performance.*

H2: *The amount of books present in a house predicts reading engagement, which predicts academic performance, and this effect is stronger for the dimension of reading performance*

Results

Reading performance

The explained variance (R^2) of reading performance (READ) when BOOKS and all control variables are in the model and reading engagement is not included is .190. BOOKS correlates significantly with reading performance in this model with a slope of ($b=$) .257 ($p = <.001$). For the summary and coefficients of this model see table 1a and 1b, respectively.

Table 1a – READ: Model summary

Model	R	R Square	Adjusted R square	Std. Error of the estimate
READ ^a	.436 ^a	.190	.188	86.58046

a. Predictors: (Constant), BOOKS, subjective wellbeing, age primary school, speaks test language, sex (male), being bullied
ESCS

Table 1b – READ: Coefficients

Model: READ	B	Std. Error	Beta	t	Sig.
Constant	402.310	10.918		36.848	<.001
BOOKS	55.864	3.636	.257	15.365	<.001
Sex (male)	-20.920	2.967	-.109	-7.051	<.001
Speaks test-language	46.140	5.701	.127	8.093	<.001
Age primary school	-10.621	2.039	-.080	-5.209	<.001
Subjective wellbeing	-1.783	1.727	-.016	-1.033	.302
Being bullied	-4.041	2.027	-.031	-1.994	.046
ESCS	2.309	.215	.181	10.734	<.001

For the next step of the analysis, it was tested whether BOOKS has a significant relationship with reading engagement (RENG). Indeed, BOOKS correlated ($b=$) .392 with RENGL ($p = <.001$) For the results on RENGL see table 2a and 2b.

Table 2a – Reading engagement: model summary

Model	R	R Square	Adjusted R square	Std. Error of the estimate
RENG ^a	.479 ^a	.229	.228	.75404

a. Predictors: (Constant), BOOKS, subjective wellbeing, age primary school, speaks test language, sex (male), being bullied, ESCS

Table 2b – Reading engagement: coefficients

Model: RENG	B	Std. Error	Beta	t	Sig.
Constant	.341	.095		3.582	<.001
BOOKS	.761	.032	.392	23.996	<.001
Sex (male)	-.427	.026	-.249	-16.504	<.001
Speaks test-language	-.094	.050	-.029	-1.892	.059
Age primary school	-.021	.018	-.018	-1.168	.243
Subjective wellbeing	.015	.015	.015	1.013	.311
Being bullied	.053	.018	.046	3.015	.003
ESCS	.002	.002	.017	1.028	.304

Adding RENG to the original READ model lead to several changes. The explained variance (R^2) increased with almost .100 to .282. The slope of BOOKS lost about half of its strength and decreased from .257 to .124. Furthermore, RENG correlates ($b=$) .344 ($p = <.001$) with READ, making it the strongest predictor for reading performance in the model. As for the control variables, being male is weakly and negatively correlated with reading ($b = -.022 = <.001$). This would be in line with findings that males generally lead slightly worse than females, but the relationship was not found to be significant in this case ($p = .145$). Speaking the language of the PISA tests at home has a positive effect ($b = .137 p = <.001$), as expected. The age at which primary school is started correlates negatively ($b = -.074 p == <.001$), also as expected: the later a child started school, the worse his performance. The subjective wellbeing of the student was found to relate to READ negatively ($b = -.021$), which was unexpected as wellbeing was expected to affect performance positively. However, this effect was not significant ($p = .156$). The experience of being bullied was found to affect READ negatively ($b = -.047 p = .001$), as expected. Finally, ESCS correlates with READ positively and significantly ($b = .173 p = <.001$). Next, the SOBEL test was undertaken to detect a mediation effect of RENG between BOOKS and READ. Inserted in the test were the unstandardized regression coefficient (B) and the standard error for BOOKS \rightarrow RENG ($B = .761$ std. error = .032) and for RENG \rightarrow READ ($B = 38.537$ std. error = 1.841). From this was derived a significance value (p) of 0, meaning a mediation effect is present. The final model of reading performance is displayed in tables 3a and 3b.

Table 3a – READ*: model summary

Model	R	R Square	Adjusted R square	Std. Error of the estimate
READ* ^a	.531 ^a	.282	.280	81.46811

* Final model (with reading engagement)

a. Predictors: (Constant), BOOKS, subjective wellbeing, age primary school, speaks test language, sex (male), being bullied, ESCS, reading engagement

Table 3b – READ*: coefficients

Model: READ*	B	Std. Error	Beta	t	Sig.
Constant	389.435	10.300		37.808	<.001
BOOKS	26.910	3.703	.124	7.267	<.001
Sex (male)	-4.230	2.903	-.022	-1.457	.145
Speaks test-language	50.013	5.369	.137	9.316	<.001
Age primary school	-9.873	1.921	-.074	-5.139	<.001
Subjective wellbeing	-2.311	1.627	-.021	-1.420	.156
Being bullied	-6.148	1.910	-.047	-3.218	.001
ESCS	2.208	.203	.173	10.867	<.001
Reading engagement	38.537	1.841	.344	20.929	<.001

* Final model (with reading engagement)

Mathematic performance

The total explained variance (R^2) of the mathematic performance (MATH) model, with all variables except RENG included, is .202. In this model, BOOKS correlates ($b=$.267 with MATH ($p = <.001$). Of the control variables, ESCS has the strongest relationship with MATH ($b = .209$ $p = <.001$). For a view on the summary and the coefficients of the model, see tables 4a and 4b. Adding RENG to the model, lead to the following changes. The R^2 went up to .254. The slope of BOOKS dropped with almost .100 ($b = .169$ $p = <.001$). Furthermore, RENG correlates the strongest of all independent variables ($b = .258$ $p = <.001$). Then there are the control variables: being male is positively related to MATH, as expected ($b = .121$ $p = <.001$); speaking the test language affects MATH positively ($b = .140$ $p = <.001$); the age at which primary school was started correlates negatively ($b = -.068$ $p = <.001$); subjective wellbeing correlates also negatively ($b = -.033$ $p = .025$) which is unexpected as the relationship was thought to be positive; being bullied correlates $-.054$ ($p = <.001$) with MATH; and ESCS correlates .201 ($p = <.001$) with MATH. For the model summary and coefficients see tables 5a and 5b. Next, the mediation effect was sought after. Inserted in the SOBEL test were the relevant coefficients for BOOKS \rightarrow RENG ($B = .761$ std. error = .032) and for RENG \rightarrow MATH ($B = 23.773$ std. error = 1.543). The test resulted in a p-value of 0, meaning there is a mediation effect present.

Table 4a – MATH: Model summary

Model	R	R Square	Adjusted R square	Std. Error of the estimate
MATH ^a	.449 ^a	.202	.200	70.66601

a. Predictors: (Constant), BOOKS, subjective wellbeing, age primary school, speaks test language, sex (male), being bullied, ESCS

Table 4b – MATH: Coefficients

Model: MATH	B	Std. Error	Beta	t	Sig.
Constant	427.801	8.911		48.007	<.001
BOOKS	47.850	2.968	.267	16.124	<.001
Sex (male)	8.808	2.421	.056	3.638	<.001
Speaks test-language	39.501	4.653	.132	8.489	<.001
Age primary school	-7.878	1.664	-.072	-4.734	<.001
Subjective wellbeing	-2.756	1.409	-.030	-1.956	.051
Being bullied	-4.445	1.654	-.042	-2.687	.007
ESCS	2.192	.176	.209	12.488	<.001

Table 5a – MATH*: Model summary

Model	R	R Square	Adjusted R square	Std. Error of the estimate
MATH* ^a	.504 ^a	.254	.253	68.27968

* Final model (with reading engagement)

a. Predictors: (Constant), BOOKS, subjective wellbeing, age primary school, speaks test language, sex (male), being bullied, ESCS, reading engagement

Table 5b – MATH*: Coefficients

Model: MATH*	B	Std. Error	Beta	t	Sig.
Constant	420.007	8.633		48.652	<.001
BOOKS	30.225	3.104	.169	9.739	<.001
Sex (male)	19.165	2.433	.121	7.878	<.001
Speaks test-language	41.950	4.499	.140	9.323	<.001
Age primary school	-7.454	1.610	-.068	-4.629	<.001
Subjective wellbeing	-3.051	1.363	-.033	-2.238	.025
Being bullied	-5.808	1.601	-.054	-3.627	<.001
ESCS	2.117	.170	.201	12.435	<.001
Reading engagement	23.773	1.543	.258	15.405	<.001

* Final model (with reading engagement)

Science performance

The explained variance (R^2) of the first science performance (SCIE) model is .185. In this model, BOOKS has a slope of ($b = .251$ ($p < .001$)). For an overview of this model, see tables 6a and 6b. Adding RENG to the analysis changes the model as follows. The R^2 increases to .265. BOOKS's correlation coefficient decreases roughly by 50 percent, to .128 ($p < .001$). RENG correlates the strongest out of the model ($b = .319$ $p < .001$). Then follow the control variables: being male has a slight significant effect on SCIE ($b = .068$ $p < .001$); speaking the test language at home also has a positive effect ($b = .128$ $p < .001$); age of starting primary school has an expected negative effect ($b = -.059$ $p < .001$); subjective wellbeing has an unexpectedly negative effect ($b = -.030$ $p = .041$); being bullied has a negligible negative and insignificant effect ($b = -.003$ $p = .852$); and ESCS has a positive and significant effect ($b = .202$ $p < .001$). For an overview of the final model, see tables 7a and 7b. The Sobel test was used with the following coefficients: BOOKS \rightarrow RENG ($B = .761$ std. error = .032) and RENG \rightarrow SCIE ($B = 33.197$ std. error = 1.731). As with reading performance and mathematics performance, the test resulted in a p-value of 0, confirming the presence of mediation.

Table 6a – SCIE: model summary

Model	R	R Square	Adjusted R square	Std. Error of the estimate
SCIE ^a	.431 ^a	.185	.184	80.65523

a. Predictors: (Constant), BOOKS, subjective wellbeing, age primary school, speaks test language, sex (male), being bullied, ESCS

Table 6b – SCIE: Coefficients

Model: SCIE	B	Std. Error	Beta	t	Sig.
Constant	411.271	10.171		40.436	<.001
BOOKS	50.789	3.387	.251	14.995	<.001
Sex (male)	-2.225	2.764	-.012	-.805	.421
Speaks test-language	39.990	5.311	.118	7.530	<.001
Age primary school	-7.966	1.899	-.065	-4.194	<.001
Subjective wellbeing	-2.678	1.609	-.026	-1.665	.096
Being bullied	1.541	1.888	.013	.816	.414
ESCS	2.487	.200	.209	12.413	<.001

Table 7a – SCIE*: Model summary

Model	R	R Square	Adjusted R square	Std. Error of the estimate
SCIE* ^a	.514 ^a	.265	.263	76.57580

* Final model (with reading engagement)

a. Predictors: (Constant), BOOKS, subjective wellbeing, age primary school, speaks test language, sex (male), being bullied, ESCS, reading engagement

Table 7b – SCIE*: Coefficients

Model: SCIE*	B	Std. Error	Beta	t	Sig.
Constant	400.079	9.682		41.323	<.001
BOOKS	25.952	3.481	.128	7.456	<.001
Sex (male)	12.179	2.728	.068	4.464	<.001
Speaks test-language	43.356	5.046	.128	8.592	<.001
Age primary school	-7.305	1.806	-.059	-4.046	<.001
Subjective wellbeing	-3.125	1.529	-.030	-2.044	.041
Being bullied	-.336	1.796	-.003	-.187	.852
ESCS	2.396	.191	.202	12.547	<.001
Reading engagement	33.197	1.731	.319	19.181	<.001

* Final model (with reading engagement)

With these findings, H1 can be confirmed: on all three performance grounds, books at home have a positive effect and this effect is mediated by reading engagement. H2, which predicted that the effect was strongest for reading performance, can also be accepted, though with a footnote: BOOKS and RENG together predict (b=) .468 of reading performance. This is the highest combined coefficient of the three measures, with .427 for MATH and .427 for SCIE. RENG alone is also strongest in predictive ability for reading performance: (b=) .344 for READ; .258 for MATH; and .319 for SCIE. But, BOOKS alone are found to correlate strongest with mathematic performance, surprisingly, and not reading performance. BOOKS correlates .169 for MATH, .124 for READ, and .128 for SCIE. Thus although the complete effect is strongest in READ, it is noted that math performance is most benefitted by solely having more books in the home.

Conclusion & Discussion

In this paper was researched whether the amount of books in a students' home benefits their academic performance, measured as reading performance, science performance, and mathematics performance. The sample for the study consisted of 4765 Dutch students and data was derived from the 2018 PISA round. It was expected and argued that having more books at home would increase the chance a student becomes engaged with reading, which is recorded to positively affect academic performance. The first hypothesis of the study was created to test this prediction. The results of the study show that a greater amount of books at home indeed contribute to academic performance of all three kinds, and that this relationship is mediated by reading engagement. This hypothesis is therefore retained. The second hypothesis predicted that of the three performance areas, the effect

of hypothesis 1 would be strongest for reading performance, given the obvious ties between books, and reading. Indeed, books at home and reading engagement together predict reading performance the strongest of the three academic performance measures. The second hypothesis can therefore also be retained. However, it was found that mathematic performance benefits the most from just having more books at home, without the effect of reading engagement. This finding implies that there exist (an)other mediator(s) between books at home and mathematics performance. Future research could labor to uncover what these mediators might be. Perhaps books are the parents' status symbol, causing for a increased effort of their children in mathematics, the academic area which is most likely to result in the acquirement of higher status (finance, IT, science jobs), as the child seeks to emulate the parent. Research on mediators for books at home and academic performance is an inexhausted area.

A valuable finding is the consistent value of reading engagement in relation to the academic performance measures. Thus far, reading engagement had not been unequivocally related to academic performance. It had been related to reading performance only (OECD², 2018), or only half of the concept (reading enjoyment or reading practices) had been related to academic performance measures. (Galik, 1999; and Whitten, 2016 on enjoyment; Fransisco & Madrao, 2019; and Keeves 1972; as found in Bradley et al., 1988 on reading practices). The current study solidifies the importance of reading engagement in relationship to academic performance, with a complete measurement of the concept and convincing results.

A strange finding was the recurring negative coefficient of wellbeing in relation to academic performance, albeit insignificant in some cases. Bücken et al. (2018) note that although subjective wellbeing is found to be statistically significant in relationship to academic performance, the relationship is not absolute. High performing students do not necessarily report high wellbeing and low performing students do not necessarily report low wellbeing. The inconsistency of wellbeing in the current study is attributed to this finding. Apart from wellbeing, no noteworthy unexpected findings occurred in the study.

The findings of the study are of aid to Dutch government officials and educational professionals who seek to improve the academic performance of Dutch students, which has worsened over the recent years. The study also helps in the process of combatting educational inequalities. Seeing that books are a valuable resource in students' homes, officials could strive to ensure book access is a reality for students of all income strata. Programs and funding for supplying lower income parents with books could be initiated based on this study's findings of the significant effect of having books at home on reading engagement and academic performance. Furthermore, although the study focused only on Dutch students, it can be argued that governments worldwide can make use of the study's findings. Books, reading and education are inseparably related in educational systems across the globe, and so the value of books at home is expected to be universal. Indeed, a quick SPSS analysis on the entirety of the PISA data, undifferentiated per country, shows that books at home and reading engagement affect academic performance throughout. Future research might test the relationship in different country contexts, seeing that context might matter in this relationship. A location where literature is hard to come by is likely to produce a greater effect for books at home, given the advantage book owners here would have over their peers. This in contrast to The Netherlands, a wealthy country where books are accessible at school, libraries, and digitally, if not on the shelves at home. A final suggestion for future researchers would be to identify the impact of E-Book readers and online reading in relation to academic performance. PISA 2018 already found that print book readers read better and more than digital book readers (OECD², 2018). With digital reading increasing, it could be studies what its effects are for academic performance.

To conclude, the study contributes to literature on the home environment, reading, and academic performance. Home environment literature had, as of yet, not not included books as a

potential and significant contributor to academic success. Reading engagement evidence for performance was also thin spread. The current study aids both areas. Furthermore, books within the home environment is a fruitful subject for future research, as investigation on potential mediators besides reading engagement is lacking. Books at home could arguably and reasonably also be related to other outcome measures such as academic achievement motivation and attitudes towards school and learning, to name some examples.

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