The effect of early entrepreneurship education

Evidence from a randomized field experiment

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The aim of this study is to analyze the effectiveness of *early* entrepreneurship education. To this end, we conduct a randomized field experiment to evaluate a leading entrepreneurship education program that is taught worldwide in the final grade of primary school. We focus on pupils' development of relevant skill sets for entrepreneurial activity, both cognitive and non-cognitive. The results indicate that cognitive entrepreneurial skills are unaffected by the program. However, the program has a robust positive effect on non-cognitive entrepreneurial skills. This is surprising since previous evaluations found zero or negative effects. Because these earlier studies all pertain to education for adolescents, our result tentatively suggests that non-cognitive entrepreneurial skills are best developed at an early age.

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1 Introduction

In the past decade policy makers and - more cautiously - economists have labeled entrepreneurship as one of the key factors to increase economic growth and innovation. In the wake of this development entrepreneurship education programs are proliferating all over the world, as these are considered a way of fostering successful entrepreneurial activity. The mission of these programs, ranging from primary schools to universities, is usually threefold. The first aim is to develop knowledge and a variety of cognitive and non-cognitive entrepreneurial skills.[1] Especially non-cognitive skills, such as persistence, creativity and pro-activity, are increasingly relevant determinants of labor market outcomes in general (Heckman et al., 2000; Gensowski et al., 2011), not just for entrepreneurs. The second aim of most programs is to (possibly selectively) increase awareness of entrepreneurship as a possible career opportunity. Finally, the programs provide pupils and students with the opportunity to assess whether entrepreneurship is a suitable occupation for them. Achieving this set of objectives should ultimately result in an increase of successful entrepreneurial activity and a reduction of the costs associated with unsuccessful start-ups (EU, 2006). Thus, a relevant research question is whether entrepreneurship education programs are effective in reaching their stated goals.

In recent years a number of evaluation studies have addressed this question. All of these measure the effectiveness of entrepreneurship programs aimed at adolescents in secondary or higher education and most of them focus on the impact on entrepreneurial intentions only. The results obtained are mixed. Some studies find positive effects on entrepreneurial intentions (Peterman and Kennedy, 2003; Souitaris et al., 2007), while others find no or even a negative effect (Oosterbeek et al., 2010; von Graevenitz et al., 2010).[2] Part of the explanation for the mixed findings might be that the two studies finding a positive effect are based on non-random assignment; self-selection may then lead to an upwardly biased estimate of the program's impact. Only Oosterbeek et al. (2010) measure the impact on the development of entrepreneurial competencies, besides intentions. They find insignificant effects for a student mini-company program that is part of the international 'Young Enterprise' program offered by the Junior Achievement Worldwide network.[3]

A potential explanation for the non-positive outcomes established in this small literature based on studies of programs in secondary and higher education is provided by Cunha and Heckman (2007)'s model of the technology of skill formation. This model emphasizes the importance of early investment in both cognitive and non-cognitive skills. An investment

[1] Unger et al. (2011) have shown that task related human capital is important for entrepreneurial success.

[2] von Graevenitz et al. (2010) develop a formal Bayesian updating model to explain the mixed findings on entrepreneurial intentions and predict that program participation causes a sorting effect among students with different entrepreneurial abilities. Those students who discover to be less suitable for becoming an entrepreneur will have lower intentions after the program than those who receive positive signals during the course. They find empirical support for their sorting prediction.

[3] Recent studies by Karlan and Valdivia (2011) and Fairlie et al. (2012), using randomized experimental designs, report mixed results on the impact of entrepreneurship training for entrepreneurs. Karlan and Valdivia (2011) find positive effects on business knowledge. However, neither of the studies finds an (positive) impact of entrepreneurship training on business outcomes.

in skills not only has a direct impact on the current stock of skills; it also produces higher skill levels in subsequent periods by boosting current skills (*self-productivity* of skills) and makes investments later in life more productive (*dynamic complementarity*). Investments in entrepreneurial skills (only) at the age of around 20 might thus be too late.

Estimates of Cunha and Heckman (2007)'s model have been produced by Cunha and Heckman (2008) and Cunha et al. (2010), both using the Children of the National Longitudinal Survey of Youth from 1979. The first assumes a linear technology and finds that investments affect cognitive skills more at younger ages (6-8 years old) than at older ages (9 to 13). Investments in non-cognitive skills are most effective in middle childhood (9 to 11 years old). Cunha et al. (2010) estimate a non-linear technology and find that self-productivity becomes stronger when children get older. This also holds for the complementarity between cognitive skills and investment. Yet for non-cognitive skills dynamic complementarity slightly decreases with children's age. Together these findings suggest that it is somewhat easier to remediate lower skill levels by later investments for non-cognitive than for cognitive skills. The optimal timing of investment in skills is not easily determined though, as it depends on the returns to early relative to late investment, the outcome being targeted, and the costs of remediating the forgone early investments later in life.

Pfeiffer and Reuss (2008) use a simulation model calibrated to German data to get an idea of the financial returns to investments in skills over the life cycle that the Cunha and Heckman (2007) model may imply. Consistent with the predictions by Knudsen et al. (2006) and Borghans et al. (2008), self-productivity and direct complementarity are assumed to differ between cognitive and non-cognitive skills. In early childhood these are higher for cognitive skills, but from late childhood (10-11 years old) onwards this is the other way around. As a result, investments in cognitive skills are relatively more important during the pre-school years, whereas the school years play an important role in the development of non-cognitive skills. Because the positive complementarities decrease over time, the analysis of Pfeiffer and Reuss (2008) also suggests that additional investments in pre-school and primary school yield higher returns than investment impulses in secondary or tertiary education. Obviously, these (potential) benefits of self-productivity and complementarity only turn up if early investment has an immediate impact on the stock of skills in the first place. It is the latter question that we address with our field experiment.

In this paper we evaluate the *direct* (short term) effect of early entrepreneurship education on the development of cognitive and non-cognitive entrepreneurial skills and entrepreneurial intentions. We report the results from a randomized field experiment using *BizWorld*, one of the leading, internationally renowned entrepreneurship education programs for primary schools. BizWorld aims to teach children aged 11-12 the basics of business and entrepreneurship and to promote teamwork and leadership in the classroom through an experiential learning program that takes five days (within a time span of 2-4 weeks). Our sample consists of 63 different primary schools (118 classes, 2,751 pupils) in the western part of the Netherlands that voluntarily signed up for the BizWorld program

in 2010 and/or 2011. We were at liberty to randomly assign these schools and classes to either the treatment or the control group. In both treatment and control we used a pre-test-post-test design, allowing an (unbiased) difference-in-differences estimate of the net treatment effect.

Our findings indicate that the BizWorld program has a significantly positive effect on non-cognitive entrepreneurial skills. On average, the skill levels in the treatment group increase to a larger extent than in the control group for all nine skills tested. The results are significant for seven skills. Self-reported scores on (constructs of) *Self-Efficacy*, *Need for Achievement*, *Risk Taking*, *Persistence*, *Analyzing*, *Pro-activity* and *Creativity* all increase significantly more in the treatment group than in the control group. Compared to the results found by Oosterbeek et al. (2010), this tentatively suggests that it might be more efficient to invest in the development of entrepreneurial skills of children rather than of adolescents. On top of the larger immediate (short term) impact that we measure, the empirical literature on the technology of skill formation inspired by Cunha and Heckman (2007) suggests that early investments may also have positive spill-over effects to later periods (which we cannot measure).

For cognitive entrepreneurial skills, i.e., entrepreneurship knowledge, we do not find a significant impact of the program. Our results also indicate that, if anything, the program has a negative effect on the entrepreneurial intentions of children.

Our study's contribution is based on three defining characteristics. To the best of our knowledge this is the first study to look at the effects of entrepreneurship education on children (aged 11 or 12) in primary school. All existing studies concern adolescents. Moreover, unlike most previous studies we focus on the development of both cognitive and non-cognitive entrepreneurial skills. By conducting a randomized field experiment, we are able to estimate the unbiased (short term) effect of early entrepreneurship education on these skills.

The remainder of this paper is structured as follows. In Section 2 we describe the entrepreneurship education program and its context. The research design is described in Section 3. Section 4 reports the empirical findings. In Section 5 we summarize and conclude.

2 Program and context

The entrepreneurship education program evaluated in this study is called BizWorld. It is worldwide one of the leading entrepreneurship education programs for primary schools.[4] The program originated in the United States in the late 1990's and over 350.000 children from 84 countries have participated since then.

The duration of the program is five days in a period of 2-4 weeks. The lessons, all five with a practical orientation, lead the participating pupils through a firm's business cycle

[4] A similar international program is the 'Young Enterprise' program offered by the Junior Achievement Worldwide network.

Figure 1: Course material

from start-up to liquidation. Only the first day starts with a theoretical introduction on entrepreneurship. At the start of the practical part on the first day, the teacher divides the class into teams of five or six children. Each child then writes an application letter applying for his/her preferred role within their team. The positions to be fulfilled are: General Manager (CEO), Finance Director (CFO), Director of Product Design, Director of Manufacturing, Marketing Director, and Sales Director. The teacher matches the candidates to positions based on their knowledge of the child, the child's application letter and the job descriptions provided in the course guidelines. Team members fulfill their specific roles besides working (and learning) together as a team.

On the second day, each team has to think of a company name, officially register their company with the "Chamber of Commerce", formulate a business plan and present this to a "venture capitalist".[5] Companies sell stocks -where stock prices are determined based on the assessed quality of the business plan- to raise funding to cover the costs of the design and production process. The game's currency is 'BizEuros' instead of actual Euros.

The third day is devoted to design, procurement and production. The available raw materials for sale (see Figure 1) are most suitable for producing friendship bracelets, although bookmarks or key or phone cords are alternative possibilities. Production is prepared intensively because production time is limited (to one hour). After having calculated production costs, including salaries, raw materials and rent, the companies determine the sales price.

The fourth day is used for preparing the marketing campaign, which consists of a poster, the store presentation and a "commercial" (i.e., a two minute stage play). On this day, the products are also sold to the children in the grade below, usually at an organized fair. The buyers all have a fixed amount of BizEuro's to spend. Before the sale starts, each team is given the opportunity to present their product by means of their "commercial" in front of the group of prospective buyers. After the sales market is over, revenues are calculated. The balance sheet and profit and loss statement are prepared and checked during the fifth and final day of the program. At the end of this day the team that was

[5]Most of the official agencies having a role in the BizWorld program, such as the Chamber of Commerce, bank, venture capitalist, etc. are represented by the teacher.

most successful, in the sense that it has created the highest company value, wins. A small gift for the winning team is usually provided by the entrepreneur or company sponsoring the program. Moreover, the BizWorld foundation provides each member of the winning team with a winning team certificate. In general, children are very motivated to win.

Usually, a couple of weeks before the program starts the course materials for the teacher, containing all the details about the education program, are handed out during a two hour train-the-trainer session. The guidelines for the program are very strict and described in detail in the instruction manual which is part of the course material. Additionally, instruction videos are available on the BizWorld website, to give the teacher a preview of the course content.[6]

Our study includes schools in (the western part of) the Netherlands. The Dutch BizWorld program started in 2004 and approximately 25.000 children have since then participated. An addition to the original program from the United States is that the in the Dutch program the course is taught by an entrepreneur in cooperation with the teacher. The entrepreneur brings real life examples and experiences into the classroom, which makes the project more realistic and special. Furthermore, the Dutch program is externally funded (sponsored by companies and/or subsidized by the government) and is therefore free of charge for the schools.

In The Netherlands, all classes in the last grade of all primary schools -whether private or public- are eligible for BizWorld. Schools usually get in touch with the program through BizWorld marketing campaigns (i.e., BizWorld sending letters to schools to invite them to participate) or through sponsoring entrepreneurs or companies (from the neighborhood for instance). In general the BizWorld Foundation matches schools and sponsoring entrepreneurs willing to participate. Thus, financial or network constraints do not hinder schools' participation in the program.

Most schools have either one or two (parallel) classes in last grade. In general, the voluntary decision to participate in the program is taken at the school level (for all classes in the last grade), although it is possible that one class in a school does participate, whereas the other does not. The minimum level of participation is an entire class, i.e., individual pupils or teams cannot participate. Schools sign up at the beginning of each school year (before January).

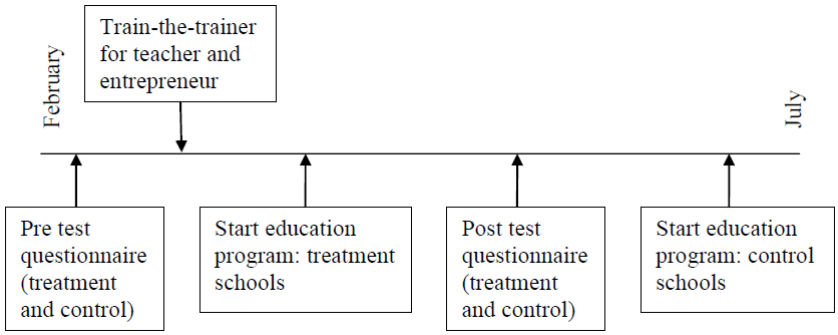
3 Data and methodology

3.1 Design of the field experiment

To estimate the impact of BizWorld on the development of pupils' entrepreneurial skills and intentions, a randomized field experiment was conducted between February and July in 2010, and again during the same period in 2011. In January of both years the BizWorld

[6] See: www.bizworld.org/teachers/index.php or www.bizworld-nederland.nl/C100-3-Dag-1-Ontwerpdag.html

Figure 2: Time line field experiment



foundation provided us with a list of Dutch schools that planned on participating in the program next spring. In total, 120 schools signed up in 2010 (58 in the western part of the country) and 153 schools in 2011 (55 in the western part). We focus on schools close to Amsterdam, i.e. where our University is located, in the densely populated western part of the country (where 37% of the population lives), to be able to monitor each school closely.

Due to the endogeneity of the participation choice at the school level, it is not possible to compare schools that chose to participate with schools that did not sign up for the program. Therefore, the schools or classes in the treatment group *and* in the control group were randomly selected from the group of schools that signed up for the program. Thus we assure that all schools in our sample have the same predisposition towards entrepreneurship (education).[7] Random assignment to the treatment or control group takes place at the class level. Hence, for schools with more than one class in the final grade it is possible that one class was assigned to the treatment group and the other class to the control group.[8]

Classes assigned to the control group were not excluded from participating in the education program. We merely exploited the fact that the period in which the lessons were to be conducted was flexible (i.e., somewhere between March and July). After we had completed the random assignment, the actual dates for the program were determined by mutual agreement between the teacher and the entrepreneur. In the classes in the control group the program was taught a month or two later than in the classes in the treatment group, leaving enough time in between to fill out two questionnaires prior to the start of the program. The timing of the field experiment within one year is shown in Figure 2.

To gather the required information for determining the effect of the education program, all pupils had to complete two extensive questionnaires, measuring not only entrepreneurial skills and intentions but also a wide array of individual background characteristics. The first questionnaire, accompanied by a letter including some information for the parents about the research project, was sent out to all schools in the sample at the same time (in February of both years). Schools were demanded to have their pupils fill out the

[7] This means that if there is self-selection with respect to the participation in the program, it is only at the school level. This can, at most, affect the external validity of our results, not the internal validity.

[8] Overall there are eight schools in the sample where, within one year, one of the classes was part of the treatment group and another class was part of the control group.

questionnaire as soon as possible and we explained to those schools in the control group the purpose and importance of a control group in this type of research.

During the train-the-trainer session for teachers and entrepreneurs prior to the program, the details of the research project were extensively explained and discussed. Moreover, it was emphasized that the teachers and entrepreneurs should not deviate from the course content described in the instruction manual. We visited every school after they had finished the education program to check their compliance with the course guidelines and to encourage response to the second questionnaire.

The second questionnaire was sent out to both treatment and control schools leaving approximately the same time span between the two questionnaires for both groups. For the control group we emphasized that the questionnaires had to be completed before the start of the education program, i.e., before the first introductory lesson. The pupils of the treatment schools were asked to fill out the second questionnaire after the program.

This research design has some drawbacks. Most prominently, we cannot measure long term treatment effects due to the fact that all children in our sample eventually participate in the program.

3.2 Sample

All schools that signed up for BizWorld in the western part of the Netherlands, i.e., 58 and 55 in 2010 and 2011 respectively, were contacted by the beginning of February in the respective years. We informed them about and invited them to participate in the research project. In total, of the 58 (55) schools in our research population 12 (16) schools refused participation in 2010 (2011).[9] Our resulting sample consists of $46 + 39 = 85$ schools consisting of $64 + 54 = 118$ classes and 2,751 pupils in the last grade ($2010 + 2011$).[10] Because the program is executed at the class level, we treat classes as the unit of observation, not schools. We shall perform robustness checks though to assess the validity of this practice.[11]

Table 1 shows that we randomly assigned 77 classes to the treatment group and 41 classes to the control group (Column 1). However, some classes had to be switched from the control group to the treatment group or the other way around after the initial assignment (but before the start of the program). Teachers and entrepreneurs often met for the first time at the train-the-trainer session and planned the dates for the program there. Sometimes, their joint calendars didn't allow participation in the assigned control group (21 classes)

[9] In 2010 (2011), 3 (4) had objections against the research project and 9 (6) schools eventually decided to drop out of the education program. In 2011 another 6 schools were disqualified from the sample because they had already started the education program before we could send them the first questionnaire.

[10] At the school level there was an overlap between 2010 and 2011 resulting in a sample of 63 different schools.

[11] The validity check will address the possible effects of assuming independence of observations at the class level (i) of multiple class observations within one school in the same year and (ii) within schools that participated twice (2010 and 2011). Appendix Table A1 shows the distribution of schools in the sample with one, two and more classes that participated in one or both years in the program.

Table 1: Sample composition

	classes		**pupils**	
	initial assignment	final participation	Full sample	Final sample
Treatment	77	85	2001	1729
Control	41	33	750	684
Total	118	118	2751	2413

or treatment group (13 classes).[12] The second column of Table 1 shows the realized sizes of the treatment (85 classes) and the control group (33 classes), whereas the right hand side of the table (Column 3 and 4) shows the distribution of *pupils* over the treatment and control groups (1,729 versus 684 in the final sample). The full sample consists of 2,751 pupils who have filled out at least one of the two questionnaires, whereas the final sample only includes those pupils who have filled out both questionnaires (n=2,413).[13] The overall response rate is $87,7\%$. Because we are interested in the development of individuals over time, our final sample consists only of the observations of those children for whom we have received both questionnaires.

3.2.1 Internal Validity

An important assumption underlying the validity of our (difference-in-difference) estimation is the random assignment to the treatment and control group. In theory, our procedure should have resulted in random assignment of children with different (observed and unobserved) characteristics to the two groups in our sample at $t = 0$. However, our research design could be contaminated by the two changes that occurred between our initial random treatment assignment and the final treatment participation (see Table 1): (i) The reshuffling of classes between the treatment and control group after the initial assignment and (ii) attrition in our sample between the pre- and post-measurements that could possibly be selective.

To test whether there are any systematic differences between the treatment and the control group prior to the start of the program, we compare the observed characteristics of the individuals in the treatment and control groups in the final sample. There are hardly any differences in the pre-treatment outcome variables and background characteristics between the treatment and the control group, see Table 2 Columns (9-11).[14]

[12] For participation in the control group the program should be planned later in the Spring such that the second questionnaire could be filled out before the start of the program. On the contrary, for participation in the treatment group the program should be run sufficiently early in the Spring semester leaving enough time between the end of the program and the summer holidays to complete the second questionnaire.

[13] In 2010 all classes returned the pre-treatment questionnaires and only one class did not fill out the second questionnaire. In 2011 the first questionnaire was missing for one class, and the second for four classes. Some questionnaires were missing in both years due to the absenteeism of individual children at 'test' days.

[14] The only significant difference is that a larger part of the children attending Roman Catholic schools is part of the treatment group, whereas a larger part of the children attending Protestant schools has been (accidentally) assigned to the control group. The percentage of children attending public schools,

In addition, we perform a specific test addressing the potential problem of non-random reshuffling of classes from the treatment to the control group or vice versa after the initial assignment. We re-estimate the main specification using an instrumental variables (IV) estimation with the initial treatment assignment as an instrument for receiving treatment. Section 4 will show that the results are qualitatively the same, albeit weaker than the main results. Furthermore, Table 2 enables a comparison of the pre-treatment differences between the full and the final sample. The results show no evidence of selective attrition.

Finally, we also checked with the teachers whether the children in the control group were not systematically engaged in activities specifically aimed at changing their entrepreneurial skills, knowledge and intentions at the time of our field experiment. We acknowledge that this would be unlikely, especially given the fact that they intend to participate in the treatment program a bit later. Indeed, the check confirms that this is not the case.[15]

We conclude that there are no observed pre-treatment differences between the treatment and control group. Hence, our random assignment was not contaminated by the reshuffling of classes from the treatment to the control group after the initial random assignment nor by selective attrition, ensuring us that the estimated treatment effect is indeed causal. Furthermore, we are confident that the measured treatment effects are not biased (downwards) due to the engagement in the same kind of program by classes in the control sample.

3.2.2 External Validity

The external validity of our study could be limited for two reasons. First, the execution of the program might be a-typical in this sample due to the research project. Second, the sample itself might not be representative for the population studied. With respect to the program there is little we can test. However, the large number of schools involved in the project and our small influence on the execution practice makes us confident that the program tested is very similar to the general practice in The Netherlands. We admit, though, that the program is slightly different in The Netherlands from elsewhere, for instance in the United States, where the involvement of entrepreneurs is lacking.

Concerning the representativeness of the sample (for the Dutch population of school kids in the last grade of primary school) we test whether there are statistical differences between our sample and the population in terms of standard individual background characteristics, school characteristics and neighborhood characteristics.[16] We collected information on those characteristics by means of the questionnaires, schools' websites and Statistics Netherlands, respectively.

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however, is the same for both groups. We compared the (observed) individual characteristics of the children going to Roman-Catholic and Protestant schools and we found no significant pre-treatment differences between these two groups.

[15] There were two exceptions: in 2010 one school participated in a micro-finance program in the month prior to the entrepreneurship education program (i.e., at the time the pre-test was completed). In 2011 another school was part of an entrepreneurial primary school project (not specifically designed for the children in the last grade). We also estimated the treatment effect without these schools and confirmed that the results remain the same.

[16] Each neighborhood is characterized by a four-digit postal code (see www.cbsinuwbuurt.nl).

Table 2: Pre-treatment differences between the treatment and the control group

	Total sample		**Full sample**				**Final sample**				
	Treatm. + Contr.	Control	Treatment	diff (T-C)	SE	p-value	Control	Treatment	diff (T-C)	SE	p-value
Entrepreneur Competencies:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Self-Efficacy	4.157	4.151	4.159	0.0077	(0.064)	0.904	4.137	4.164	0.0272	(0.066)	0.682
Need for Achievement	4.542	4.545	4.541	-0.0040	(0.082)	0.962	4.542	4.540	-0.0017	(0.085)	0.984
Risk Taking	4.415	4.386	4.425	0.0387	(0.075)	0.605	4.368	4.417	0.0491	(0.076)	0.522
Social Orientation	5.041	4.994	5.058	0.0644	(0.072)	0.372	4.986	5.063	0.0765	(0.075)	0.309
Persistence	4.899	4.937	4.884	-0.0527	(0.065)	0.423	4.934	4.886	-0.0480	(0.068)	0.484
Motivating	4.856	4.846	4.860	0.0139	(0.064)	0.827	4.834	4.863	0.0297	(0.069)	0.666
Analyzing	4.219	4.202	4.225	0.0221	(0.068)	0.747	4.193	4.228	0.0349	(0.073)	0.632
Pro-activity	4.574	4.558	4.580	0.0212	(0.067)	0.751	4.562	4.572	0.0094	(0.067)	0.889
Creativity	4.361	4.303	4.382	0.0786	(0.079)	0.323	4.293	4.385	0.0919	(0.081)	0.260
Intentions and knowledge:											
% Entrepreneur intentions	0.249	0.267	0.243	-0.0238	(0.021)	0.260	0.276	0.250	-0.0265	(0.022)	0.238
Own business (0: no, 1: maybe, 2:yes)	1.126	1.098	1.137	0.039	(0.033)	0.237	1.083	1.140	0.056	(0.034)	0.098*
% Entrepreneurship knowledge	0.729	0.729	0.729	-0.0003	(0.019)	0.987	0.755	0.746	-0.0088	(0.017)	0.613
Background (individual)											
% female	0.503	0.497	0.506	0.0091	(0.020)	0.650	0.499	0.510	0.0113	(0.020)	0.577
Age pre-test	11.625	11.650	11.616	-0.0343	(0.033)	0.305	11.642	11.610	-0.0317	(0.035)	0.371
High school track (1: pre-voc - 5: pre-uni)	2.946	2.930	2.952	0.0219	(0.133)	0.869	2.951	2.952	0.0013	(0.136)	0.993
Nationality parents: Both non-dutch	0.322	0.360	0.308	-0.0522	(0.062)	0.405	0.336	0.280	-0.0563	(0.064)	0.380
% mother entrepreneur	0.075	0.076	0.074	-0.0015	(0.014)	0.910	0.082	0.076	-0.0061	(0.015)	0.675
% father entrepreneur	0.152	0.136	0.158	0.0219	(0.021)	0.297	0.146	0.165	0.0186	(0.022)	0.406
Education mother (1: uni - 4: no high school)	2.059	2.015	2.076	0.0605	(0.097)	0.535	2.029	2.074	0.0454	(0.099)	0.649
Education father (1: uni - 4: no high school)	1.923	1.930	1.929	-0.0013	(0.078)	0.987	1.913	1.927	0.0200	(0.082)	0.809
Number of observations	2751	750	2001				684	1729			
Background (school)											
Class size	24.25	23.82	24.41	0.5968	(1.076)	0.581	24.04	24.44	0.403	(1.053)	0.703
Roman Catholic	0.285	0.113	0.350	0.2365	(0.089)	0.01***	0.117	0.359	0.242	(0.091)	0.01***
Protestant	0.366	0.495	0.318	-0.1763	(0.121)	0.150	0.515	0.302	-0.213	(0.120)	0.081*
Public	0.282	0.282	0.281	-0.0013	(0.095)	0.989	0.265	0.290	0.025	(0.095)	0.793
Other religion (Islam, Hindu)	0.056	0.091	0.043	-0.0472	(0.037)	0.201	0.099	0.050	-0.049	(0.040)	0.227
Neighborhood characteristics (based on 4-digit postal code)											
Average income per year in €	20148	19848	20260	411.97	(943.29)	0.664	19985	20212	226.41	(958.34)	0.814
Number of observations	63	26	51				25	48			

Note: */**/*** indicates significance at the 10%/5%/1%-level. Observations on individual characteristics are clustered at the class level. School and neighborhood characteristics are clustered at the school level. Robust standard errors in parentheses.

The pre-treatment individual background characteristics for the entire sample are shown in the first column of Table 2. Conform expectation, girls make up 50% of our sample and the average age is 11.5 years. The distribution of the intended future high school track - its measure based upon the pupils' (self-reported) registration in these tracks for the next school year - is also in accordance with the national distribution. Approximately 8% of the mothers of the children in the sample is an entrepreneur and 16% of the fathers run their own business, which is also in line with the countrywide average of 11% and 18% percent among working mothers and fathers, respectively. The percentage of children in our sample with a Dutch background (i.e., whose parents are both born in the Netherlands) is 56%, and somewhat lower than for the population (79%). The fraction of Surinam, Turkish and Moroccan children in our sample is higher, i.e., 8.8%, 3.5% and 4.1% respectively compared to approximately 2% for each of these in the population. This difference could be caused by the limitation of our population to the large urban areas in the western part of the Netherlands, where the ethnic diversity is largest.

At the school level we observe that the average class size in our sample is 24 children, close to the national average of 23.4. The distribution across (religious) denominations of the schools is also representative; 29% of the children in the sample go to Roman-Catholic schools, 37% go to Protestant schools and 28% go to public schools. The school's neighborhood level statistics on income imply that the schools participating in the program are situated in a representative cross section of neighborhoods.[17]

3.3 Main variables

We measure the development of three outcome measures: cognitive entrepreneurial skills, non-cognitive entrepreneurial skills and intentions to become an entrepreneur.

Non-cognitive entrepreneurial skills

Since the early sixties, entrepreneurship researchers have tested which non-cognitive skills are crucial for (successful) entrepreneurship, see for instance Begley and Boyd (1987); Hornaday and Aboud (1971) and McClelland (1965). Two competencies traditionally associated with both entrepreneurial intentions and performance are 'need for achievement' and 'low risk aversion' (see for example Caliendo et al., 2010). Shane (2003) notes that self-efficacy is important for becoming an entrepreneur because confidence in one's own ability increases the willingness to pursue entrepreneurial opportunities. Furthermore, Davidsson and Honig (2003) have shown that social capital, i.e., the ability to benefit from social connections, is important for becoming an entrepreneur as well as for the success rate of making it through the start-up phase. Finally, both Shane (2003, Ch. 5) and, more recently, Parker (2009, Ch. 4), provide an overview of the other psychological factors that are associated with entrepreneurial intentions and success. Table 3 provides an overview of

[17] The average gross income in these neighborhoods is €20.147 per income recipient per year, whereas the national average is €24.100 for couples with children below the age of 18 and €16.100 for single parents with children below the age of 18.

Table 3: Entrepreneurial skills

Entrepreneurial skills	Definition	estimated effect on... *intentions*	*success*	Cronbach's α $t=0$	$t=1$
Self-efficacy	Belief in own ability	+	+	0.63	0.70
Need for achievement	Desire to do well	+	+	0.65	0.73
Risk taking	Predisposition towards risky alternatives	+	$\cap$	0.72	0.78
Social orientation	Ability to make useful connections	+	+	0.58	0.68
Persistence	Ability to continue despite setbacks	+	+	0.56	0.65
Motivating	Ability to inspire or stimulate subordinates	0	+	0.77	0.82
Analyzing	Ability to assess complex situations	0	+	0.53	0.58
Pro-activity	Willingness to take action	+	+	0.54	0.62
Creativity	Ability to create many opportunities	+	+	0.72	0.78

the relationships established in the literature between the non-cognitive skills we measure and entrepreneurial intentions and success.

In our questionnaire we include tests of the following nine non-cognitive skills that are all commonly associated with entrepreneurship. *Self-efficacy* means believing in your own ability, feeling self confident and in control of your own success. *Need for achievement* is the desire to do well in order to attain an inner feeling of personal accomplishment. *Risk taking propensity* reflects the predisposition towards risky alternatives, the willingness to risk a loss and to deal with uncertainty. *Social orientation* is the ability to make useful connections in order to realize (new) ideas. *Persistence* is the ability to continue despite setbacks or objections. *Motivating* is about inspiring and stimulating others. *Analyzing* is the ability to assess different (complex) situations, to find solutions and to make correct, well-balanced choices. *Pro-activity* is the willingness to take action and the ability to tackle problems and execute (new) ideas. *Creativity* refers to the ability to generate many possible solutions to a particular problem and to turn them into new opportunities.

The separate skills presented in Table 3 are not solely important for entrepreneurs, but are powerful predictors of social economic success in general (see Heckman et al., 2000; Gensowski et al., 2011; Borghans et al., 2008). However, as described above, this *combination* of skills is known to be important for successful entrepreneurship.

We measure these entrepreneurial skills using validated self-assessment tests. Self-reported paper and pencil tests are the most widely used measures in personal psychology (Borghans et al., 2008). Recent psychological studies have confirmed the validity of the use of self-assessment tests in middle and late childhood, i.e., for children between 8 and 12 years old (Barbaranelli et al., 2003; McCrae et al., 2002). Our test is based on the one used and further validated by Oosterbeek et al. (2010) and Hoogendoorn et al. (2011). Of course, because our study pertains to children at the age of 11 or 12 instead of (young) adults, we have developed and validated a slightly adapted version of this test. We did so in close collaboration with a child psychologist. Three elements characterize the transformation to the younger target group. First, we shortened the questionnaire by using three

instead of four statements per skill, thus matching the concentration time span of children. Second, we excluded those constructs, such as market awareness, networking skills, etc., that are difficult to relate to as a child. Third, we rephrased the original statements to make them easier for children to understand (see also Barbaranelli et al., 2003). Examples of statements are: "I can encourage other children to do their best" (motivating), "I am able to understand difficult things" (analyzing), "I like to take chances" (risk taking), and "I think I'm good at solving problems" (self-efficacy). Statements had to be answered on a seven-point scale, expressing the extent to which a child agrees with each statement.[18] The Cronbach's α's range from 0.53 to 0.77 in the pre-test ($t = 0$), and from 0.58 to 0.82 in the post-test ($t = 1$) (see the last two columns of Table 3).[19]

The developments in these non-cognitive skills are measured per individual by the change in the score of each construct between $t = 0$ and $t = 1$.

Cognitive entrepreneurial skills

Research has shown that cognitive skills and knowledge are important for entrepreneurial success too (see for example Hartog et al., 2010; Unger et al., 2011). One of the desired results of the BizWorld program is the development of cognitive skills that are relevant for entrepreneurship, in this case knowledge about what an entrepreneur does and what it entails to run a business. A set of seven specific multiple choice questions is used to measure these cognitive skills. Examples are: "If a company makes less revenue by selling products or services than it spends, it will... a) be registered at the stock market, b) make a profit, c) make a loss, d) have debts", and "To set the price of a product you have to take into account... a) how much it costs to make the product, b) how many products can be made in a certain amount of time, c) the price that competitors ask for their products, d) all of the above". The development of these cognitive entrepreneurial skills or knowledge was measured by a change, between $t = 0$ and $t = 1$, in the percentage of correct answers to these questions.[20]

Entrepreneurial intentions

In addition to our main outcome variables, we measure the impact of the program on the

[18] When starting with the development of the test for children, we tested the (internal) validity of our adapted measures by conducting a pilot study consisting of 118 children who participated in the BizWorld program and filled out both pre-test and post-test questionnaires in the fall of 2009. One skill (*Flexibility*, $\alpha = 0.10$) was removed from the questionnaire and another skill (*Need for power*, $\alpha = 0.46$) was replaced by *Need for achievement*.

[19] There are two constructs with low internal validity: Analyzing and Pro-activity, with Cronbach's α of 0.58 and 0.62 respectively at $t = 1$. Furthermore, a principal component analysis to check the independence of the scales revealed that Self-efficacy, Need for Achievement and Pro-activity do not load into separate components/factors, despite the high Cronbach's α for the first two constructs. Given the low internal validity of Pro-activity and its correlation with statements from other constructs, we should be cautious when interpreting the results for this measure.

[20] Three out of the seven questions in the first questionnaire were rephrased in the second questionnaire. For example, instead of asking about making a loss (as in the example question given above), the question was: "If a company makes *more* revenue by selling products or services than it spends, it will... a) be registered at the stock market, b) make a profit, c) make a loss, d) have debts".

children's intentions to become an entrepreneur. Although raising entrepreneurial intentions is not a specific goal of the program, it is one of the main goals of entrepreneurship education in general and it is frequently used as an outcome measure in other impact evaluation studies.

The measurement of entrepreneurial intentions at the age of 12 is difficult and no precedents are available to indicate the validity or predictive power of any such measure. We use two different measures to estimate the change in the intention to start a business as a result of program participation. First, children were asked to select a maximum of three jobs they might like for their future occupation from a list of 22 professions, one of which was 'entrepreneur - (boss in your own company)'. A dummy variable is created to indicate whether entrepreneur was on the list of three. This was the case for a quarter of the sample pre-treatment. The change in intentions is measured by the differences in this (dummy) variable between the first and the second questionnaire.

Our second measure of entrepreneurial intentions is the answer to the question: 'Do you think that you would like to start your own company one day?'; (*yes*, *no* or *maybe)*. We coded this variable in such a way that a change in the answer to this question from *yes* (code 2) to *maybe* (code 1) and from *maybe* to *no* (code 0) is regarded as a similar decrease in entrepreneurial intentions. A change from *yes* to *no* is regarded as a more negative change in intentions. We will interpret the results for intentions with great care for the reasons stated before.

4 Empirical results

4.1 Estimation method

To analyze the effect of the BizWorld program on our outcome variables, a difference-in-differences analysis (DID) is used. The value of the outcome variable of individual i in the treatment group before the start of the program ($t = 0$) is denoted by $y_{Ti,0}$, while $y_{Ti,1}$ gives the corresponding value after the treatment period ($t = 1$). For the control group we use similar notation, i.e., $y_{Ci,0}$ and $y_{Ci,1}$. The difference between the two measures, $\Delta_{Ti} = y_{Ti,1} - y_{Ti,0}$ and $\Delta_{Ci} = y_{Ci,1} - y_{Ci,0}$, reports the changes in the level of each outcome variable between time $t = 0$ and $t = 1$ for an individual in the treatment or the control group respectively. The average change per outcome variable between the pre-test and the post-test of all the children in the treatment and the control group are denoted by Δ_T and Δ_C. Hence, the DID estimate is given by:

$$\delta = \Delta_T - \Delta_C \tag{1}$$

We use the following linear regression model to obtain unbiased estimates of the net treatment effect, δ:

$$\Delta y_i = \alpha + \delta D_i + \epsilon_i \tag{2}$$

Table 4: Treatment effects

	Treatment				Control				**DID no controls**		**DID with controls**	
	(1)	(2)	(3)		(4)	(5)	(6)		(7)		(8)	
Outcome variables	t = 0	t = 1	Δ_T		t = 0	t = 1	Δ_C		δ		δ	
Non-cognitive entrepreneurial skills												
Self-Efficacy	4.16	4.37	0.218***	(0.025)	4.14	4.22	0.075**	(0.035)	0.149***	(0.049)	0.155***	(0.043)
Need for Achievement	4.54	4.78	0.245***	(0.026)	4.54	4.62	0.077**	(0.038)	0.166***	(0.052)	0.158***	(0.054)
Risk Taking	4.41	4.62	0.208***	(0.024)	4.37	4.48	0.111**	(0.044)	0.114**	(0.050)	0.124***	(0.051)
Social Orientation	5.06	5.17	0.108***	(0.025)	4.99	5.06	0.073**	(0.035)	0.063	(0.053)	0.048	(0.053)
Persistence	4.89	4.91	0.026	(0.026)	4.93	4.84	-0.098**	(0.039)	0.105**	(0.050)	0.110**	(0.049)
Motivating	4.87	5.00	0.132***	(0.029)	4.84	4.90	0.065	(0.045)	0.079	(0.055)	0.071	(0.056)
Analyzing	4.23	4.45	0.223***	(0.025)	4.20	4.30	0.107***	(0.035)	0.127***	(0.044)	0.135***	(0.048)
Pro-activity	4.57	4.70	0.136***	(0.025)	4.57	4.56	-0.009	(0.036)	0.144***	(0.050)	0.166***	(0.045)
Creativity	4.38	4.60	0.216***	(0.029)	4.30	4.45	0.155***	(0.043)	0.096*	(0.052)	0.114**	(0.054)
Cognitive entrepreneurial skills	0.75	0.79	0.040***	(0.006)	0.75	0.77	0.019**	(0.009)	0.015	(0.014)	0.0098	(0.013)
Entrepreneurial intentions												
Future job: entrepreneur (0/1)	0.25	0.25	-0.004	(0.011)	0.28	0.30	0.023	(0.018)	-0.027	(0.025)	-0.034	(0.023)
Own Business (0-2)	1.14	1.05	-0.094***	(0.015)	1.08	1.15	0.070***	(0.023)	-0.134***	(0.031)	-0.136***	(0.032)
Number of observations	1729	1729			684	684			2351		2304	

Note: The estimates in each cell come from separate regressions. Observations clustered at the class level, robust standard errors in parentheses. All regressions control for the baseline level of the outcome variable. DID with controls includes individual characteristics: age, gender, future high school track, nationality parents, parents entrepreneurial status; school/neighborhood characteristics: class size, school denomination, avg. income per year and a year dummy for 2010/2011. */**/*** indicates significance at the 10%/5%/1%-level.

Here Δy_i denotes the individual change in outcome variable y, D_i is a dummy variable which takes the value 1 if individual i was part of the treatment group and ϵ_i is an error term. In all our estimations we control for the baseline level of the outcome variable to correct for a potential ceiling effect (i.e., if your initial score or skill level is high, there is less room for improvement as a result of the treatment). Furthermore, because the results for children in the same class are potentially correlated, we cluster the observations per class, to obtain estimations with robust standard errors. To confirm the robustness of the estimated coefficients from Equation (2), we will also estimate the model with a vector of control variables (X_i) such as age, gender, parental entrepreneurial activity, etc.

4.2 Main results

The results for the DID estimation of Equation (2) are shown in Table 4. The mean values for the outcome variables at $t = 0$ and $t = 1$ are shown for both the treatment (Columns 1 and 2) and the control group (Columns 4 and 5). Columns 7 and 8 of Table 4 show the net treatment effect, δ, and the robust standard errors in parentheses.

Non-cognitive entrepreneurial skills

The results in Table 4 show that all but one of the non-cognitive skills increase significantly between $t = 0$ and $t = 1$ within the treatment group. The only exception is *Persistence* for which the difference is positive, but not significant. In the control group six of the non-cognitive skills change positively and significantly in the same period. *Motivating* and *Pro-activity* do not show a significant change and *Persistence* decreases significantly for the children in the control group. The fact that the children in the control group also develop their skills in this time frame shows that they do not spend the time that the treated children spend on the program idly. They develop their non-cognitive skills through the regular lessons offered. This emphasizes the importance of a control group in our research design.

The results for the DID analysis show that the difference in development between the treatment and the control group is positive for all non-cognitive skills. The change in these outcome variables is larger in the treatment group than the control group. The treatment effect is statistically significant for seven out of the nine skills: *Self-Efficacy*, *Need for Achievement*, *Risk taking propensity*, *Persistence*, *Analyzing*, *Creativity* and *Pro-activity*.[21] The last column (Column 8) of Table 4 shows that the treatment effects remain the same or increase slightly when we control for individual, school and neighborhood characteristics as well as the year of the data collection.[22]

Cognitive entrepreneurial skills

The estimated effect on cognitive entrepreneurial skills, or entrepreneurship knowledge, can

[21] Note that the internal validity of the *Pro-activity* measure is low and requires careful interpretation of the results for this measure.

[22] See Table A3 in the Appendix for the detailed estimation results pertaining to the controls.

also be found in Table 4.[23] Both within the treatment group as well as in the control group there is a significant increase in the percentage of correct answers between $t = 0$ and $t = 1$. The increase is slightly larger in the treatment than in the control group, which results in a positive, yet insignificant, estimate of the net treatment effect (δ). The picture remains unchanged when we include the set of control variables. Therefore, the program does not seem to have the intended effect on the development of entrepreneurship knowledge.

Entrepreneurial intentions

The results for the first intention measure, i.e., future job choice, show that the intention towards becoming an entrepreneur decreases slightly within the treatment group and increases slightly within the control group between $t = 0$ and $t = 1$. This results in a negative though insignificant estimate of the net treatment effect. The result holds when controlling for individual, school and neighborhood characteristics.

The results from the second measure show that the intention to start a business some time in the future decreases significantly for the children in the treatment group, whereas the children in the control group show a significant positive change in this intention. Therefore, the DID estimate for this intention measure (from both equations) is significantly negative. Thus, in line with the results found by Oosterbeek et al. (2010), we find that, if anything, this entrepreneurship education program has a negative effect on the intention towards becoming an entrepreneur. As mentioned before, due to the lack of validated measures of entrepreneurial intentions for children, we treat these results with caution.

4.3 Robustness checks

The results from the previous section show that our findings are robust when we include a variety of individual, school and neighborhood characteristics. We perform five more robustness checks.

First, as announced, we use the initial treatment assignment as an instrument for receiving treatment and estimate the main equation by means of Instrumental Variables (IV) estimation. In doing so we test whether the switches from treatment to control group and vice versa after the initial assignment but before the start of the program, are random. The results for the IV estimation are shown in Table A6 in the Appendix.[24] For most of the outcome variables they are qualitatively similar to the regular DID estimates.[25] Based on a Hausman test for the endogeneity of regressors we cannot reject the null hypothesis of exogenous variables. This confirms that the actual treatment participation is exogenous (i.e., random).

[23] The detailed estimation results for cognitive skills and entrepreneurial intentions are shown in Table A2 in the Appendix.

[24] The F-statistic of the first-stage is 12.37 (p-value: 0.00), which is above the generally accepted rule of thumb (of 10) for instrument quality.

[25] The treatment effects remain significant only for two out of the seven non-cognitive skills that showed a significant effect in the original estimation, probably due to the lack of precision (i.e., increased standard errors) associated with IV.

A second robustness check indicates that it is unlikely that our results are influenced by a possible appreciation bias. For example, if the children are very enthusiastic about the program, we might be measuring the children's sheer appreciation of the program instead of actual learning. However, we measure a low positive correlation coefficient between the grade the children assigned to the education program (on a scale of 1-10) to express their appreciation of it, and their skill development, i.e., between 0.05 and 0.13.

Third, we rule out that the effects measured are only very short term and temporary. To this end, we measure if the impact of the time elapsed between the program and the completion of the second questionnaire on our outcome variables is negative. Time elapsed is (imperfectly) measured as the number of days between the start of the program and the day we received the second questionnaire (36 days on average, varying from 13 to 70 days, std. dev. 15 days, while the duration of the program itself was approximately two weeks on average).[26] Evidently, this test only includes the treatment and not the control group. We find that the time elapsed between the education program and the post-test questionnaire does not change our main results.[27]

Fourth, we establish that the (significant) results remain significant when we cluster observations at the school (n=63) instead of at the class level (n=118). Although the children, and in some cases also the teacher, change from one school year to another, one could argue that the observations per school are potentially correlated. The results of these estimations are the same and are shown in Table A4 and A5 in the Appendix.

Fifth, we try to rule out that the treatment effect is driven by the teamwork component of the program rather than the actual entrepreneurship character of it. To this end, we add several team characteristics, such as the mean and the variance of the initial skills (at the team level), to our estimation equations. None of these characteristics turn out to be important in the development of individual cognitive or non-cognitive entrepreneurial skills, nor for the development or changes in entrepreneurial intentions. This test rules out, to some extent, that any sort of program where teams are formed would have established the same learning effects.

4.4 Heterogeneous treatment effects

As a starting point for our analysis of heterogeneous treatment effects we consider the detailed results of our DID estimation (see Tables A2 and A3 in the Appendix) and focus on the control variables that have a significant impact on the outcome variables. For example, the development of cognitive and some non-cognitive entrepreneurial skills are distinct for males and females. For all independent variables that apparently move the intercept, we test whether they are also associated with heterogeneity in effect sizes. In particular, we considered interactions with gender, age, intended high school track, school denomination, year (2010 versus 2011 or both) and the average income in the school's area.

[26] Unfortunately this detailed information was only available for the 2011 sample.

[27] We only find a significant negative time effect on the development of Social orientation (p-value: 0.02), which was not significant in our initial estimation.

A few results are noteworthy and indeed show some heterogeneous effects across groups.

Using the model developed by von Graevenitz et al. (2010), we test whether the change in intention was moderated by a person's entrepreneurial ability. This turned out not to be the case: the change in entrepreneurial intentions due to treatment is the same for children with high and low pre-treatment entrepreneurial ability. We also test the proposition by von Graevenitz et al. (2010) that the decision to become an entrepreneur becomes more defined after the program, i.e., that the variance in the responses (for business ownership intentions) is larger after the program than before. However, the results do not support this proposition either. Thus, we find little evidence of sorting.

Interestingly, the treatment effect (on self-efficacy, creativity and entrepreneurial intentions) for children whose school participated in the program in consecutive years (i.e., where the pupils participated as buyers in the previous school year) is significantly larger. This result could indicate that the impact of the program is larger when the exposure to the program was repeated, though it could also be due to self-selection in the previous year.

Additionally, we looked at the possible effect of some variation in the treatment, like being member of the winning team, or the size of the team, on the change in outcome variables (thus excluding the control group from the sample). One could argue that those children that were part of the winning team put in more effort and therefore learned more. Indeed, we find a significantly positive effect on the development of *Pro-activity*, *Self-efficacy* and the intention to start a business for the children that were member of the winning team. The development of entrepreneurship knowledge, though, is unaffected by being part of the winning team.

Most of the teams consist of five or six children, but team size can vary between four and seven members per team. Despite the greater likelihood of free riding in bigger teams, possibly leading to less active participation, we do not find smaller learning effects for larger teams, nor does team size affect entrepreneurial intentions.

Finally, we establish some heterogeneous treatment effects for the different positions within the team. Most notably, the children performing the roles of General Manager or Financial Director seem to develop their non-cognitive skills the most. However, we cannot claim these differences in treatment effects to be causal since the assignment to these roles was not random, but based on the teacher's selection.

All in all, because we find almost no heterogeneities in treatment effects, we conclude that the effects we establish hold by and large across the board.

5 Conclusion

Given the key role entrepreneurial activity has in fostering economic growth and innovation, the evaluation of measures that may stimulate successful entrepreneurship is of high interest to both academics and practitioners alike. One evident measure that is used world wide and thus worth investigating concerns entrepreneurship education programs. The evaluation

studies that have been performed so far only find modest effects at most. This seems to suggest that these programs are ineffective as a policy tool to promote entrepreneurial intentions or competencies.

However, the focus up till now has been on entrepreneurship programs targeted at adolescents in secondary or higher education. The insignificant effects found there may well be due to the fact that entrepreneurial skills are more easily developed earlier in life or because the returns to training programs later in life depend on investments in entrepreneurial skills made earlier. In fact, the model of skill formation introduced by Cunha and Heckman (2007) emphasizes such dynamic spill-over effects. In this model cognitive and non-cognitive skills are developed during different stages in life, where the skills learned during one period in life (e.g. at primary school) augment the benefits of investments in these competencies in subsequent periods (e.g. at high school or university). Early investments in skills may thus be particularly effective in the long run.

In view of the potential importance of *early* educational investments, we evaluate the immediate (short term) effect of entrepreneurship education on the development of cognitive and non-cognitive entrepreneurial skills of children aged 11-12. We also consider the program's impact on entrepreneurial intentions. By using a randomized field experiment we are able to obtain unbiased estimates. Our main finding indicates that the program has the intended effect; pupils in the treatment group develop their non-cognitive entrepreneurial skills significantly stronger than those in the control group. In particular, they increase their Self-efficacy, Need for achievement, Risk taking propensity and Analyzing skills to a larger extent. Furthermore, they become more Persistent, Pro-active and Creative, even when controlling for a wide variety of individual and school characteristics. Cognitive entrepreneurial skills are unaffected by the program though. Our results on entrepreneurial intentions suggest that, if anything, the program has a negative effect on the children's intention to start their own business. As mentioned before, we interpret these findings with caution because measuring entrepreneurial intentions of children at the age of 11 or 12 is difficult. Since the moment to choose an occupation is still very remote for them, they may not directly link participation in this program to their future career path.

The size of the treatment effects we find are substantial. For instance, children in our treatment group show a significant increase in Creativity of 1.6% compared to the control group (i.e., a DID of 0.114 on a scale from $1-7$). Self efficacy, Risk taking and Need for Achievement increase by 2.2%, 1.8% and 2.3%, respectively. These effect sizes are comparable to being eligible to move up one track level in entering high school (from the base line of pre-vocational secondary education to senior general secondary education).[28]

The program evaluated in our study takes five days and has a significant and quite substantial positive effect on the development of non-cognitive entrepreneurial skills. The program aimed at college students evaluated by Oosterbeek et al. (2010) is more involved in both time and costs and has no discernible effect on entrepreneurial skills development. Together these findings suggest that it is more efficient to invest in the development of

[28] This conclusion follows from a DID estimation using standardized (outcome and explanatory) variables.

entrepreneurial skills of children instead of adolescents; the immediate impact on non-cognitive entrepreneurial skills is larger for the former group. Moreover, as mentioned above, the skills formation literature inspired by Cunha and Heckman (2007) strongly suggests that there are important dynamic spill-over effects in the development of skills over time. It may therefore be likely that the effects of entrepreneurship programs in tertiary education will become larger among people who participated in these programs at a younger age. It thus appears that entrepreneurial skills are best developed already at an early age.

Obviously there are some important caveats to this tentative conclusion. We only evaluate one specific early entrepreneurship program and Oosterbeek et al. (2010) evaluate only one specific program aimed at college students. It may well be the case that results for other programs are different. Moreover, our sample is limited to primary schools in the Netherlands that chose to participate in the program. As these schools may have a certain (positive) predisposition towards entrepreneurship education, the results found in this study are not necessarily valid if the program would be compulsory for all primary schools in the Netherlands, or beyond. Third, our study is almost silent about the *precise* driving force behind our results, i.e., whether it is the content of the educational program, the competitive game or something else. Finally, we do not have data on the long term effects of early entrepreneurship education, so we do not know whether the model of skill formation indeed holds for the development of entrepreneurial skills as well. Unfortunately, we will not be able to use the current sample of children for that purpose. In our design all children eventually participated in the program. Because we did not consider it ethical to exclude children from participating in the program, we had to give up our control group for further research by allowing them to participate after they had filled out both our questionnaires.

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Appendix

Table A1: Composition of classes within the schools across years

# schools	1 year	2 years
1 class	29	10
2 classes	9	11
$>$ 2 classes	2	2

Table A2: Treatment effects Cognitive skills and Intentions (detailed)

	Entrepreneurial intentions		
Δ	Future job: entrepreneur	Own Business	Cognitive entrepreneurial skills
Treatment effect (δ)	-0.03 (0.02)	-0.14 (0.03)	0.01 (0.01)
Background (individual)			
Female	-0.08 (0.02)	-0.08 (0.02)	0.02 (0.01)
Age ($t = 0$)	-0.02 (0.01)	-0.02 (0.02)	-0.006 (0.01)
Parents both not dutch	-0.03 (0.02)	-0.02 (0.03)	-0.03 (0.01)
Mother entrepreneur	0.05 (0.03)	0.10 (0.04)	0.01 (0.02)
Father entrepreneur	0.08 (0.02)	0.16 (0.03)	-0.01 (0.01)
Intention level at $t = 0$	-0.58 (0.02)	-0.56 (0.02)	
Cognitive skill level at $t = 0$			-0.72 (0.03)
High school:			
Pre-University	0.09 (0.03)	0.06 (0.03)	0.16 (0.01)
Pre-Uni and senior general	0.05 (0.03)	0.08 (0.03)	0.14 (0.01)
Senior general secondary	0.05 (0.03)	0.002 (0.04)	0.09 (0.01)
Pre-vocational and senior general	0.04 (0.03)	0.06 (0.03)	0.09 (0.02)
Background (school)			
Class size	-0.0006 (0.00)	0.004 (0.00)	0.001 (0.00)
Avg. income per year (x €1000, −)	-0.002 (0.00)	0.003 (0.00)	0.001 (0.00)
Protestant	-0.007 (0.02)	-0.03 (0.03)	0.02 (0.02)
Roman Catholic	-0.03 (0.02)	-0.03 (0.03)	0.01 (0.02)
Religion other	0.08 (0.05)	0.05 (0.06)	0.01 (0.03)
Year dummy (1= 2010/0=2011)	0.01 (0.02)	-0.02 (0.03)	-0.006 (0.01)
_cons	0.43 (0.18)	0.74 (0.23)	0.50 (0.10)
Number of observations	2360	2354	2141

Robust standard errors in parentheses. Observations clustered at the class level.

Table A3: Treatment effects Non-cognitive skills (detailed)

Δ	Motivating	Analyzing	Pro-activity	Creativity	Self-efficacy	Need for Ach	Risk taking	Social orient	Persistence
Treatment effect (δ)	0.07 (0.06)	0.14 (0.05)	0.17 (0.04)	0.11 (0.05)	0.16 (0.04)	0.16 (0.05)	0.12 (0.05)	0.048 (0.05)	0.11 (0.05)
Background (individual)									
Female	0.07 (0.04)	-0.08 (0.03)	0.004 (0.04)	-0.06 (0.05)	-0.07 (0.04)	-0.10 (0.04)	-0.12 (0.04)	0.11 (0.04)	0.08 (0.03)
Age ($t = 0$)	0.03 (0.04)	0.03 (0.03)	0.01 (0.03)	0.02 (0.04)	0.02 (0.03)	-0.02 (0.03)	-0.005 (0.03)	-0.02 (0.03)	0.06 (0.03)
Parents both not dutch	0.05 (0.06)	0.02 (0.06)	-0.02 (0.05)	-0.05 (0.06)	0.05 (0.05)	0.04 (0.06)	-0.06 (0.06)	-0.05 (0.06)	0.06 (0.05)
Mother entrepreneur	-0.08 (0.10)	0.02 (0.07)	0.08 (0.06)	0.11 (0.08)	-0.05 (0.07)	0.05 (0.06)	0.05 (0.08)	0.03 (0.07)	-0.03 (0.07)
Father entrepreneur	0.01 (0.07)	0.02 (0.05)	0.04 (0.04)	0.03 (0.06)	-0.01 (0.05)	0.14 (0.05)	0.02 (0.06)	0.008 (0.05)	-0.03 (0.05)
Skill level at $t = 0$	-0.45 (0.02)	-0.45 (0.02)	-0.43 (0.02)	-0.42 (0.02)	-0.43 (0.02)	-0.37 (0.02)	-0.38 (0.02)	-0.41 (0.02)	-0.43 (0.02)
High school:									
Pre-University	0.26 (0.07)	0.47 (0.07)	0.33 (0.06)	0.39 (0.07)	0.28 (0.06)	0.27 (0.07)	0.05 (0.07)	0.09 (0.05)	0.29 (0.06)
Pre-Uni and senior general	0.26 (0.07)	0.35 (0.06)	0.21 (0.06)	0.34 (0.07)	0.15 (0.06)	0.26 (0.06)	0.16 (0.07)	0.13 (0.06)	0.24 (0.06)
Senior general secondary	0.23 (0.07)	0.13 (0.07)	0.19 (0.07)	0.23 (0.08)	0.15 (0.07)	0.13 (0.06)	0.02 (0.07)	0.10 (0.06)	0.10 (0.07)
Pre-vocational and senior general	0.25 (0.07)	0.04 (0.07)	0.04 (0.07)	0.10 (0.08)	0.05 (0.07)	0.08 (0.07)	0.12 (0.07)	0.01 (0.06)	0.18 (0.06)
Background (school)									
Class size	-0.002 (0.01)	0.004 (0.01)	-0.007 (0.00)	-0.003 (0.01)	-0.01 (0.01)	-0.0008 (0.01)	-0.005 (0.00)	0.0005 (0.01)	0.002 (0.01)
Avg. income per year (x €1000, –)	0.006 (0.01)	-0.0008 (0.01)	0.003 (0.00)	-0.005 (0.01)	0.003 (0.01)	0.003 (0.01)	0.005 (0.00)	0.006 (0.01)	0.006 (0.01)
Protestant	0.03 (0.06)	-0.02 (0.05)	0.08 (0.05)	0.005 (0.06)	-0.04 (0.05)	-0.03 (0.06)	-0.04 (0.05)	-0.06 (0.06)	-0.07 (0.05)
Roman Catholic	0.10 (0.06)	-0.02 (0.05)	0.03 (0.05)	-0.009 (0.06)	0.01 (0.06)	0.02 (0.06)	-0.03 (0.05)	0.005 (0.06)	-0.08 (0.05)
Religion other	0.20 (0.09)	0.07 (0.13)	0.25 (0.10)	0.12 (0.11)	0.27 (0.08)	0.05 (0.09)	0.14 (0.09)	-0.07 (0.09)	0.08 (0.08)
Year dummy (1= 2010/0=2011)	0.0005 (0.05)	-0.002 (0.04)	0.04 (0.04)	-0.01 (0.05)	0.08 (0.05)	-0.02 (0.05)	0.0007 (0.04)	-0.03 (0.05)	0.006 (0.05)
_cons	1.56 (0.50)	1.38 (0.42)	1.66 (0.44)	1.72(0.51)	1.60 (0.44)	1.85(0.42)	1.85 (0.40)	2.19 (0.40)	1.02 (0.44)
Number of observations	2302	2304	2303	2297	2304	2304	2304	2304	2304

Robust standard errors in parentheses. Observations clustered at the class level.

Table A4: Treatment effects Non-cognitive skills (clustered at school level)

Δ	Motivating	Analyzing	Pro-activity	Creativity	Self-efficacy	Need for Ach	Risk taking	Social orient	Persistence
Treatment effect (δ)	0.07 (0.05)	0.14 (0.05)	0.17 (0.05)	0.11 (0.05)	0.16 (0.04)	0.16 (0.06)	0.12 (0.05)	0.05 (0.05)	0.11 (0.05)
Background (individual)									
Female	0.07 (0.04)	-0.08 (0.03)	0.004 (0.03)	-0.06 (0.04)	-0.07 (0.04)	-0.10 (0.05)	-0.12 (0.04)	0.11 (0.04)	0.08 (0.04)
Age ($t = 0$)	0.03 (0.03)	0.03 (0.04)	0.01 (0.03)	0.02 (0.04)	0.02 (0.04)	-0.02 (0.03)	-0.005 (0.03)	-0.02 (0.03)	0.06 (0.03)
Parents both not dutch	0.05 (0.06)	0.02 (0.05)	-0.02 (0.05)	-0.005 (0.07)	0.05 (0.05)	0.04 (0.06)	-0.06 (0.05)	-0.05 (0.05)	0.06 (0.05)
Mother entrepreneur	-0.08 (0.11)	0.02 (0.06)	0.08 (0.06)	0.11 (0.07)	-0.05 (0.07)	0.05 (0.07)	0.05 (0.07)	0.03 (0.07)	-0.03 (0.07)
Father entrepreneur	0.01 (0.06)	0.02 (0.05)	0.04 (0.05)	0.03 (0.05)	-0.009 (0.04)	0.14 (0.04)	0.02 (0.06)	0.008 (0.05)	-0.03 (0.04)
Competency at $t = 0$	-0.45 (0.02)	-0.45 (0.02)	-0.43 (0.02)	-0.42 (0.02)	-0.43 (0.02)	-0.37 (0.02)	-0.38 (0.02)	-0.41 (0.02)	-0.43 (0.02)
High school:									
Pre-University	0.26 (0.08)	0.47 (0.07)	0.33 (0.06)	0.39 (0.06)	0.28 (0.06)	0.27 (0.06)	0.05 (0.07)	0.09 (0.06)	0.29 (0.06)
Pre-Uni and senior general	0.26 (0.07)	0.35 (0.06)	0.21 (0.06)	0.34 (0.07)	0.15 (0.06)	0.26 (0.06)	0.16 (0.07)	0.13 (0.05)	0.24 (0.06)
Senior general secondary	0.23 (0.08)	0.13 (0.07)	0.19 (0.06)	0.23 (0.08)	0.15 (0.08)	0.13 (0.06)	0.02 (0.06)	0.10 (0.05)	0.10 (0.06)
Pre-vocational and senior general	0.25 (0.07)	0.04 (0.08)	0.04 (0.07)	0.10 (0.09)	0.05 (0.06)	0.08 (0.07)	0.12 (0.07)	0.01 (0.06)	0.18 (0.07)
Background (school)									
Class size	-0.002 (0.01)	0.004 (0.01)	-0.007 (0.00)	-0.003 (0.01)	-0.01 (0.01)	-0.0008 (0.01)	-0.005 (0.01)	0.0005 (0.01)	0.002 (0.01)
Avg. income per year (x €1000, –)	0.006 (0.01)	-0.0008 (0.00)	0.003 (0.00)	-0.005 (0.01)	0.003 (0.01)	0.003 (0.01)	0.005 (0.00)	0.006 (0.01)	0.006 (0.01)
Protestant	0.03 (0.06)	-0.02 (0.05)	0.08 (0.05)	0.005 (0.05)	-0.04 (0.06)	-0.03 (0.06)	-0.04 (0.05)	-0.06 (0.05)	-0.07 (0.05)
Roman Catholic	0.10 (0.06)	-0.02 (0.05)	0.03 (0.05)	-0.009 (0.06)	0.01 (0.06)	0.02 (0.07)	-0.03 (0.05)	0.005 (0.06)	-0.08 (0.05)
Religion other	0.20 (0.07)	0.07 (0.06)	0.25 (0.05)	0.12 (0.07)	0.27 (0.05)	0.05 (0.08)	0.14 (0.08)	-0.07 (0.07)	0.08 (0.05)
Year dummy (1= 2010/0=2011)	0.0005 (0.05)	-0.002 (0.04)	0.04 (0.04)	-0.01 (0.05)	0.08 (0.04)	-0.02 (0.05)	0.0007 (0.04)	-0.03 (0.05)	0.006 (0.05)
_cons	1.56(0.42)	1.38 (0.46)	1.66 (0.45)	1.72 (0.48)	1.60 (0.49)	1.85 (0.44)	1.85 (0.42)	2.19 (0.41)	1.02 (0.42)
Number of observations	2302	2304	2303	2297	2304	2304	2304	2304	2304

Robust standard errors in parentheses. Observations clustered at the school level.

Table A5: Treatment effects Cognitive skills and intentions (clustered at school level)

	Entrepreneurial intentions		
Δ	Future job: entrepreneur	Own Business	Cognitive entrepreneurial skills
Treatment effect (δ)	-0.03 (0.02)	-0.14 (0.03)	0.01 (0.01)
Background (individual)			
Female	-0.08 (0.02)	-0.08 (0.02)	0.02 (0.01)
Age ($t = 0$)	-0.02 (0.01)	-0.02 (0.02)	-0.006 (0.01)
Parents both not dutch	-0.03 (0.01)	-0.02 (0.03)	-0.03 (0.01)
Mother entrepreneur	0.05 (0.04)	0.10 (0.04)	0.01 (0.01)
Father entrepreneur	0.08 (0.02)	0.16 (0.03)	-0.01 (0.01)
Intention level at $t = 0$	-0.58 (0.02)	-0.56 (0.02)	
Cognitive skill level at $t = 0$			-0.72 (0.03)
High school:			
Pre-University	0.09 (0.03)	0.06 (0.04)	0.16 (0.01)
Pre-Uni and senior general	0.05 (0.03)	0.08 (0.04)	0.14 (0.01)
Senior general secondary	0.05 (0.03)	0.002 (0.04)	0.09 (0.01)
Pre-vocational and senior general	0.04 (0.03)	0.06 (0.03)	0.09 (0.02)
Background (school)			
Class size	-0.0006 (0.00)	0.004 (0.00)	0.001 (0.00)
Avg. income per year (x €1000, −)	-0.002 (0.00)	0.003 (0.00)	0.001 (0.00)
Protestant	-0.007 (0.02)	-0.03 (0.03)	0.02 (0.02)
Roman Catholic	-0.03 (0.02)	-0.03 (0.03)	0.01 (0.02)
Religion other	0.08 (0.04)	0.05 (0.05)	0.01 (0.02)
Year dummy (1= 2010/0=2011)	0.01 (0.02)	-0.02 (0.03)	-0.006 (0.01)
_cons	0.43 (0.17)	0.74 (0.25)	0.50 (0.11)
Number of observations	2360	2354	2190

Robust standard errors in parentheses. Observations clustered at the school level.

Table A6: DID - IV estimation results

	IV - DID no controls		**IV - DID with controls**	
Outcome variables	δ		δ	
Non-cognitive entrepreneurial skills				
Self-Efficacy	0.249*	(0.134)	0.191	(0.136)
Need for Achievement	0.247*	(0.147)	0.328*	(0.170)
Risk Taking	0.110	(0.119)	0.151	(0.130)
Social Orientation	-0.136	(0.157)	-0.117	(0.158)
Persistence	0.102	(0.133)	0.113	(0.129)
Motivating	-0.066	(0.165)	-0.049	(0.178)
Analyzing	0.015	(0.137)	0.079	(0.149)
Pro-activity	0.069	(0.133)	0.093	(0.120)
Creativity	0.062	(0.152)	0.118	(0.165)
Cognitive entrepreneurial skills	0.008	(0.046)	0.039	(0.040)
Entrepreneurial intentions				
Future job: entrepreneur (0/1)	-0.004	(0.060)	0.008	(0.068)
Own Business (0-2)	-0.191**	(0.079)	-0.148*	(0.083)
Number of observations	2351		2304	

Note: The estimates in each cell come from separate regressions. Observations clustered at the class level, robust standard errors in parentheses. All regressions control for the baseline level of the outcome variable. Second regression includes individual characteristics: age, gender, future high school track, nationality parents, parents entrepreneurial status; school/neighborhood characteristic tics: class size, school denomination, avg. income per year and a year dummy for 2010/2011. */**/*** indicates significance at the 10%/5%/1%-level.