Health and Competitiveness in Children: An Experimental Analysis

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Abstract

The formation of human capital is important for a society's welfare and economic success. Recent literature shows that child health can provide an important explanation for disparities in children’s human capital development across different socio-economic groups. However, while this literature focuses on cognitive skills as determinants of human capital, it neglects non-cognitive skills. We analyze data from economic experiments with preschoolers and their mothers to investigate whether child health can explain developmental gaps in children’s non-cognitive skills. Our measure for children’s non-cognitive skills is their willingness to compete with others. We find that health problems are substantially negatively related to children’s willingness to compete. Moreover, we find that the effect of health on competitiveness differs significantly with socio-economic background. Health has a strongly negative effect in our sub-sample with low socio-economic background, whereas the effect is negligible and insignificant in our sub-sample with high socio-economic background.

JEL-code: C91, I10
Keywords: health care, competitiveness, human capital formation, non-cognitive skills, economic experiments

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1. Introduction

What are the determinants of human capital formation in children, and are these determinants related to parental socioeconomic background? These questions have been of enduring interest in virtually all branches of the social sciences (Heckman, 2007; see also e.g. Bleichrodt and van Doorslaer, 2006; Cunha and Heckman, forthcoming; Knudsen et al., 2006) because the formation of human capital is of fundamental importance for a society's welfare. In this paper, we use economic games and experimental tools to provide new insights in answering these questions.

From an economic perspective, the analysis of the association between parents' socio-economic status and child developmental outcomes provides particularly important insights. Several studies showed that measures of developmental outcomes, e.g. children's cognitive scores, are significant determinants of adult human capital indicators, such as employment and earnings history (e.g. Dustmann et al., 2003) or participation in criminal and other risky activities (e.g. Cunha and Heckman, 2007; Heckman et al., 2006). Two important findings emerge from these studies: First, child health can offer an important explanation for disparities in children's cognitive development among different socio-economic groups (e.g. Case et al. 2005). Second, human capital is developed through an interactive process that requires not only cognitive skills, like mathematical abilities, but non-cognitive skills as well, such as social and emotional capacities (e.g. Dohmen et al., 2009, Heckman, 2007; Shonkoff and Phillips, 2000).

Surprisingly however, despite regular emphasis on the importance of non-cognitive skills, previous studies have failed to investigate the extent to which child health is also an explanation for children's non-cognitive development, and how the development of these skills varies among different socio-economic groups. Our study is a first step in this direction. It focuses on one important dimension of children's non-cognitive skills, namely their willingness to compete. An individual's willingness to compete with others is a crucial element of his fitness and success, not only from an evolutionary point of view but also from an economic perspective: work and career efforts are often driven by vigorous competition for promotion to better paid jobs associated with a high prestige. Less competitive people, however, shy away from direct competition for career opportunities. Preferences for competition are thus an important non-cognitive determinant of human capital indicators, such as adult economic achievements and productivity (e.g. Niederle and Vesterlund, 2007; see also the extensive literature in evolutionary and social biology on the development of competitiveness, e.g. Knight, 2002).

To the best of our knowledge, this is the only study to use economic games and experimental tools to address the question whether child health can explain developmental gaps in non-cognitive skills.[2] The advantage of this approach is that incentivized experiments provide a precise measure of preferences for competition, an important dimension of human capital. Specifically, we analyze a unique data set from several economic experiments implemented within a household survey study (the German Socio-Economic Panel) with preschool children and their mothers. We measure children’s desire to compete with others, henceforth denoted competitiveness, by giving them either the choice of competing in a tournament or receiving a piece rate in a task that requires skill, concentration, and effort. Since a tournament is intrinsically riskier than a piece rate, we also elicit the children’s risk attitudes with incentivized experimental procedures. Our measure for children’s health conditions is based on the information whether a child had a medical condition that forced him or her to see a medical practitioner at least once during the last three months before the experiments took place.

Since our experiments are integrated into a household survey, we have a rich set of additional information about the children, including cognitive skills and personality traits, as well as data on the family's socio-economic background. We also used incentivized procedures to

[2] Recent experimental studies addressing pertinent topics in other areas of health economics include, for example, Bleichrodt and Filko (2008) and Schram and Sonnemans (2008).

elicit the mothers' risk attitudes and use this information as a control variable in our analysis, because the decision to visit a doctor could be related to the extent to which the mother is inclined to prevent risks.[3] Thus, our data allow for testing whether our measure of child health can account for differences in children's competitiveness while controlling for a large number of potentially relevant factors.

Related Literature: Previous studies analyzed the relationship between socio-economic characteristics and child health. For example, a robust positive association between parents' socio-economic status and child health has been found in several countries such as the United States (Case et al., 2002), Canada (Currie and Stabile 2003), and the United Kingdom (Currie et al., 2007). Several studies also analyzed the relationship between parents' socio-economic status and children's cognitive development and report that family economic resources are an important determinant of child cognitive outcomes (Aughinbaugh and Gittleman, 2003; Taylor et al. 2004; Blau, 1999). Complementary to this literature, scholars have studied the relation between health and cognitive skills (Paxson and Schady, 2007; Currie et al., 2008), with a particular interest in the question of whether this relationship differs by socio-economic characteristics (for a survey see Currie, forthcoming,). Using British data, Case et al. (2005) find that children born into poorer families experience poorer childhood health and – controlling for parental income, education, and social class – that poorer childhood health is associated with significantly lower socio-economic status in adult life. Salm and Schunk (2009) use administrative data from Germany to show that certain health conditions are negatively related to children's cognitive skills and that health also accounts for developmental gaps between children of high and low socio-economic status.

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[3] Earlier studies have elicited experimental data from two generations; examples are Schotter and Sopher (2003) and (2007).

Our study contributes to the existing literature in two ways. First, we find that our measure of health condition is negatively associated with children's competitiveness. This suggests that child health is associated with human capital formation not only via cognitive, but also via non-cognitive skills. Second, we show that the association of our measure of health condition with non-cognitive development differs, depending on the children's socio-economic backgrounds. While health and competiveness are negatively correlated for children with a low socio-economic background, we do not find an association for children with a high socio-economic background. This result mirrors previous findings that child health and cognitive skills are more negatively associated with a lower socio-economic background.

2. Experimental Design

This paper is based on a data set from a pilot study that explores the feasibility of integrating incentivized economic experiments into the German Socio-Economic Panel (SOEP), a representative longitudinal survey of private households in Germany.[4] The study targeted mothers with preschool children. In addition to answering a questionnaire, mothers also participated in choice experiments that took place in their households. We also conducted experiments with their children at their daycare centers. The experiments were adapted to take the time, technical, and spatial constraints into account, which arise when moving from the standard laboratory to the field (the mothers' households and children's daycare centers). All interviews and experiments were conducted between May and November 2008. The interviews and experiments with the mothers were conducted by specially trained and experienced interviewers from the same professional survey company that also collects the data for the SOEP. Two trained child psychologists performed the experiments with the children.

[4] See http://www.diw.de/english/soep/29012.html

The sampling procedure was as follows. First, request letters were sent to a stratified random sample of 95 daycare centers in the metropolitan area of Munich (Germany), of which 23 agreed to participate. If a center participated, they forwarded information leaflets and consent forms to all mothers of 5 to 6 year old children at the center. In total, 118 mother and child pairs participated in the study. The mothers went through a computer assisted personal interview in their households. In the first part, each mother filled out a survey about her personality, cognitive abilities, and socio-economic status. She also answered questions about the personality traits, cognitive skills, and health conditions of the child that took part in the experiments at the daycare centers. In the second part, we conducted a computerized experiment with the mothers to elicit their risk preferences. The measure of mothers' risk preferences serves as a control variable in our regression analyses of children's competitiveness in the next section. We employed the same design as Dohmen et al. (2007): Subjects made 20 choices between a lottery that paid out either 300 Euros or nothing with equal probability, and a fixed payment that increased from 0 to 180 Euros in increments of 10. Subjects were informed that one of their 20 choices would be randomly selected for potential payout, and that another random device decides with probability 1/9 whether the earnings from the experiment would actually be paid out.[5]

At the daycare centers, we conducted experiments with the children to obtain behavioral measures of their preferences for competition and, as a control variable, their risk attitudes. Instead of using a computer and money, the children's experiments were embedded in a playful environment where they received plastic chips as payments that could be exchanged for different gifts at the end of the experiments. The children were informed that more attractive gifts could be obtained with more chips. In order to avoid confounding taste differences, we took great care in

[5] To minimize the interviewer's influence, the laptop computer was turned towards the subject during the experiment so that the interviewer could not see the mothers' choices. The earnings from the experiment were paid out with a check that was sent by mail.

preventing the children from seeing the selection of toys while they actively participated in the experiment.[6] Moreover, after a child completed all experiments and exchanged his or her chips for a gift, the chosen gift was placed in an opaque bag labeled with the child's name. The daycare center teacher then kept the bag until the end of the day to prevent the children from observing and being directly influenced by the gifts, as the experiments took place one after another.

Our experimental measure for competitiveness was elicited as follows. Children had to self-select into either a piece rate or a tournament compensation scheme for a "real effort task." Children had to flip toy frogs into a toy pond that was placed at some distance so that scoring a hit required some skill. We conducted five non-incentivized trial rounds so that the children could become familiar with the task. We then asked each child which of two possible game alternatives he or she would like to play. In both games children received ten toy frogs, i.e. ten trials, and they were told to try to hit the pond as many times as possible. In the first game alternative, they would receive one chip for each frog that hit the pond (piece rate). In the second game alternative, they would receive 20 chips if they scored higher than another, randomly chosen child of same age and sex. However, if they scored less hits they would not receive any chips at all (tournament scheme). The rules of the two game alternatives were visualized on a cardboard and comprehension questions were asked to ensure their understanding.[7] After a child made his or her decision but before the chosen game alternative was played, we also asked: "What do you think: will other children score rather higher or lower than you?" We use the answer to this question as a confidence measure in our regression analyses in the next section.

The children's risk preferences were elicited as follows (the design corresponds to the *Gambling game* in Hoffrage et al., 2003). A child was presented with 10 indistinguishable small

[6] However, there were a number of different gifts to ensure that each child could find a toy that attracts her or him.
[7] If a child could not answer the questions correctly, the procedure was explained again. If a child could not answer the question after three rounds of explanations, he or she would have been excluded from the study. However, all children were able to answer the comprehension questions correctly.

boxes. They were told that 9 of the 10 boxes contained a chip, but that the figure of a robber was in one of the boxes. Children could open as many boxes as they wanted. They could keep all chips that were in the opened boxes but if they opened the box with the robber they lost all chips. The average number of unopened boxes serves as a measure of risk aversion. The fewer boxes a child opens, the more risk-averse is he or she. After the interviewer explained the rules of the game, a practice round was conducted to familiarize the children with the task and comprehension questions were asked to ensure the understanding of the rules.[8] Finally, children had to choose how many boxes to open; they only received feedback on the content of the single boxes after having decided how many boxes to open.[9]

3. Experimental Results

To what extent do health conditions affect the development of non-cognitive skills in children? And how does socio-economic status affect the relation between health conditions and the development of non-cognitive skills? We address these questions in this section using our experimental measure of non-cognitive skills, i.e. whether a child self-selects into a competitive environment, and the information on the children's health condition taken from the household questionnaires their mothers completed. In particular, we have information whether a child had a medical condition forcing her or him to see a medical practitioner at least once in the last three months before the experiments took place. However, we do not know the type of medical condition that initiated the child's visit of the medical practitioner.[10]

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[8] The procedure was as in the competitiveness experiments (see footnote 6); all children understood the game.

[9] This strategy method of eliciting risk aversion makes sure that the obtained data on children's risk aversion do not suffer from a censoring problem.

[10] The translation of our question was: "Did you have to visit or call a doctor in the last three months because of medical conditions of your child?". ["Mussten Sie in den letzten drei Monaten wegen gesundheitlicher Probleme Ihres Kindes einen Arzt aufsuchen oder rufen?"]

We use linear probability models with robust standard errors and regress the choice for competition on the dummy *Medical condition* that indicates whether the child had a medical condition, controlling simultaneously for a number of other factors that potentially influence self-selection into competition.[11] Descriptive statistics of all variables included in this study are shown in Table 1.

[Include Table 1 about here]

We find an economically and statistically highly significant difference in the propensity to select into competition depending on our measure of health condition (see column 1 of Table 2). Ceteris paribus, a child is about 28 percent less likely to self-select into competition if she had a medical condition at least once in the last three months.

[Include Table 2 about here]

We consider additional health measures as explanatory variables. The dummy *Low birth weight* takes on value one if a child's birth weight was below 2500 grams. This definition follows the International Statistical Classification of Diseases and Related Health Problems (World Health Organization 2007). While not reaching statistical significance, we find that the effect of low birth weight on competitiveness is negative. The finding of a negative effect is in line with results in a large literature linking low birth weight to lower average scores on various tests of cognitive and social development and to lower average educational attainment (see, e.g., Behrman and Rosenzweig, 2004). The dummy variable *Low BMI* has the value one if the child's body mass index is below the 10 percentile of the BMI distribution, and the variable *High BMI* indicates whether the child's body mass index is above the 90 percentile of the BMI

[11] All findings from this paper also hold if we use probit or logit models instead of linear probability models.

distribution.[12] As a measure for *Mental health* we also include the SDQ Total Difficulties Score.[13] None of these variables are significant.

As additional control variables, the regression further includes *Ability*, which stands for the performance in the practice rounds and the dummy *Confidence*, which indicates whether a child expects to score rather more hits than the other children. We find that *Confidence* has a positive and significant effect. We also control for *Risk aversion* (measured in our risk experiment as the number of unopened boxes) because the tournament involves more risk than the piece rate. We find a negative but insignificant effect of risk aversion. We also include *Age*, a gender dummy *Boy*, *Number siblings*, and *Birth order*, but all three of these variables are insignificant.

Cognitive skills are related to behavior in various economic experiments (e.g., Benjamin et al. 2006, Dohmen et al. 2007; Frederick 2005). We thus control for *IQ*[14] and find that more intelligent children significantly more often self-select into the competitive environment. This complements earlier studies showing that child cognitive scores significantly determine adult human capital (e.g. Dustmann et al., 2003).

Finally, we control for the mother's risk preferences (measured in our household risk experiment) because more risk-averse mothers might be more cautious, thus more inclined to send their children to a medical practitioner. However, we do not find an effect.

[12] The respective percentiles cutoff-values that we use are gender and age specific and have been calculated based on values of a German calibration study (Kromeyer-Hauschild et al., 2001).

[13] The Strengths and Difficulties Questionnaire (SDQ) is a standardized questionnaire, first developed in England and specifically designed for children from age four to eleven (Goodman 2001). It has been officially translated into over 40 languages, and the German version has been systematically evaluated (Woerner et al. 2004). The SDQ asks for about 20 attributes, and parents rate each of the 20 items as being true, somewhat true, or certainly true. Our variable *Mental health* represents the Total Difficulties Score which is computed as the sum of all 20 items.

[14] We used a revised and shortened version of the Peabody Picture Vocabulary Test Revised (PPVT-R), which is an untimed individual intelligence test, taken from Tietze et al. (2005).

In summary, the dummy *Medical condition* in the regression in column 1 is the only highly significant variable in our regression, and it has by far the largest effect on self-selection into the competitive environment. This result is stated in the following:

Result 1: *If a child had a medical condition at least once in the last three months, he or she self-selects less often into the competitive environment.*

Recent studies have shown that child health can be an important explanation of disparities in children's cognitive development among different socio-economic groups (see, e.g., Case et al., 2005; Currie, forthcoming; Salm and Schunk, 2009). In the following we therefore analyze how the effect of our measure of child health on competitiveness depends on the socio-economic status of the children's families.

To address this question we conducted a median split depending on the level of household income and ran the same regression as specified above for the two sub-samples separately (see columns 2 and 3 of Table 2). In the sub-sample with low socio-economic background, a child is about 39 percent less likely to self-select into competition if he or she had a medical condition. However, we fail to find any effect of our measure of health condition on competitiveness in the sub-sample with high socio-economic background. We also ran a fully interacted model with the full data sample and find that *Medical condition* is the *only* variable that differs significantly (p=0.04) between the two sub-samples, suggesting that the relationship between health and competitiveness differs significantly by the socio-economic background of the children. We summarize these observations in our second result:

Result 2: *The negative relation between health and competitiveness depends on the children's socio-economic status and is only significant in our sub-sample with low socio-economic status.*

Our second result complements studies showing that the relation between child health and cognitive skills differs by socio-economic background.

One explanation for the second finding could be that households with a higher socio-economic background have more means to compensate for health deficits than households with a lower socio-economic background. Another interpretation could be that mothers with a higher socio-economic background are more cautious than mothers with a lower socio-economic background and may even visit a medical practitioner for minor illnesses. In this case, the observation that a child had to see a medical practitioner would, on average, indicate more severe illnesses in the sub-sample with low socio-economic background. However, we included our measure for a mother's risk aversion to control for her caution, i.e. her inclination to send her child to preventive medical checkup. Also, we find the fraction of children that had to see a medical practitioner is very similar in the two sub-samples (t-test: p=0.45).

4. Conclusion

In this paper, we asked two questions. First, to what extent do health conditions affect the development of non-cognitive skills in children? And second, how does the parents' socio-economic status affect the relation between health conditions and the development of non-cognitive skills? The answers to these questions are of relevance, because a society's welfare and economic success depends crucially on the successful formation of human capital. The existing literature shows that child health can be an important explanation of disparities in children's *cognitive* development among different socio-economic groups. With this paper, we complement this literature by analyzing the development of *non-cognitive* skills.

Specifically, we analyze data from economic experiments implemented in a household survey study with preschoolers and their mothers. We use the children's choices between a tournament and piece rate payment scheme, i.e. their competitiveness, as a measure of non-cognitive skills. Our measure for health condition is based on the information whether a child had a medical condition at least once during the last three months before the experiments took place. We find that our health measure is substantially negatively associated with children's self-selection into the competitive environment. Moreover, we find that the relation between health and competitiveness differs significantly by socio-economic background: it is very strong in our sub-sample with lower socio-economic background and almost absent in families with a higher socio-economic status.

Our results suggest, first, that health is a pathway for the formation of human capital, not only for cognitive, but also for non-cognitive skills. Second, it suggests that family conditions can overcome the negative effects of health problems on non-cognitive skill development. The second result is especially surprising, given that the health care system in Germany, where the study was conducted, is characterized by almost universal health insurance coverage and a focus on child health and prevention programs: 99.8 percent of the German population are enrolled in mandatory health insurance, and those who are not enrolled are mostly the very rich (German Federal Statistical Office 2004). The almost universal health care coverage thus shows that differential access to the health care system does not drive our results. Rather, disadvantages in the development of human capital seem to arise in family environments that cannot compensate for the adverse consequences of health problems.

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TABLE 1: Descriptive Statistics

Variable	Min	Max	Mean	Median	Std. Dev.
Competition	0	1	0.212	0	0.41
Medical condition	0	1	0.356	0	0.48
Low birth weight	0	1	0.043	0	0.20
Low BMI	0	1	0.085	0	0.28
High BMI	0	1	0.144	0	0.35
Mental Health	0	13	3.670	3	2.56
Ability	0	5	1.600	1	1.14
Confident	0	1	0.593	1	0.49
Risk aversion	1	9	5.237	5	1.86
Age (in months)	55	85	68.585	69	6.15
Boy	0	1	0.475	0	0.50
Number of siblings	0	6	0.958	1	0.83
Birth order	1	5	1.542	1	0.69
IQ	25	55	43.441	44	6.01
Risk aversion mother	1	21	11.35	10	5.34
Net household income [€/month]	640	20,000	4,078	3,520	2,467

Notes: Competition takes on value 1 if the child self-selected into the competitive scheme. *Medical condition* takes on value 1 if the child had a medical condition at least once in the three months before the experiments took place. *Low birth* takes on value 1 if a child's birth weight was below 2500 grams. *Low BMI* has value 1 if the child's body mass index (BMI) is below the 10 percentile and *High BMI* has value 1 if the child's BMI is above the 90 percentile of the BMI distribution. *Mental health* shows the SDQ Total Difficulties Score. *Ability* stands for the performance in the practice rounds of the real effort task. *Confidence* takes on value 1 if a child expects to score more hits than the other children. *Risk aversion* is the number of unopened boxes in our risk elicitation game. *IQ* shows the child's score in a Peabody Picture Vocabulary Test. *Risk aversion mother* is the switching point in the risk elicitation price list.

TABLE 2: Regression Models

	(1)	(2)	(3)
	Full sample	Parents' income below median	Parents' income above median
Medical condition	-0.281***	-0.394***	-0.027
	(0.079)	(0.126)	(0.124)
Low birth weight	-0.061	-0.199	-0.011
	(0.171)	(0.227)	(0.190)
Low BMI	-0.091	-0.056	-0.105
	(0.085)	(0.193)	(0.077)
High BMI	0.143	0.034	0.315*
	(0.128)	(0.170)	(0.169)
Mental Health	0.003	-0.002	-0.020
	(0.018)	(0.028)	(0.022)
Ability	0.033	0.090	-0.011
	(0.032)	(0.084)	(0.033)
Confident	0.203**	0.299**	0.099
	(0.084)	(0.133)	(0.117)
Risk aversion	-0.003	-0.009	-0.009
	(0.020)	(0.044)	(0.016)
Age	-0.001	0.001	-0.000
	(0.008)	(0.015)	(0.011)
Boy	0.062	0.160	0.032
	(0.075)	(0.128)	(0.092)
Number of siblings	0.034	0.068	-0.095
	(0.074)	(0.120)	(0.093)
Birth order	-0.063	-.087	0.134
	(0.090)	(0.121)	(0.141)
IQ	0.015**	0.009	0.012
	(0.007)	(0.013)	(0.008)
Risk aversion mother	-0.004	-0.003	0.002
	(0.007)	(0.012)	(0.011)
Constant	0.375	-.246	-0.662
	(0.992)	(1.093)	(0.682)
Observations	117	58	59

Notes: The table reports the estimation results of a linear probability model (robust standard errors in parentheses). The dependent variable is a dummy variable indicating whether the child has chosen to compete. Parents' educational status and log household income are included as additional controls, all being insignificant. Significance levels are denoted as follows: * $p<0.1$, ** $p<0.05$, *** $p<0.01$. The findings reported above are robust to using probit or logit models.