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Opening the Black Box of Primary Effects: Relative Risk Aversion and Maternal Time Investments in Preschool Children

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DFG Research Center (SFB) "From Heterogeneities to Inequalities"

Whether fat or thin, male or female, young or old – people are different. Alongside their physical features, they also differ in terms of nationality and ethnicity; in their cultural preferences, lifestyles, attitudes, orientations, and philosophies; in their competencies, qualifications, and traits; and in their professions. But how do such heterogeneities lead to social inequalities? What are the social mechanisms that underlie this process? These are the questions pursued by the DFG Research Center (Sonderforschungsbereich (SFB)) "From Heterogeneities to Inequalities" at Bielefeld University, which was approved by the German Research Foundation (DFG) as "SFB 882" on May 25, 2011.

In the social sciences, research on inequality is dispersed across different research fields such as education, the labor market, equality, migration, health, or gender. One goal of the SFB is to integrate these fields, searching for common mechanisms in the emergence of inequality that can be compiled into a typology. More than fifty senior and junior researchers and the Bielefeld University Library are involved in the SFB. Along with sociologists, it brings together scholars from the Bielefeld University faculties of Business Administration and Economics, Educational Science, Health Science, and Law, as well as from the German Institute for Economic Research (DIW) in Berlin and the University of Erlangen-Nuremberg. In addition to carrying out research, the SFB is concerned to nurture new academic talent, and therefore provides doctoral training in its own integrated Research Training Group. A data infrastructure project has also been launched to archive, prepare, and disseminate the data gathered.

Research Project A1 "Social Closure and Hierarchization: Contextual Conditions of Unequal Developmental Opportunities in Early Phases of Life"

This project extends research on the genesis and effects of individual heterogeneity to cover psychological characteristics and their interplay with socioeconomic characteristics. It looks at cognitive and non-cognitive competencies on the one hand, and various dimensions of cultural and social capital on the other, asking how far these overlap, how far each determines the genesis of the other, and how far each impacts upon academic success and a successful life. Do they contribute particularly strongly to the early and largely irreversible reduction of opportunities, to the accumulation of advantage and disadvantage? For the first time, two established but previously unconnected research traditions are being integrated into one research design. Although this means a certain degree of competition between them, it simultaneously creates the possibility of integrating the two bodies of existing knowledge.

The studies are conducted not only on the level of the individual life course, but also taking into consideration the contextual conditions of different family constellations, social networks and neighborhoods, and educational organizations and institutions. All these contextual levels may harbor social exclusion mechanisms. The particular significance of the family of origin for the genesis of social inequalities is taken into account by considering both the stratification features of families of origin and the increasing diversity of family structures, with the resulting hierarchization of family positions and roles. In addition, the project goes beyond differences between families to study differences in the significance of one and the same family for its various members – particularly for siblings in terms of gender, age difference, and birth order.
The project focuses on the early phases of life. Empirically, it will pay special attention to developing and implementing innovative operationalizations of life-course cohort analyses, based on the German Socio-Economic Panel Study (SOEP) and comparable panel studies in other countries, primarily the Child Development Supplement of the Panel Study of Income Dynamics (PSID).

The Authors

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Opening the black box of primary effects: Relative risk aversion and maternal time investments in preschool children[†]

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Abstract

Judging from the abundant and expanding literature on educational inequalities, the apparent consensus is that divergent educational outcomes of individuals can be explained by two main mechanisms: class-specific differences in children's skills (primary effects) and educational choices, net of skills (secondary effects). Contrary to the widespread agreement that primary effects stem from differences in parental tangible and cultural resources and that secondary effects result from decisions made based on class-specific constraints, we contend that parents across social classes invest in their children differently for equivalent levels of children's perceived skills—thus, primary effects and secondary effects work in similar ways. Formulating a rational-choice model of primary effects, we hypothesize that parental investments in children's skills during the early stages of their life course are stratified according to the combined effects of *relative risk aversion* and *cumulative advantage*. Using data from the German Socio-Economic Panel (SOEP) and controlling for parental resources, we tested this hypothesis by asking whether mothers spend more or less time engaged in cognitively stimulating activities with their preschool children at age 5 to 6 depending on the child's observed past language skills and the parents' social class. Ordinary least squares estimates suggest that mothers' activities with their children not only are stratified across social classes but also reflect a class-specific reaction to children's observed past ability consistent with our assumed mechanisms. Lower-class mothers invest in cognitively stimulating activities in a selective way: the higher the perceived ability of the child, the more effort is invested in these activities; in contrast, higher-class mothers do not differentiate their investment according to their child's observed ability. Level of maternal education and extent of child care support in the household have an additional positive impact on levels of activity. Implications of the results and possible extensions of the model are discussed.

Keywords: primary effects; secondary effects; relative risk aversion; cumulative advantage; skill development; parental investments

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1. Introduction

Despite the abundant interdisciplinary effort that goes into research on social mobility and educational inequality, the astonishingly universal and persistent influence of the family of origin—partially reduced over the last decades by the undoubted successes of educational expansion and school democratization (Breen, Luijkx, Muller, & Pollak, 2010)—remains largely unexplained. The pathways from social origin to children's attainment not only are due to a variety of social factors (Smeeding, Erikson, & Jäntti, 2011) but also are intertwined with genetic influences in complex ways (Branigan, Freese, & McCallum, 2013). Aside from properly considering the genetic contribution to the transmission of advantage and disadvantage, two shortcomings in the previous research on social stratification are increasingly coming into focus. First, existing research devotes perhaps too much attention to the conditions for upward mobility, whereas an important part of the durable reproduction of inequality may be due to the fact that downward mobility from the top is mostly avoided and therefore less likely than upward mobility. Therefore, a social mechanism describing how downward mobility is avoided could make a particularly powerful contribution to the overall explanation of durable inequality across social origins. Second, there is increasing evidence that the sensitive period of early childhood is already of seminal importance for the intergenerational transmission of advantage and disadvantage. In this early life stage, plasticity is more pronounced than it is later on, with unfavorable as well as beneficial experiences being more influential for individual development (Thomas & Johnson, 2008).

In this article, we intend to address both these shortcomings. We develop a formal model of primary effects based on parental decisions about investing in their children's skills given the social class of the household and existing inequalities in parental resources. We assume that more favorable social origins are advantageous for children's skill development because these parents have more material and cultural resources to invest. In addition, we argue that parents behave differently; the degree to which they invest in their children depends on their subjective level of uncertainty regarding the expected success of their offspring in terms of reaching different positions in the social hierarchy. From this standpoint, the same observed ability of the child is evaluated differently by parents from different social origins. To test the main predictions of the model, we look at cognitively stimulating maternal activities with children at the age of 5 to 6 according to parental social class and resources, and children's past verbal ability as observed by the mother when the child was 2 to 3 years of age. We focus on social class but also consider household income, child care conditions, and the mother's available time and education level. This allows us to determine whether class-based motives for

avoiding downward mobility are due to an unequal distribution of resources between social classes, or whether they play a decisive role irrespective of such unequally distributed resources.

Our model fits well into the sociological research on the primary effects of social origin as well as into the economic research on skill production and parental investments. To explain this relationship, one favorite approach in sociological research is to develop theories based on some variant of cultural capital (van de Werfhorst & Hofstede, 2007; Lareau, 2011), showing that things "money can't buy" (Mayer, 1997) are often more important than income or poverty. We follow this line of research by focusing on parenting practices that can be understood as cognitively stimulating activities belonging to the "concerted cultivation" type of parenting described by Lareau (2011) as prevalent among middle and high-class parents to stimulate their children's skill development. From an economic perspective, these activities can also be seen as investments in the development of the child (Cunha & Heckman, 2007; Almond & Currie, 2011); they start long before school enrollment and target general skills that have been shown to be important for success in school, labor markets, and life in general (Heckman & Kautz, 2012).

Although we do not deal with educational success in this article, we borrow from the *relative risk aversion* mechanism proposed by Breen and Goldthorpe (1997) to investigate the hitherto overlooked possibility that the primary effects of skill development may result from the same constraint action and motivation to avoid downward mobility given class position as secondary effects on schooling, and not simply from an unequal distribution of resources.[1] In addition, we consider a second mechanism, *cumulative advantage*, as a further process that explains differences in skill development over time. If we find that the mechanism underlying both primary and secondary social origin effects is similar and can show how it is consonant with cumulative processes of skill growth, we might provide a key to understanding why the impact of social origin is so persistent in shaping life chances, and why the avoidance of downward mobility from the top contributes so much to this persistence. This finding would also provide an example for Tilly's (1998) observation that durable inequalities are structured by the repeated operation of the same mechanism for the same subgroups across different contexts.

This article is organized as follows: In Section 2 we formulate an analytical model of parental decisions and primary effects and derive its main predictions. To test model predictions, we use data from the German Socio-Economic Panel (SOEP) on maternal cognitively stimulating activities with preschool children. Section 3 presents data, measures, and methods, and the results are displayed in Section 4. The

[1] The model of relative risk aversion explicitly excludes primary effects from its explanandum (Breen & Yaish, 2006, p. 233).

final section discusses the relevance of our results to the question of intergenerational transmission of inequality and suggests some model extensions.

2. Parenting practices and social class: A formal model

To derive predictions about parental investment behavior, we develop a simple rational-choice model that resembles Breen and Goldthorpe's (1997) model for secondary effects. Our model is based on three sets of assumptions: those related to the *social structure*—the system of positions in which individuals are embedded; those related to *skills*—what they are and how they grow; and, most central to the model, those related to *parental choices*—the factors that shape the way parents behave when allocating resources to their children. In the final part of this section (**Section 2.6**), we present five model predictions based on these assumptions about parental investment behavior and children's skills as a function of social class. Readers who are not interested in the formal structure of the model may skip Sections 2.1 to 2.5 and go directly to the discussion of the model predictions.

2.1. Social structure

The social structure consists of a set of positions occupied by households which are associated with distinct sets of desirable goods and life chances. The exact boundaries of these positions need not be specified. They can be defined along the lines of types of employment relationships, as in the Erikson–Goldthorpe–Portocarero (EGP) class scheme (Erikson & Goldthorpe 1992, ch. 2) or alternative class models, as long as three conditions are met:

(1) The dimensions that define social positions are perceived by households; they are not nominally created groups, such as "the proletariat," but correspond to salient attributes used by individuals to define themselves and others.[2]

(2) The positions demarcated by social structure can be ordered hierarchically from lower to higher in terms of desirability.

(3) There is a commonly shared agreement about the relative ordering of these positions. For the purposes of our model, and to keep the algebra simple, we assumed the existence of three social positions: high (H), intermediate (M), and low (L). The model can be extended to any number of positions higher than three.

[2] In the case of the EGP scheme, it would be difficult to argue that individuals are aware of belonging to the "service class." However, they certainly are aware of the type of employment relationship that dictates their working conditions and are able to compare it with others in different employment relationships.

2.2. Skills

Skills encompass cognitive abilities that include but are not limited to those measured by IQ tests, as well as socioemotional capacities such as perseverance, achievement striving, assertiveness, ambition, curiosity, sociability, and delay of gratification, which have a positive impact on economic and social success (Heckman & Kautz, 2012). Although skills are by definition multiple, to simplify the model we assumed the existence of a single dimension of skills, which can be understood as a bundle of various skills. Children are born with a skill endowment, designated s_0. From this initial level, skills grow through a cumulative, path-dependent process that is a function of past skill levels (s_{t-1}), where s represents skill and t represents time, and parental investments (I_t), as suggested by research on the economics of skill formation (Cunha & Heckman, 2007). We make no assumptions about the distribution of skills in society, contending that there may be a social gradient of initial skill endowments with unknown distribution as the result of both genetic factors and prenatal parental behavior (Hackman, Farah, & Meaney, 2010) (see **Section 2.5** on mechanisms and reinforcing factors).

2.3. Parental choices

Parents and households are treated as a single entity that decides whether to invest in their children's skills, and if so, how much. All the parents have only one child, so no distinction is made between decisions made by the mother or the father, nor is there a need to consider the intrahousehold allocation of resources among siblings. Parents decide how much to invest in their children's skills given the costs of investment, available resources, and expected utility, which is a function of parental expectations about the child's future position within the social structure. Aside from costs and available resources, investment decisions are affected by beliefs about the likelihood that parental efforts will pay off in terms of higher skill levels (π) and the expected probabilities that different levels of skills will confer differential access to positions in the social structure in the child's future (θ).

How effective parents are in solving this allocation problem is an empirical question and not an assumption of our model. We do not pose any form of optimization that requires perfect information and superhuman abilities. We simply assume constrained action, that is, parents try their best to ensure their offspring's future success by providing them with a good start in life in terms of skills, given available resources, investment costs, and expected benefits.

2.3.1. Parental investments

In general, parental investments can be defined as all monetary, time, and emotional resources that parents provide to their children and that contribute to their well-being. The reason we use the concept of *parental investment* is not that we subscribe to an economistic or biologistic reduction of parenting to maximization of expected returns (Becker & Tomes, 1986) or offspring survival (Hamilton, 1964a, b; Trivers, 1972). Rather, we use the term *investment* because parental resources are non-gratuitous and finite (money, time, affection) and hence subject to allocation, and because resource allocation is not arbitrary but responds to parents' expectations about the impact these resources are likely to have on their children's skills and, ultimately, on their future social and economic success.

We explicitly narrow down the scope of our analysis to the subset of those parental investments that positively affect children's skills. Among others, these investments include availability of books in the household or of stimulating leisure activities (such as playing an instrument), which have been shown—and which parents often assume—to have a positive impact on a child's skill development (Jaschke, Eggermont, Honing, & Scherder, 2013; Schellenberg, 2011). This distinction refers to the concept of cultural capital suggested by Lareau (2011), who distinguished between "concerted cultivation," which tends to be found among the intermediate and higher classes, and "accomplishment of natural growth," which is predominant among the lower classes. In a corresponding view, these parental activities, seen as investments, are also part of the skill production function (Cunha, Heckman, & Schennach, 2010). Thus, the model is not about explaining the expressive side of parenting, nor is it about how much parents love their children and care for them, but rather it is about shedding light on the more instrumental side of parenting, on that extra effort some parents consciously make to secure an advantage for their children in the education system and, later, in labor markets by promoting their abilities early in life.

2.3.2. Costs

Parents are faced with direct costs and opportunity costs. Investments in children's skills require attention and time spent with children as much as they do financial resources to pay for books, musical instruments, and private lessons. Opportunity costs take the form of less leisure time and foregone income. We assume that the costs for comparable investment levels are the same for parents in all social positions.

2.3.3. Beliefs about success of parental investments (π)

As in Breen and Goldthorpe's (1997) model, in which the expected probabilities of success differ among pupils, in our model parents differ in their beliefs about how much their investments contribute to children's skill development. To avoid cultural explanations of parental investments that pose the existence of class-specific parenting styles, we assume no class-specific differences in the ability of parents to provide their children with appropriate stimulation and thus no differences in π aside from individual deviations, which are not systematically related to social position.

2.3.4. Beliefs about skill levels and future social position (θ)

Parents expect their children to fare differently later in life depending on their skill levels. These beliefs are captured by a set of subjective probabilities θ_i, which assigns to each level of skills a value between 0 and 1 of reaching a high (θ_1), intermediate (θ_2), or low (θ_3) social position, such that $\theta_3 = 1 - \theta_1 - \theta_2$. Because skills are a continuous variable, there are as many probabilities θ of reaching a given class of destination as there are skill levels.

2.3.5. Parental decision tree

For any given level of observed skills, parents decide between investing and not investing in their children. If they do invest, the success or failure of their efforts is determined by the subjective probability π. To each of these three possibilities they attach a different set of θ_i probabilities. If investments are successful, the set of subjective probabilities, α_i, captures parental expectations about entry into each one of the three possible positions in the social hierarchy. If the investments are not successful, probabilities are represented by β_i, whereas γ_i represents the subjective probabilities of abstaining from investing in children. Note that the investment decisions made by parents are dynamic; they observe *s* in each *t* and decide to invest or not to invest according to the decision tree depicted in **Figure 1**.

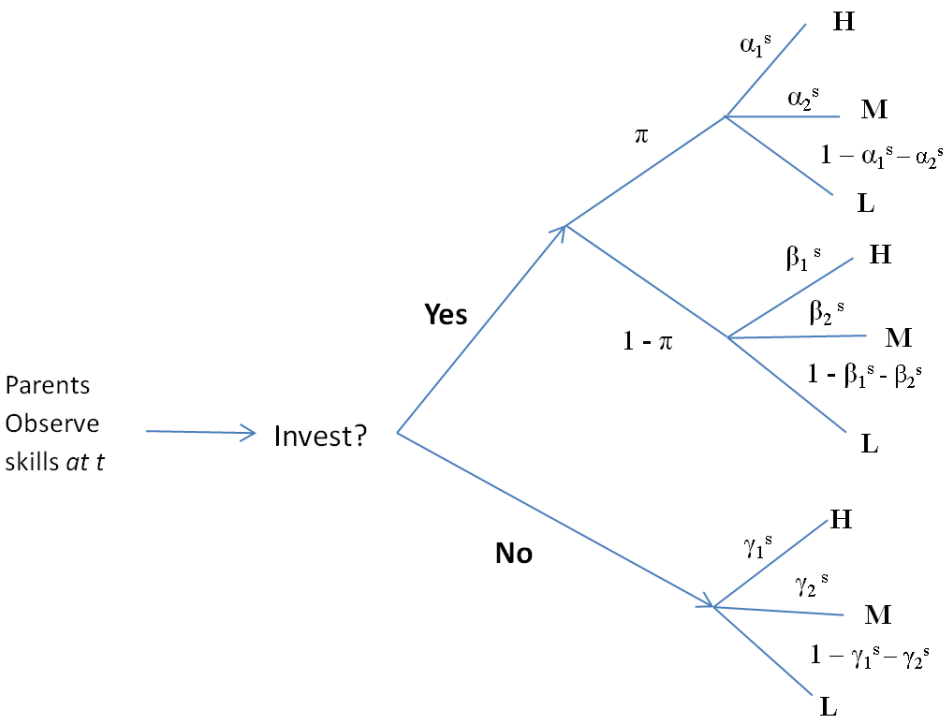


Figure 1. Parental decision tree.

2.4. Assumptions about α_i, β_i, γ_i, and π

Although probabilities π and θ_i are subjective, we assume that individuals have some common beliefs about the relationship between skills and access to different positions in the social structure. Small deviations from the norm should not affect the predictions of the model. For a given level of observed skills(s), we assume the following conditions for parameter values:

***Assumption i*: $\pi > 0.5$**. Parents expect investments in stimulating activities to be successful, that is, to lead to higher skills than no investments.

***Assumption ii*:** The relative ordering of α_i, β_i, and γ_i is equal for all individuals regardless of social position.

***Assumption iii*: $\alpha_1^s > \beta_1^s > \gamma_1^s$**. Successfully investing in cognitively stimulating activities raises the probability of reaching the highest social position ($\alpha_1^s > \beta_1^s$). Even if investments in cognitively stimulating activities are not successful in increasing children's skills, they are not perceived as harmful and hence are always thought to be conducive to achieving high social positions compared with not investing in children at all ($\beta_1^s > \gamma_1^s$).

Assumption iv*: $\gamma_3^s > \beta_3^s > \alpha_3^s$** (corollary of condition ***iii above). Not investing in cognitively stimulating activities increases the risk of ending up in the lowest social position.

Assuming three points in the skill distribution—one from the top of the distribution (s^T), one from the bottom (s^B), and the average (s^A)—three additional assumptions can be formulated:

***Assumption v*: $\alpha_1^{sT} > \alpha_1^{sA} > \alpha_1^{sB}$**: Investing in children with high skill levels is believed to improve their chances of reaching high social positions compared with investing in children with average or low skill levels.

Assumption vi*: $\gamma_3^{sT} > \beta_3^{sT} > \alpha_3^{sT} > 0$**. Despite condition ***v above, high skill levels are not seen as a guarantee for avoiding the lowest social position.

***Assumption vii*: $\alpha_3^{sB} > \alpha_3^{sA} > \alpha_3^{sT}$; $\beta_3^{sB} > \beta_3^{sA} > \beta_3^{sT}$; $\gamma_3^{sB} > \gamma_3^{sA} > \gamma_3^{sT}$**. Low skill levels are believed to increase the risk of entering the lowest social position**.**

2.5. Mechanisms and reinforcing factors

In our model, we propose that two linked general mechanisms—relative risk aversion and cumulative advantage—combined with differences in parental resources can explain how social origin translates into unequal chances for children. The distinction between mechanisms and parental resources as reinforcing factors is not arbitrary. Reinforcing factors are constitutive elements of existing inequalities that set the stage for parental behavior. They are reified past inequalities, such as differences in parental income, education, or available time, which facilitate or impede investing successfully in children's skills.[3] In contrast, the two mechanisms we propose refer to the generative processes that transform those reified structural conditions into fresh inequalities, perpetuating existing disparities through constrained individual actions from one generation to the next.

2.5.1. Relative risk aversion

As suggested by Breen and Goldthorpe (1997), and later supported empirically by Breen and Yaish (2006), the ambition and perceived ability of children in the lower classes must be higher than those for children in the upper classes in order for parents to choose to continue their schooling and higher education. The reason for this is that a dominant reason for investing in education is to maintain status or prevent downward mobility. To reach a class position at least as good as the one with which children in lower classes begin, a lower level of education is needed, and a risky and costly continuation of the child's educational career is therefore less likely for a given level of motivation and/or ability. In other words, parents react differently to the same child ability or school performance depending on their own social class. This same argument can be extended to parental investments: if the goal of parents is to avoid downward social mobility, and if skills are perceived to be as consequential for their offspring's future class positioning as educational decisions are, then their decision about whether or not to invest in their children should be in line with a risk-minimizing strategy that will keep them from sliding down in the social hierarchy. Thus, parents will invest in their children if the expected probability of downward social mobility is lower than if they decide not to invest in their children's skills.

[3] Aside from time, money, and education, favorable genetic endowment, which is difficult to measure, certainly contributes to reinforcing factors. See Branigan et al. (2013) and Diewald, Baier, Schunck, and Schulz (in press) on how genetic factors interact with social forces to produce the impact of the family of origin on socioeconomic attainment.

2.5.2. Cumulative advantage

If "skills beget skills and abilities beget abilities" (Cunha & Heckman, 2007, p. 35) via an interplay between observed child's skills and parents' reinforcing engagement in cognitively stimulating activities with the child, a strong version of cumulative advantage should describe skill growth in children (DiPrete & Eirich, 2006). Given the cumulative character of skill growth, parental investments will tend to show a certain level of path dependence: if parents believe in the benefits of their investments in terms of children's skill growth as a function of observed skills, then children will tend to receive more from their parents if their skills are higher, which in turn enhances their skill development, thus creating a self-reinforcing beneficial spiral. Over time, small differences in ability should grow further apart. In our model, we focus on only one part of this cycle, namely, the assumption that a higher level of observed skills prompts more parental engagement in cognitively stimulating activities. The other side of the causal relationship, the effect of investments on skills, has been amply studied in the work of Heckman and others (e.g., Cuhna et al., 2010).

Note that depending on class position the effect of the two mechanisms we have just identified can potentially be contradicting. According to cumulative advantage, and insofar as "concerted cultivation" activities consume more time and energy than other parenting practices, parents should engage their children more in these activities than in others if the perceived skills of the child lead them to believe that the invested effort will fall on fertile ground. At the same time, investments in cognitively stimulating activities should be greatest if they promise to protect against the fear of future downward mobility, which is greatest if the level of skills is low. Because resources are distributed unequally among classes, this explanation implies that higher-class parents may invest in their children even if the ground is perceived to be less fertile, whereas lower-class parents make such investments only if what they perceive suggests a safe investment. How relative risk aversion and cumulative advantage interact, and whether they neutralize or reinforce each other, should be an empirical question.

2.5.3. Reinforcing factors

Because investments are costly, the distribution of resources directly affects the capacity of parents to invest. For example, there is ample evidence that not only do more highly educated mothers spend more time with their children than do less educated mothers (Guryan, Hurst, & Schettini Kearney, 2008; Sayer, Gauthier, & Furstenberg, 2004), but they do so in qualitatively different activities, such as reading instead of watching television (Bianchi & Robinson, 1997; Hofferth & Sandberg, 2001). Also, household income correlates positively with the amount of time parents spend with their children

(Guryan et al., 2008; Zick & Bryant, 1996). In short, if more resources are available in higher social positions, then parents in these positions would tend to invest more than parents in intermediate and low social positions.

2.6. Model predictions

Based on our assumptions about π and θ_i (see **Section 2.4**), the following three model predictions can be derived. Mathematical derivations of these predictions are presented in **Appendix B**.

2.6.1. Relative risk aversion

Prediction 1a: For any given level of children's skills, parents in high social positions tend to invest more in their children than do parents in intermediate and low social positions.

Prediction 1b: Compared with parents in intermediate social positions, parents in high social positions are more willing to invest in their children if they are at the bottom of the skill distribution relative to children with average skills.

Prediction 1c: Compared with parents in high social positions, parents in intermediate and low social positions are more willing to invest in their children if they are at the top of the skill distribution relative to children with average skills.

2.6.2. Cumulative advantage

Prediction 2: Parents invest more in children with higher skills than in children with lower skills.

2.6.3. Reinforcing factors

Prediction 3: The more resources parents command, the higher their investments in their children's skill development.

3. Data, measures, and methods

3.1. Data

We use data from the German Socio-Economic Panel (SOEP, v29), a representative longitudinal study of private households in Germany that has been conducted annually since 1984 (Wagner, Frick, &

Schupp, 2007). The data come primarily from the mother–child questionnaires which were introduced in 2003 and which collect detailed information from mothers about various aspects of their children's lives. Data on every child in the sample are collected every 2 years starting at birth. For our analysis, we pool all the completed mother–child questionnaires on children surveyed at ages 2 to 3 and 5 to 6 between 2005 and 2012 (N = 872) and combine these data with data from the household questionnaire and from parents' individual questionnaires in the SOEP study. Of the pooled results, roughly 25% of the children are siblings belonging to the same household who were surveyed at different years of age. We take advantage of this fact in our statistical analysis but do not conduct any sibling analyses.

3.2. Measures

Our dependent variable is parental investments, measured as *mothers' frequency of cognitively stimulating activities with their children*. Mothers self-report the frequency of these activities using a four-item scale (*daily*, *several times per week*, *at least once a week*, and *never*) which includes the following four types of activities: singing children's songs with or to the child, painting or doing arts and crafts, reading or telling stories, and playing cards or the game of dice. These are considered "quality time" activities in which the child is the primary focus (Price, 2008), hence we plausibly assume that they reflect developmental, especially cognitively stimulating, ways in which the mother interacts with her child (Zick & Bryant, 1996; Hofferth & Sandberg, 2001), as opposed to activities in which the parent and child simply spend time together. We test the scalability of these four items using both factor analysis and Mokken scale analysis, which is a more natural way to work with categorical data.[4] Both methods suggest one dimension. We then construct a standardized sum index with the four items.

Our main explanatory variables are children's skills and parental class position. In the SOEP study, children's skills are measured using a battery of items related to child development based on a modified version of the Vineland scale (Sparrow, Balla, & Cicchetti, 1984) and adapted for Germany by Tietze (1998). Of the different dimensions of child development measured by this scale, we focus on language skills because they are directly related to our measurement of investments.[5] The scale includes five questions about children's language skills, listed in **Appendix A**, which are answered by the mother with "yes," "to some extent," or "no." We code each of the respective answers with 2, 1, or 0 to provide

[4] Mokken scale analysis is an item response theory (IRT) model that allows one to test the scalability of categorical items on a cumulative scale (Mokken, 1971; Molenaar, 1997).
[5] The other three dimensions measured by this scale in SOEP are everyday skills, movement, and social relationships.

a summary index for all five items, resulting in values between 0 (minimum) and 10 (maximum). Because mothers are asked to rate their children's skills, this measure confounds actual skill levels with maternal beliefs about skill levels. Although this scale's proxy character certainly increases errors in the measurement of actual skill levels, it offers an advantage for testing the predictions of our model, which is constructed around parental subjective beliefs. This would not have been the case had we used a more "objective" measure of skills that ignores maternal perceptions.

To measure social class, we use the EGP scheme (Erikson & Goldthorpe, 1992). Because our model requires a hierarchical ordering of classes, we adopt Breen and Yaish's (2006) recommendation and work with a modified four-class model in which the high service class is at the top (class I), followed by the low service class (class II), then mixed classes (classes III, V, and VI), and the labor class at the bottom (class VII). These four classes are ordered based on the type of employment contract, service contract, or labor contract. The self-employed and the "petty bourgeoisie" (class IV) are excluded from the analysis on the assumption that mobility in these classes is more about the inheritance of property than about the attainment of status as a result of educational and occupational success (ibid., p. 242). In terms of our model, this means that mobility in those classes is not about promoting skills. By the same token, because mobility in the classes included in our analysis is not about inheritance of wealth, we exclude household wealth from the list of control variables. To these four classes we add a fifth group: the unemployed. As research on skill development and adverse events in the life course suggests, parental unemployment may have a negative impact on child development partially through a direct effect on parental investments (see, e.g., Duncan, Brooks-Gunn, & Klebanov, 1994). To assign a household to any of the resulting five categories (one of the four EGP classes or the unemployed), we take the maximum value between mother and partner, if available.

In addition to children's skills and parental class position, we include measures for parental resources, in particular household income and maternal education, as well as variables that affect maternal time availability. As a measure for income, the equivalized disposable income is used, which adjusts household income to account for the number and age of household members according to the new OECD scale. To measure education, the mother's educational attainment is used according to the CASMIN typology, with four categories (basic, intermediate, maturity, and tertiary).

We consider a comprehensive list of controls that affect how much time mothers devote to cognitively stimulating activities with their children. Household composition is measured by considering the number of siblings in the household and family type (single mothers, couples, and multigenerational households). We also include dichotomous variables (yes/no) for at least one hour of child care in a

normal week by the partner or father, the grandparents, institutionalized daycare, or older siblings. For the mother, we also include age (in years), working hours per week, and overall self-reported child care time; the last variable was reported separately for weekends and weekdays. We add up these figures and divide the result by the number of hours in a 7-day week to produce an index of overall time devoted to child care. The index is defined in the range 0 (minimum) to 1 (maximum). This control is important because the frequency of cognitively stimulating activities could otherwise be confounded with the overall time devoted to activities that does not include cognitively stimulating ones or to activities shared with siblings. Finally, we control for the child's age (in months), gender, and any diagnosed impairments or health conditions (yes/no). Summary statistics are displayed in **Table 1**. Only those cases with complete data for the dependent and all independent variables are presented (N = 766).

Table 1. Summary statistics

Variable	Mean	SD	Min	Max
Frequency of maternal activities (std. index)	0.03	0.99	−3.20	1.81
Language skills of child	8.98	1.57	0	10
Age of child (in months)	69.02	3.86	62	79
Health of child (yes/no)	0.57	0.50	0	1
Gender of child (boys = 1)	0.49	0.50	0	1
No. of siblings in household	1.19	1.04	0	10
Child care by partner (yes/no)	0.75	0.43	0	1
Child care by father (yes/no)	0.08	0.27	0	1
Child care by grandparents (yes/no)	0.54	0.50	0	1
Day care (yes/no)	0.77	0.42	0	1
Child care by siblings (yes/no)	0.18	0.38	0	1
Equivalized annual household income (in thousand)	43.94	2524	2	288
Mother's age (in years)	36.57	5.54	22	50
Mother's working time	17.92	16.25	0	80
Mother's years of education	12.98	2.82	7	18
Mother's total child care time (% week)	0.29	0.20	0	1

3.3. Analytical strategy

We fit linear regressions with ordinary least squares estimates for children at ages 5 to 6. We compare frequencies of activities across individual children, not within families. To control for shared sibling variance in cases where more than one child had been surveyed at different waves in the same family, we use clustered standard errors at the household level. We run two model variations. Model 1 focuses on class and child characteristics only and excludes parental resources and other maternal and household covariates. It also includes an interaction term between social class and perceived past child

language skills when children were 2 to 3 years old. Measuring the effect of past observed skills on present levels of investments should help us get around the problem of reverse causality. Model 2 adds to Model 1 parental resources (income, family type, child care, maternal education) and variables affecting maternal available time. Based on these models, we test the five predictions formulated in **Section 2.6.**

4. Results

4.1. Bivariate analysis

Table 2 displays the average observed language skills of children at age 2 to 3 according to class. As expected and consistent with previous research, the skills of children even at this young age differ between higher and lower social classes.

Table 2. Average children's language skills according to class in our sample

Class*	**Mean language skills**
I	9.18
II	9.20
III, V, VI	8.95
VII	8.74
Unemployed	8.50
Overall average	**8.98**

*All class designations are from the EGP scheme except for Unemployed.

The frequency of cognitively stimulating activities across social classes are shown in **Figure 1**. We see, in line with Prediction 1 of our model, as well as the literature on cultural capital—especially the distinction between "concerted cultivation" in higher classes and "natural growth" in lower classes (Lareau, 2011)—the expected stratification of such activities. It is the same pattern that describes average skills, with class I at the top and the unemployed at the bottom (remember that the index for frequency of activities is standardized around 0). The evidence one finds in **Table 2** and **Figure 2** is confirmed by a simple analysis of variance (ANOVA): children's language skills and the frequency of maternal activities differ according to class ($p < 0.01$).

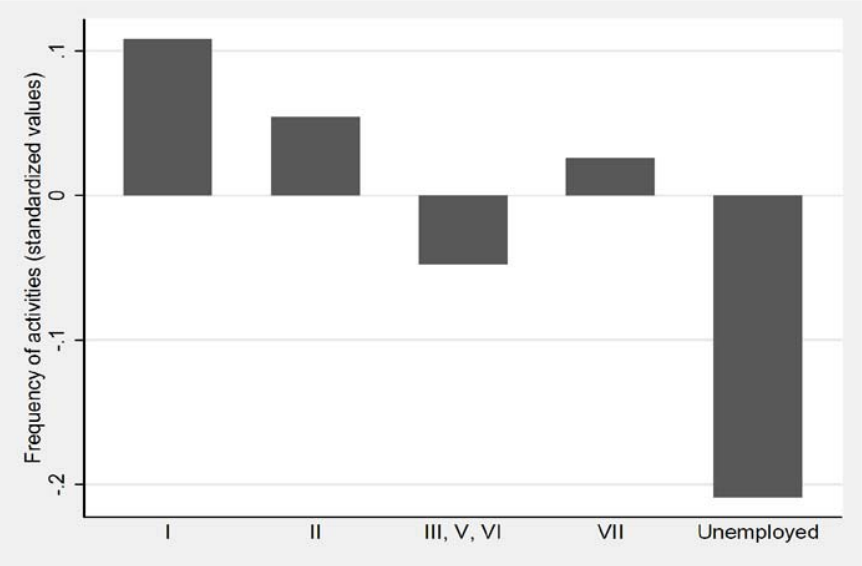


Figure 2. Average frequency of activities according to social class

4.2. Multivariate analysis

Parameter estimates for Models 1 and 2 are shown in **Table 3**. Because both models include an interaction term, we made use of predicted mean values to visualize our results more clearly and to test our hypotheses.

4.2.1. Relative risk aversion

Prediction 1a. As summarized in **Figure 3**, the adjusted average frequencies of activities by class in both models follow the decreasing pattern depicted in **Figure 2**, yet the differences among the classes are not statistically significant. Only the positive value for class I in Model 1 is statistically different from zero. Once parental resources are included in the model (Model 2), average values in all classes tend to converge to the average. Relative class ordering remains intact, however: class I is at the top, with above-average values, and the unemployed are at the bottom, with values below the average. This finding suggests that some but not all class differences with respect to frequency of activities, as displayed in **Figure 2**, are due to inequalities in parental resources. Class still makes a difference after all control variables are included, which is compatible with our hypothesis that class-specific motives are agnostic to resources such as time, money, or education. However, as shown by the confidence intervals around the predicted averages in **Figure 3**, which combines the main and interaction effects, these "pure" class differences are estimated with broad confidence intervals.

Table 3. Parameter estimates for Models 1 and 2

	Model 1		**Model 2**	
Child				
Age	−0.026	**	−0.022	**
	(0.010)		(0.010)	
Health impairments	0.087		0.061	
	(0.073)		(0.074)	
Gender (boys)	−0.284	***	−0.271	***
	(0.071)		(0.072)	
Language skills (t−1)	−0.024		−0.024	
	(0.043)		(0.044)	
Household				
EGP (ref. class I)				
II	−0.714		−0.644	
	(0.641)		(0.727)	
III, V, VI	−0.772		−0.658	
	(0.583)		(0.593)	
VII	−2.029	***	−1.858	**
	(0.723)		(0.740)	
Unemployed	−1.540	**	−1.307	*
	(0.745)		(0.730)	
HH Income (yearly; 000)			−0.001	
			(0.002)	
Family type (ref. single mothers)				
Couple			0.149	
			(0.164)	
Multigenerational			0.703	*
			(0.391)	
Number of siblings			−0.057	
			(0.051)	
Child care				
Partner			−0.021	
			(0.105)	
Father			0.128	
			(0.153)	
Grandparents			0.018	
			(0.075)	
Day care			0.097	
			(0.095)	
Older siblings			0.015	
			(0.103)	

	Model 1		Model 2	
Mother				
Working hours (per week)			−0.002	
Education (ref. basic)			(0.003)	
Intermediate			0.179	
			(0.118)	
Maturity			0.310	**
			(0.141)	
Tertiary			0.278	**
			(0.131)	
Overall child care time			0.382	*
			(0.198)	
Interaction terms				
Language skills (t−1) x EGP (ref. class I)				
II	0.074		0.066	
	(0.068)		(0.077)	
III, V, VI	0.076		0.067	
	(0.063)		(0.063)	
VII	0.212	***	0.201	**
	(0.079)		(0.081)	
Unemployed	0.153	*	0.132	*
	(0.081)		(0.079)	
(constant)	2.183	***	1.548	*
No. of children	766		766	
No. of households	670		670	
R2 (adjusted)	0.039		0.046	

Standard error is shown in parentheses; *p < 0.1, **p < 0.05, ***p < 0.01

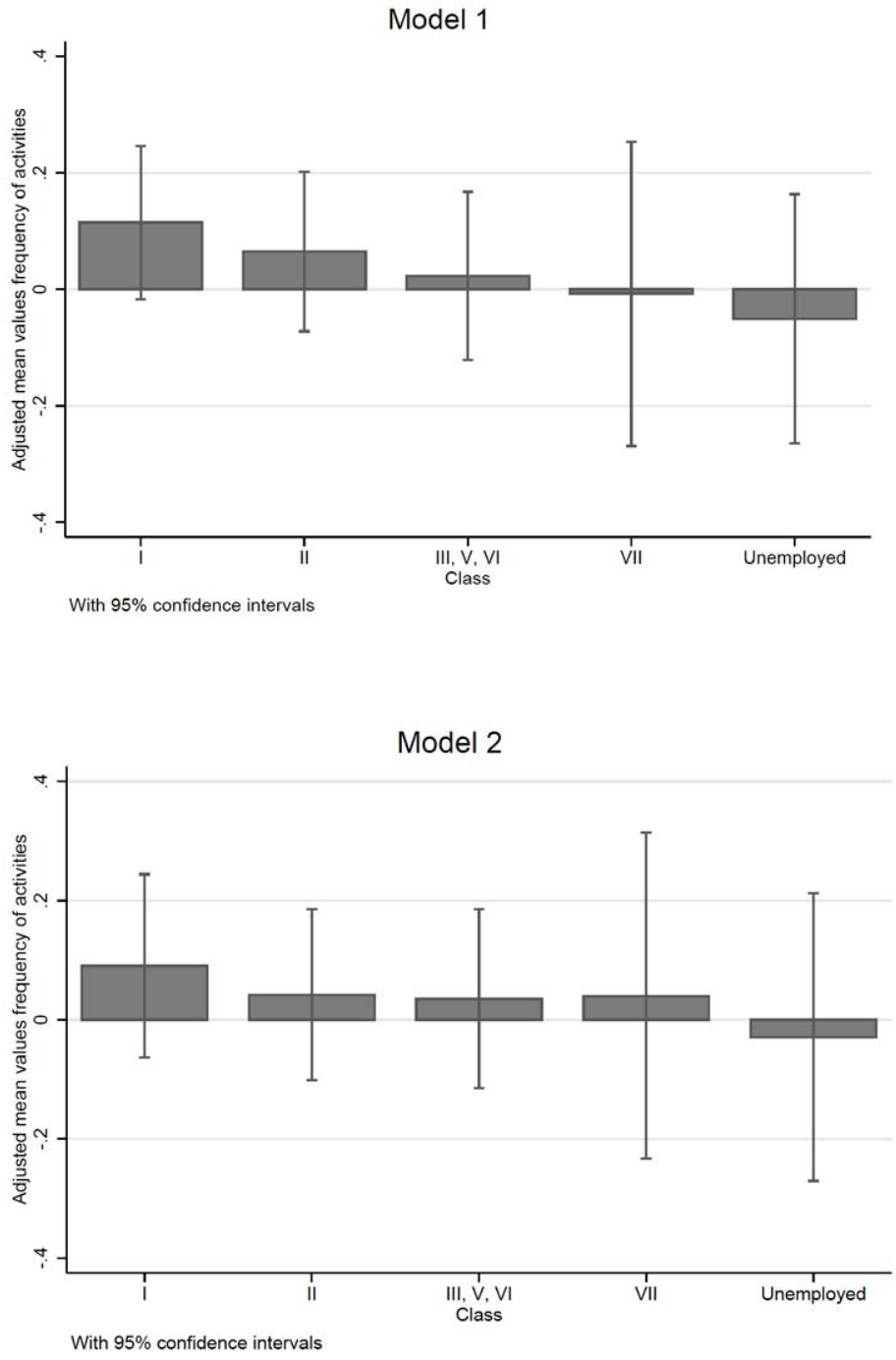
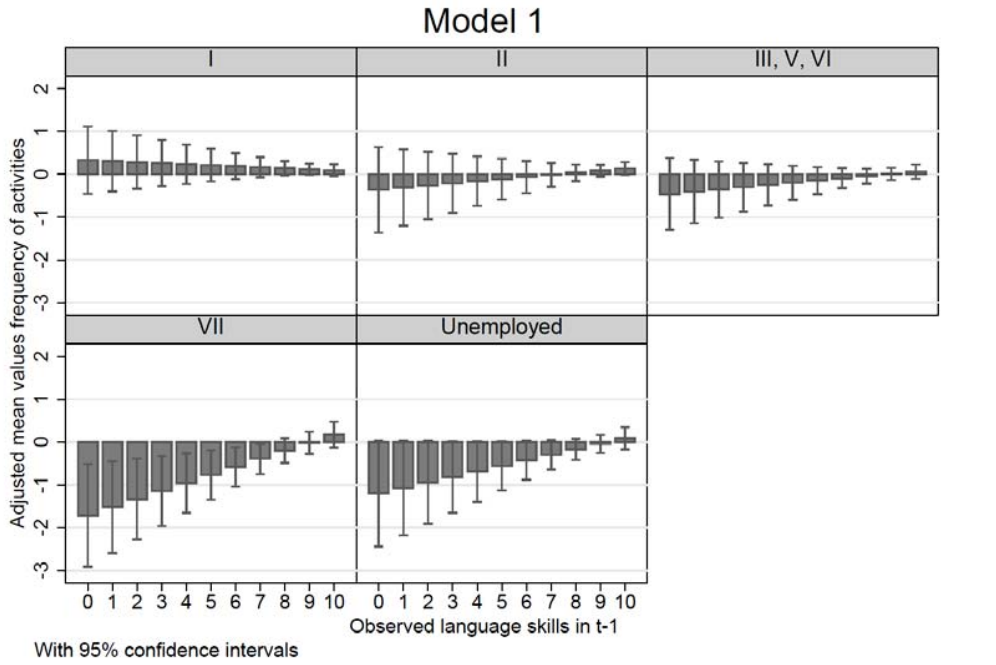


Figure 3. Predicted average frequency of activities according to class

Predictions 1b and 1c. As shown in **Figure 4**, the variation in the adjusted mean frequency of cognitively stimulating activities dependent on different levels of past observed language skills does not

follow the same pattern across social classes. As expected, the predicted mean frequency of activities for children with low skill levels in service class I is above average and greater than for children with high skill levels. However, these differences are small and not statistically significant. We therefore refrain from interpreting this result as compensatory maternal investments in cognitively stimulating activities. In contrast, and also consistent with our predictions, the opposite is true for intermediate classes and particularly for the lower classes. Mothers in class VII and in the unemployed category invest well below average in children with low skill levels and slightly above average in children with high skill levels. The size of the predicted underinvestment in children with low skill levels is considerable in terms of frequency of activities. Mothers in class VII invest 1.6 standard deviations below average, and unemployed mothers invest 1.0 standard deviation below average. Referring back to the raw scores of the scale, a 1.0 standard deviation fewer activities corresponds to a reduction from doing an activity daily, say reading a book with the child, to never doing it, or to go from doing all four activities daily down to doing them several times per week. In short, maternal investments at the top of the class hierarchy appear not to be dependent on children's observed skills. In contrast, mothers in the lower classes (class VII and unemployed) are more sensitive to observed skills by making below-average investments in children with lower observed skill levels.

By comparing the two models, an additional conclusion can be drawn. The response of mothers to different children's skill levels found in Model 1 does not change much if variables for parental resources—time, income, and education—are introduced. This finding suggests that the difference among classes in parental behavior given children's skills are explained not by variations in resources confounded with class membership but by class-specific motives.



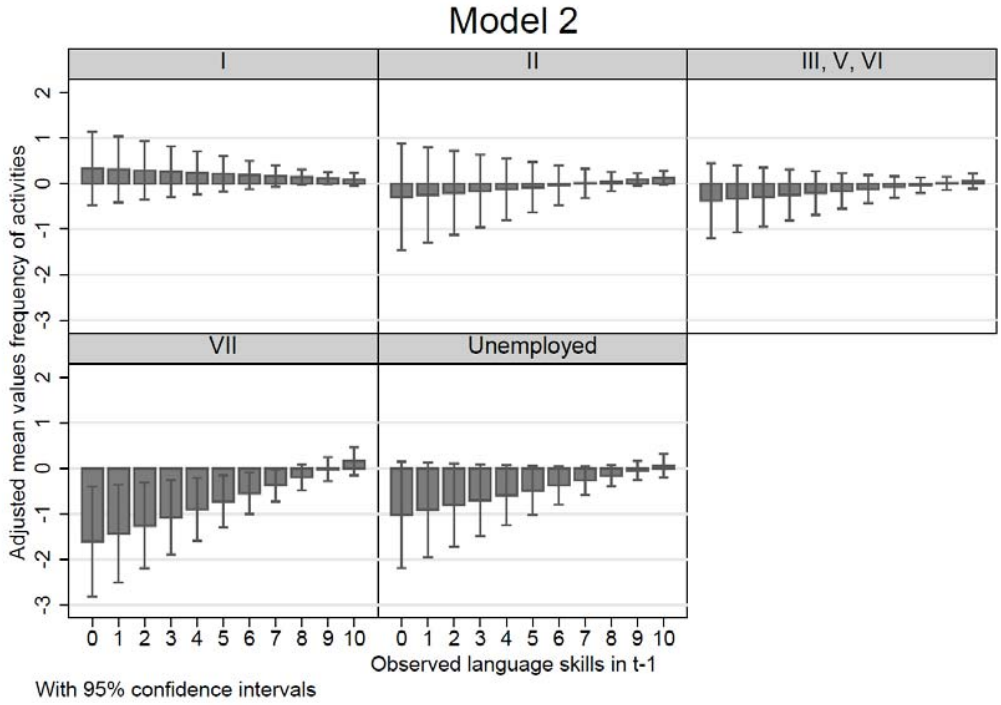


Figure 4. Contrast of adjusted mean values for frequency of activities according to class and past observed language skills

4.2.2. Cumulative advantage

Prediction 2. So far we have shown that mothers in the lower class react selectively to observed past language skills, thus presumably reinforcing past skill levels, which constitutes a form of cumulative investment behavior in itself. On average for all mothers, there is also evidence of a cumulative advantage mechanism. As summarized in **Table 4**, the marginal effect of past skills on frequencies of activities irrespective of class position is positive and statistically significant. This is true for both Model 1 and Model 2 and gives credence to the cumulative character of parental investments as a function of children's skills.

Table 4. Marginal effect of past language skills on current frequency of activities

	Marginal effect	**Std. error**	**t**	***p* value**	**[95% conf. interval]**	
Model 1	0.055	0.025	2.220	0.027	0.006	0.104
Model 2	0.047	0.026	1.790	0.074	−0.005	0.098

4.2.3. Reinforcing factors

Prediction 3. In addition to class effects through relative risk aversion and cumulative advantage, parental resources reinforce differences in frequency of activities as well. Parameter estimates (**Table 3**, Model 2) show that cultural and social resources in the form of maternal education and support for child care have a positive impact on maternal activities with the child. The effect of maternal education is particularly sizable and statistically significant and suggests that even within classes differences in cultural resources, which probably correlate with parenting abilities and parenting style, contribute to higher investments in cognitively stimulating activities. Similarly, if the mother lives in a household with her partner or in a multigenerational household, and if, in addition, the partner is actively involved in child care, the frequency of activities tends to be higher. Also, mothers who spend more time providing child care tend to undertake more cognitively stimulating activities with their children, which is certainly not surprising. What is surprising, however, is the negligible effect of income and maternal working time on the frequency of activities undertaken with the child. Low-income working mothers do not necessarily engage in fewer cognitively stimulating activities with their children, especially if they live with their partner or other members of the family, whereas single mothers with low education levels do tend to invest less.

4.2.4. Additional tests of robustness

To further explore the impact of income and education and to test for the robustness of our results, we have also tried out more operationalizations of education and income as possibly relevant resources. For education we have considered education for both parents, taken separately as well as the maximum and minimum values for the household. Income has also been tested using quadratic terms and as a categorical variable to distinguish low-income households from the rest. Low-income households, as compared with high-income households, have been identified based on the European Union definition of an income equal to or below 60% of the equivalized disposable income ("at risk for poverty"). Results remain stable in light of these modifications. (Details of these analyses can be obtained from the authors upon request.)

5. Discussion and outlook

In conclusion, our model predictions appear to hold up under empirical scrutiny. Mothers appear to behave in a way that is consistent with two social mechanisms: relative risk aversion and cumulative advantage. In line with the hypothesis that parental investment behavior is class-specific, the frequency of cognitively stimulating activities that mothers share with their children varies across classes, from the service class at the top down to the labor contract class at the bottom. Although on average mothers invest more in children with higher skill levels, there are class differences in terms of how much attention children with low skill levels receive. This appears to indicate that the interaction between the rich-get-richer cumulative process of skill growth and the motives of relative risk aversion operate differently within each class. In particular, those at the top of the class hierarchy appear to be insensitive to children's skills and to invest equally in children across the skill distribution. Those at the bottom, by contrast, appear to invest reinforcingly, reacting mostly to high skill levels and giving less than average stimulation to children with low skill levels.

These results partially contradict the assumption of class-based cultures and habits where children are simply treated along uniform frames of "natural growth" versus "concerted cultivation" (Lareau, 2011). If it is true at all, this assumption finds empirical support in our data for the higher service class only, whereas parents in lower classes and among the unemployed apparently are not simply caught up in parenting ideas that are disadvantageous for skill development, but selectively invest in parenting practices that are beneficial for skill development but restrict these practices to those offspring who are promising candidates from the outset. In fact, for children with high skill levels, and controlling for

resources, maternal investments are comparable across social classes. In a nutshell, parental investment behavior may explain both persistence of minimal downward mobility from the top of the social hierarchy (compensatory investments in children with low skill levels) and minimal upward mobility from the bottom (minimal investments in children with low skill levels).

Considering parental resources, we found that cultural and social resources, not material resources, reinforce class differences in terms of frequency of activities. This makes our model of parental investments and class position compatible with accounts of intergenerational transmission of inequality based on cultural capital, if by that one means differences in parental behavior in terms of cognitively stimulating activities. Cultural practices in the form of parenting style may reinforce rational decisions dictated by motives to avoid downward mobility. We thus avoid contrasting or separating cultural capital explanations and rational choice as opposing pathways to explain social origin effects and instead integrate both into one model. It is striking that household income and working time have no effect on frequency of activities. This appears to indicate that parental investments are driven more by class-specific motives and cultural resources than simply by composition effects in terms of material resources, which tend to correlate with social class. Our results therefore echo previous studies on the greater relevance of what "money can't buy" (Mayer, 1997) within the family of origin as the starting point for future socioeconomic attainment.

Of course, both the model and the empirical analysis are not free from limitations and can be extended in future work. On the theoretical side, parents may be considered separately and may be modeled to have different levels of risk aversion and be more or less successful in influencing each other in deciding how much to invest in their children. There may also be differences in parental investment behavior with respect to class membership. For example, parents in higher social positions may be more aware of the importance of skills for reaching high positions in the social hierarchy or more capable of providing the right type of stimulation for their children, which would make their subjective probabilities of investment success reinforce investments for any given level of child skills. It is also plausible to assume that it is more costly to invest in children with lower skill levels than in children with higher skill levels—remedial investments cost more.

On the empirical side, there are some interesting open questions that we could not address given our data. Regarding cumulative advantage, we observed only one side of the coin, namely, the effect of observed skills on parenting. How parenting affects skills growth was not measured. Similarly, we had no measures for subjective expectations regarding parental investments nor measures for perceived costs and expected returns. Such measures would allow testing not only model predictions but also

model assumptions. Perhaps more promising is the possibility that our model could contribute to a more general explanation of the transmission of social inequality if tested using longitudinal data. The finding of relative risk aversion as a mechanism that creates unequal opportunities also for primary social origin effects constitutes a variant of cumulative advantage in itself if considered from a life course perspective. Although we did not test the relevance of relative risk aversion in secondary effects of social origin, if the same mechanism is relevant across various different situations, it can be expected that inequalities become more durable if they start early in the life course. If that were the case, then the same mechanism, relative risk aversion, could account for primary and secondary effects and for early and later stages of the life course. In addition to longitudinal analysis, our model and empirical evidence can also be extended to make sense of the intrahousehold allocation of resources. Do parents reinforce or compensate for siblings' differences in skills following the same logic of avoiding downward mobility, or are egalitarian rules the predominant force behind the distribution of parental investments within the family? Extending our model to sibling differences with appropriate data would also have the advantage of allowing us to control empirically for unobserved heterogeneities at the household level.

Appendix A. Five questions from the Vineland scale adopted for use in the SOEP to measure a child's language skills

For parents, it is always a big event when their child learns something new. Based on your child's verbal skills, please indicate "yes," "to some extent," or "no" *for each of the following questions about new things your child has learned:*

1. Understands brief instructions such as "go get your shoes"?
2. Forms sentences with at least two words?
3. Speaks in full sentences (with four or more words)?
4. Listens attentively to a story for 5 minutes or longer?
5. Passes on simple messages such as "dinner is ready"?

Appendix B. Mathematical derivations of model predictions

Expected probabilities of downward mobility

Based on the probabilities π, α_i, β_i, and γ_i, as defined in Section 4 (see **Figure 1**), the expected probabilities of downward mobility for investing or not investing in children for parents in the high and intermediate classes are summarized in **Table B.1**.

Table B.1. Expected probabilities of downward mobility for investing or not investing in children

Social position	**Investing**	**Not investing**
High (H)	$\pi\,(\boldsymbol{\alpha_2 + \alpha_3}) + (\mathbf{1} - \pi)(\boldsymbol{\beta_2 + \beta_3}) = \pi\,(\mathbf{1} - \boldsymbol{\alpha_1}) + (\mathbf{1} - \pi)(\mathbf{1} - \boldsymbol{\beta_1})$	$\gamma_2 + \gamma_3 = \mathbf{1} - \gamma_1$
Intermediate (I)	$\pi\,(\boldsymbol{\alpha_3}) + (\mathbf{1} - \pi)(\boldsymbol{\beta_3}) = \pi\,(\mathbf{1} - \boldsymbol{\alpha_1} - \boldsymbol{\alpha_2}) + (\mathbf{1} - \pi)(\mathbf{1} - \boldsymbol{\beta_1} - \boldsymbol{\beta_2})$	$\gamma_3 = \mathbf{1} - \gamma_1 - \gamma_2$

According to Table B.1, parents will invest in their children if they expect the probability shown in the second column to be smaller than the probability shown in the third column.

Proofs of model predictions for relative risk aversion

In the following proofs, model predictions are shown to follow logically from the premises of relative risk aversion and cumulative advantage.

Prediction 1a. For any given level of children's skills, parents in high social positions tend to invest more in children than parents in intermediate and low social positions.

This is true if the subjective probability of downward mobility of investing in children relative to not investing in children is lower for parents in high social positions compared with parents in intermediate and low social positions:

$$\frac{\pi\,(1 - \alpha_1) + (1 - \pi)(1 - \beta_1)}{1 - \gamma_1} < \frac{\pi\,(1 - \alpha_1 - \alpha_2) + (1 - \pi)(1 - \beta_1 - \beta_2)}{1 - \gamma_1 - \gamma_2} \qquad \text{(A1)}$$

Proof:

A1 can be shown to be true if $\pi\,\alpha_2 + (1 - \pi)\,\beta_2 > \gamma_2$

Given that the sum of α_i, β_i, and γ_i equals 1, the latter expression can be rewritten as:

$$(\pi\,\alpha_1 + (1-\pi)\,\beta_1) - \gamma_1 < \gamma_3 - (\pi\,\alpha_3 + (1-\pi)\,\beta_3)\ (\qquad \text{(A2)}$$

Given Assumptions ***i*** to ***iv*** (described in **Section 2.4**), each side of A2 corresponds to a probability between 0 and 1. These probabilities represent, on the left, the expected return of reaching the highest social class by investing in children relative to not investing, and on the right, the expected risk of sinking to the lowest class by not investing in children relative to investing. The inequality A2 is nothing less than the formal definition of the relative risk aversion mechanism: the perceived risk of downward mobility of not investing (right side) needs to be higher than the expected reward of upward mobility of investing (left side). Thus, Prediction 1a will be true if parents place more value on avoiding downward mobility than on achieving upward mobility.

Prediction 1b. Compared with parents in intermediate social positions, parents in high social positions are more willing to invest in children at the bottom of the skill distribution relative to children with average skills (s^A).

This is true if the subjective probability of downward mobility of investing relative to not investing in children at the bottom of the skill distribution (s^B) as compared with children with average skills (s^A) is lower for parents from higher classes than for parents in intermediate classes:

$$\frac{\frac{\pi\,(1-\alpha_1^{sB}) + (1-\pi)(1-\beta_1^{sB})}{1-\gamma_1^{sB}}}{\frac{\pi\,(1-\alpha_1^{sA}) + (1-\pi)(1-\beta_1^{sA})}{1-\gamma_1^{sA}}} < \frac{\frac{\pi\,(1-\alpha_1^{sB}-\alpha_2^{sB}) + (1-\pi)(1-\beta_1^{sB}-\beta_2^{sB})}{1-\gamma_1^{sB}-\gamma_2^{sB}}}{\frac{\pi\,(1-\alpha_1^{sA}-\alpha_2^{sA}) + (1-\pi)(1-\beta_1^{sA}-\beta_2^{sA})}{1-\gamma_1^{sA}-\gamma_2^{sA}}}$$

(A3)

Proof:

A3 can be shown to be true if $\frac{\pi\,(\boldsymbol{\alpha_2^{sB}}) + (\mathbf{1}-\pi)\,\boldsymbol{\beta_2^{sB}}}{\boldsymbol{\gamma_2^{sB}}} > \frac{\pi\,(\boldsymbol{\alpha_2^{sA}}) + (\mathbf{1}-\pi)\,\boldsymbol{\beta_2^{sA}}}{\boldsymbol{\gamma_2^{sA}}}$**,** which can be rewritten as:

$$\frac{(1-\gamma_1^{sA}-\gamma_3^{sA})}{(1-\gamma_1^{sB}-\gamma_3^{sB})} \cdot \frac{\pi\,(\alpha_2^{sB}) + (1-\pi)\,\beta_2^{sB}}{\pi\,(\alpha_2^{sA}) + (1-\pi)\,\beta_2^{sA}} > 1 \qquad \text{(A4)}$$

To be greater than 1, at least one fraction must be greater than 1 and the other greater than or equal to 1. This is the case if:

$$(\gamma_3^{sB} - \gamma_3^{sA}) \geq (\gamma_1^{sA} - \gamma_1^{sB}) \qquad \text{(A4.1)}$$

$$\pi\left(\alpha_1^{sA} - \alpha_1^{sB}\right) + (1-\pi)(\beta_1^{sA} - \beta_1^{sB}) \geq \pi\left(\alpha_3^{sB} - \alpha_3^{sA}\right) + (1-\pi)(\beta_3^{sB} - \beta_1^{sA}) \qquad \text{(A4.1)}$$

Given assumptions ***i*** to ***iv*** and ***v*** and ***vii***, both sides of A4.1 and A4.2 are positive probabilities between 0 and 1. Put simply, Prediction 1b will hold true if *relative* to children with average skills the perceived risks of sinking to the lowest class by not investing in children at the bottom of the skills distribution (A4.1) as well as the expected returns of reaching the higher class by investing in them (A4.2) are higher or at least equal.

Prediction 1c. Compared with parents in high social positions, parents in intermediate and low social positions are more willing to invest in children at the top of the skill distribution (s^T) relative to children with average skills (s^A).

Analogous to Prediction 1b, this should be the case if the subjective probability of downward mobility of investing relative to not investing in children at the top of the skill distribution (s^T) as compared with children with average skills (s^A) is lower for parents from an intermediate social position than for parents in high social positions:

$$\frac{\frac{\pi\,(1-\alpha_1^{sT}-\alpha_2^{sT})+(1-\pi)(1-\beta_1^{sT}-\beta_2^{sT})}{1-\gamma_1^{sT}-\gamma_2^{sT}}}{\frac{\pi\,(1-\alpha_1^{sA}-\alpha_2^{sA})+(1-\pi)(1-\beta_1^{sA}-\beta_2^{sA})}{1-\gamma_1^{sA}-\gamma_2^{sA}}} < \frac{\frac{\pi\,(1-\alpha_1^{sT})+(1-\pi)(1-\beta_1^{sT})}{1-\gamma_1^{sB}}}{\frac{\pi\,(1-\alpha_1^{sA})+(1-\pi)(1-\beta_1^{sA})}{1-\gamma_1^{sB}}} \qquad \text{(A5)}$$

Proof:

Since $s^T > s^A$ and $s^A > s^B$, A5 is equivalent to A3. By substituting s^T for s^A and s^A for s^B in A4.1 and A4.2, the following two conditions for A5 are obtained:

$$(\gamma_3^{sA} - \gamma_3^{sT}) \geq (\gamma_1^{sT} - \gamma_1^{sA}) \text{ (A6.1)}$$

$$\pi\left(\alpha_1^{sT} - \alpha_1^{sA}\right) + (1 - \pi)(\beta_1^{sT} - \beta_1^{sA}) \geq \pi\left(\alpha_3^{sA} - \alpha_3^{sT}\right) + (1 - \pi)(\beta_3^{sA} - \beta_1^{sT}) \qquad \text{(A6.1)}$$

Again, given assumptions ***i*** to ***iv*** and ***v*** and ***vii***, both sides of A6.1 and A6.2 are positive probabilities between 0 and 1. The interpretation is the same as in Prediction 1c. The only difference is that Prediction 1c compares average skills with top skills and not bottom skills with average skills.

Prediction 2. Parents invest more in children with higher skill levels than in children with lower skill levels.

Given relative risk aversion, parents in all social positions will prefer to invest in a child with higher skill levels (s_1) if the probabilities of downward mobility are lower than if the child had lower skill levels (s_0).[6] Formally, if $s_1 > s_0$, the following is true for parents in high social positions:

$$\frac{\pi\,(1-\alpha_1^{s1})+(1-\pi)(1-\beta_1^{s1})}{1-\gamma_1^{s1}} < \frac{\pi\,(1-\alpha_1^{s0})+(1-\pi)(1-\beta_1^{s0})}{1-\gamma_1^{s0}} \qquad \text{(A7)}$$

Proof:

Define: $\Delta\alpha = \alpha_1^{s1} - \alpha_1^{s0}; : \Delta\beta = \beta_1^{s1} - \beta_1^{s0}; \Delta\gamma = \gamma_1^{s1} - \gamma_1^{s0}$

A7 is true if $\pi(\Delta\alpha) + (1 - \pi)(\Delta\beta) > \Delta\gamma$, which can be rewritten as:

$$\left(\pi(\alpha_1^{s1}) + (1 - \pi)(\beta_1^{s1})\right) - \gamma_1^{s1} > \left(\pi(\alpha_1^{s0}) + (1 - \pi)(\beta_1^{s0})\right) - \gamma_1^{s0} \qquad \text{(A8)}$$

For parents in intermediate or low social positions, A7 takes the following form:

$$\frac{\pi\,(\mathbf{1}-\boldsymbol{\alpha_1^{s1}}-\boldsymbol{\alpha_2^{s1}})+(\mathbf{1}-\pi)(\mathbf{1}-\boldsymbol{\beta_1^{s1}}-\boldsymbol{\beta_2^{s1}})}{\mathbf{1}-\gamma_1^{\mathbf{s1}}-\gamma_2^{\mathbf{s1}}} < \frac{\pi\,(\mathbf{1}-\boldsymbol{\alpha_1^{s0}}-\boldsymbol{\alpha_2^{s0}})+(\mathbf{1}-\pi)(\mathbf{1}-\boldsymbol{\beta_1^{s0}}-\boldsymbol{\beta_2^{s0}})}{\mathbf{1}-\gamma_1^{\mathbf{s0}}-\gamma_2^{\mathbf{s0}}} \qquad \text{(A9)}$$

Define $\Delta\alpha' = (\alpha_1^{s1} - \alpha_1^{s0}) + (\alpha_2^{s1} - \alpha_2^{s0})$; : $\Delta\beta' = (\beta_1^{s1} - \beta_1^{s0}) + (\beta_2^{s1} - \beta_2^{s0}); \Delta\gamma' = (\gamma_1^{s1} - \gamma_1^{s0}) + (\gamma_2^{s1} - \gamma_2^{s0})$

Analogous to A8, A9 is true if $\pi(\Delta\alpha') + (1 - \pi)(\Delta\beta') > \Delta\gamma'$, which can be rewritten as:

$$\left(\pi(\alpha_3^{s1}) + (1 - \pi)(\beta_3^{s1})\right) - \gamma_3^{s1} < \left(\pi(\alpha_3^{s0}) + (1 - \pi)(\beta_3^{s0})\right) - \gamma_3^{s0} \qquad \text{(A10)}$$

Given assumptions ***i*** to ***iv*** and ***v*** and ***vii***, both sides of A8 and A10 are positive probabilities between 0 and 1. In contrast to relative risk aversion, cumulative advantage emphasizes expected returns. Accordingly, inequalities A7 and A9 require the expected benefits to be greater for children with skills s_1 than for children with skills s_0. In A8, the expected probability of reaching the highest social class by investing relative to not investing has to be greater for children with skills s1 (left side), whereas in A10, the expected probability of reaching the lowest class by investing relative to not investing must be lower for children with skills s1 (left side).

[6] Note that whereas Predictions 1b and 1c express the relative risks of downward mobility among children with different skills, Prediction 2 is defined separately for each class and refers to the absolute perceived differences in risk for children with different skill levels.

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