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From Heterogeneities to Inequalities

Resource Dilution or Resource Augmentation?

Number of Siblings, Birth Order, Sex of the Child and Mother's Frequency of Activities with 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).

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Resource Dilution or Resource Augmentation? Number of Siblings, Birth Order, Sex of the Child and Frequency of Mother's Activities with Preschool Children[†]

Magdalena Osmanowski
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Abstract

This study sheds light on differences in the frequency of mother-child activities during the children's early life stages. Using data on children aged 2-3 and 5-6 from the German Socio-Economic Panel (SOEP), we answer two questions: (i) To what extent does the frequency of activities vary between families? (ii) What changes in the frequency of activities occur for each child with the birth of a new sibling? Our results indicate that (i) The frequency with which mothers engage in activities is affected by the combined effects of the number of siblings, children's sex, and birth order. In particular, as sibship size increases, mothers undertake more activities with firstborn than with middle, younger, and even only children. (ii) Children who already have a younger sibling receive an attention boost through the birth of a new sibling, while others experience a reallocation of activities. To account for these results, we go beyond the resource dilution hypothesis and offer an alternative explanation which assumes either an increase of efficiency in time spent in maternal activities or a spillover effect of other siblings on the overall level of activity with increasing sibship size.

Keywords: Sibling inequality, maternal time allocation, sibship size, birth order, resource dilution

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Foreword: This paper in the SFB 882

This paper is a part of Project A1 "Social Closure and Hierarchization: Contextual Conditions of Unequal Developmental Opportunities in Early Phases of Life" *(Martin Diewald, Jürgen Schupp, Andrés Cardona, Tobias Graf, Adrian Hille, Till Kaiser, Magdalena Osmanowski)*

Explaining and understanding the development of non-cognitive skills, competencies, and cultural capital during early stages of the life course and how they impact later success in life is the main goal of project A1. To achieve this goal, one key aim is to unveil the mechanisms that systematically create diverging life course paths even among siblings belonging to the same family. In particular, processes of closure by parents, of favoritism, and discrimination among siblings, as well as the resulting crystallization of hierarchies inside the family along categorical lines such as birth order, gender or age, are believed to be critical mechanisms for the creation of inequality starting at a young age.

This paper sheds some initial light on these processes by investigating the link between child characteristics and resource distribution within families. Resources such as money, time, or attention, are scarce and subject to deliberate allocation by parents. By focusing on maternal attention measured as frequency of mother-child activity, our results suggest that it makes a difference if a child is the firstborn and not the middle child, if she is a girl and not a boy, or if he or she has one sibling instead of two. After this first step has been taken, establishing the cause of the observed differential distribution of attention inside the family and how it impacts later outcomes will be the necessary next steps to be taken in the upcoming months and years of the project.

To be more specific, in order to expose the mechanisms of closure and hierarchization, it is necessary to unpack parental behavior and expose the logic of parental resource-allocation decisions. Are parents following conscious calculation about which child to favor? Are they blindly guided by stereotypes or norms concerning gender or birth order? Or is it something else entirely that drives parents to allocate resources differently according to their chlidren's characteristics? Perhaps a third or even a fourth or fifth mechanisms apart from exclusionary action and the emergence of hierarchies are at work and will have to be conceptualized, measured, and empirically tested in future work. Once these questions have been answered, a follow-up question has to be addressed. Irrespective of the mechanisms at play, how do different resource allocations inside the family influence children's later outcomes such as child development or schooling? Are differences within the family more or less important than differences between families? Only after child attributes can be connected to later outcomes through theoretically sound and empirically plausible mechanisms of internal family dynamics will it be possible to offer a complete account of how child heterogeneities are transformed into youth and adult inequalities.

1. Introduction

Traditionally, the study of social inequality and intergenerational mobility, both from the structuralist perspective of class analysis and the individualist approach of status attainment research, has emphasized the family as a critical factor in explaining individual disparities. Families are both the first and one of the main environmental influence to which children are exposed. Yet when discussing the role of family background on individual outcomes, social scientists tend to assume, perhaps only implicitly, that all children of the same family are treated the same by their parents. As a result, scholars tend to study the effects of the family on the production of inequality in terms of between-family differences without regard for within-family heterogeneities.

The tacit assumption that family exerts a homogenous influence on all its members has been consistently challenged by studies on siblings and inequality (Behrman, Pollak, & Taubman, 1982; Conley & Glauber, 2005; Hertwig, Davis, & Sulloway, 2002). Despite the diversity and breadth of this growing field of research, its main message can be summarized in a few words. Children in the same family are not treated the same by their parents, nor do they perceive themselves as being treated the same. The sex of the child, birth order, and number of siblings have been shown to condition how children experience their families, what they receive from their parents, and what they do not receive. Hence, despite growing up in the same family environment, siblings tend to differ in various outcomes such as educational attainment and labor market success (Black, Devereux, & Salvanes, 2004; Conley & Glauber, 2005). In other words, the image of families as an artisan shop producing handcrafted objects of varying quality rather than an assembly line manufacturing identical commodities more accurately depicts the connection between family background and social inequality.

Without losing sight of differences across families, which by all accounts still play a fundamental role in explaining the emergence and persistence of social inequality, the question arises as to how families produce inequality within their own ranks. To answer this question, we examine one possible cause of inequality both within and between families: the effect of number of siblings, sex of the child, and birth order on the distribution of parental resources, in particular on the frequency with which mothers undertake activities with their children. We argue that the intensity of maternal activities is a proxy for the time and attention given a child. Although maternal activities are but one component of the wide range of maternal and paternal resources that are allocated among children inside the family—including money, space, and affection—they offer a glimpse into possible mechanisms of parental resource distribution.

Using data from the German Socio-Economic Panel (SOEP), we show that the activities children do with their mothers, both in quantity and kind, are not only dependent upon the family's resources such as maternal education and partner support in childcare, but are also affected by the sex of the child and sibling configuration. Contrary to the resource dilution hypothesis, which insists on a negative relationship between sibship size and mother's time and attention, our results suggest that increasing the number of siblings has at most a negligible net impact on the frequency of activities undertaken by mothers with their children and that birth order and sex of the child do affect how resources are allocated inside the family. In fact,

children with younger siblings, most notably firstborn, experience substantially *higher* frequencies of activities with an increasing number of siblings.

This article makes three key contributions. First, we challenge the convention of analyzing sibship size independently of birth order and sex of the child, arguing instead for an interaction among the three dimensions. Second, we show that early in the life course, and even before children are exposed to other inequality-generating institutions such as school, there are already systematic differences in the resources received by children inside the family which might have long-lasting consequences for the production of inequality in later stages.[1] And third, complementing theoretical explanations about parents' allocation of resources among siblings driven by social norms, sex stereotypes, or utility maximization calculations, we put forward a resource augmentation hypothesis. We argue that with increasing sibship size not only are mothers able to undertake more activities with siblings without increasing childcare time, but the overall level of activities undertaken with *all* children increases with a growing number of siblings. Hence children undertake activities with their mother more often due to both efficiency gains and spillover effects.

The paper is structured as follows. The next section summarizes the main theoretical models on the distribution of resources within families, offering an overview of empirical studies and also testing their predictions. Based on this discussion, in the third section we formulate a list of three hypotheses to be tested using our data. Section four introduces the data and describes our model specifications and variable operationalization. In the fifth and sixth sections, results are reported and discussed. We conclude by introducing the resource augmentation hypothesis and by making some suggestions for further research.

2. How big a slice of the pie goes to each child? Resource allocation within the family

In the following, three competing theoretical perspectives on the distribution of resources among siblings are briefly discussed: The resource dilution model, a cultural normative perspective, and the family utility maximization model. We state the main premises of each theory and shortly review empirical evidence inspired by their basic predictions.

2.1. The shrinking piece of the pie

Numerous studies have suggested a negative relationship between sibship size and the amount of resources each child in a family receives from his or her parents. This relationship, popularized by the work of Blake (1981, 1989) under the "resource dilution hypothesis", has been known for decades in sibling studies (Anastasi, 1956). The basic idea is fairly simple. A family has finite resources available to distribute equally among its children. As the sibship size

[1] Research has been emphatic about the importance of the familial environment and the amount of resources received by children in early life stages on the development of cognitive and noncognitive skills (Cunha & Heckman, 2007, 2008), and on later individual outcomes such as educational and occupational attainment (Barber, 2000; Becker & Tomes, 1976). Also key psychological processes such as attachment (Bowlby, 1969) are known to take place during infancy and early childhood.

grows, the limited amount of resources needs to be divided among increasing numbers of children and is thus spread ever more thinly.[2]

Empirical studies have consistently supported the plausibility of the dilution hypothesis. Downey (1995) showed a negative effect of sibship size on the amount of parental economic and interpersonal resources, such as talking to a child or parental educational expectations. Kendrick and Dunn (1980) found a change in maternal attention for the firstborn child with the arrival of a second child. Especially in situations in which the mother was not occupied with the younger sibling, attention paid to her firstborn child decreased. Similarly, Baydar, Hyle, and Brooks-Gunn (1997) found that the family environment, measured as opportunities for skill development, the quality of the mother-child relationship, and the disciplinary style, all changed after the birth of a sibling. The effect these changes had on children was age-specific and only evident in younger and not in older firstborns. Steward (2005) also provided evidence for the diluting effect of parental involvement after the birth of a sibling. Blake (1989) investigated the effect of number of siblings on time spent by children aged six to eleven in different activities such as reading books and newspapers, watching TV, and engaging in sports. Consistent with the resource dilution hypothesis, she reported a negative relationship. In addition, children in smaller families also had the advantage of more intellectually stimulating settings such as music or dance lessons and travelling (Blake, 1989).

All in all, there seems to be supporting evidence for resource dilution as the number of children grows, which would help explain differences across families with varying sibship sizes. However, when it comes to shedding light on how resources are distributed among siblings inside the family, the resource dilution hypothesis falls short. It tacitly postulates an egalitarian distribution rule that disregards within-family variations in allocation rules. Two further explanations, from a cultural and from an economic perspective, explicitly deal with within-family variations and offer an answer as to why resources among siblings may not be distributed in an egalitarian manner.

2.2. The privileged and the rationalized pieces of the pie

Guided by stereotypes and norms, and not always consciously, parents give unequal amounts of resources to siblings along categorical lines such as sex or birth order. Widespread cultural norms such as primogeniture benefit firstborn children (Hrdy & Judge, 1993). Although this seems to apply more to material than to interpersonal resources such as time, research shows that the preference for the firstborn also extends to other kinds of non-material resources such as parenting style or the quality of interaction between mother and child (Baydar, Hyle, & Brooks-Gunn, 1997; Kendrick & Dunn, 1980). But even without strong preferences for firstborn children, older siblings may receive more than younger siblings. Price (2008) showed that despite an increase in the number of siblings, the firstborn still receives more parental

[2] The theory postulates that resource inputs are essential for future child outcomes, and therefore the amount of resources received affects the quality of these outcomes. For studies about the relationship between number of siblings and a child's outcomes see Black et al. (2004); educational achievement (Iacovou, 2001; Lawson, 2009; Steelman et al., 2002); educational and occupational aspirations (Marjoribanks, 1989); verbal skills (Steelman et al., 2002); IQ (Zajonc & Markus, 1975).

time. His explanation is simple. Even if time resources are allocated equally among siblings, parent-child interactions tend to decrease with the age of children, benefiting the firstborn over those born later.

Additionally, the sex of the child affects the distribution of resources within the family. Sex discrimination starts even before children are born. Parents in many countries openly express their wishes regarding the sex of their children, not to mention the extreme case of infanticide. While some studies have reported a preference for boys in the United States, Asia, and Finnland, parents in Denmark, Norway, and Sweden have been found to prefergirls (Dahl & Moretti, 2008; Hank, Andersson & Kohler, 2008). In other countries, including Germany, couples were either indifferent to the sex of their future children or wanted an equal number of boys and girls (Hank, Andersson, & Kohler, 2008). Similar results have been reported for Great Britain, the Netherlands, Canada and the US (Savulescu & Dahl, 2000).

After children are born, sex stereotypes have been shown to cause additional unequal treatment among siblings (for a summary see Jacob, 2010). Parents allocate their time differently depending on the sex of the child, both qualitatively and quantitatively; spending different amounts of time in different activities (Lundberg, 2005; Yeung, Sandberg, Davis-Kean, & Hofferth, 2001). According to Lawson (2009), parents tend to favor children with the same sex as themselves; fathers prefer boys and mothers prefer girls. The preference for sex-specific resource allocation has been tested mainly using US-data. Studies have suggested that especially fathers give different amounts of resources to their children in accordance with sex stereotypes (Lundberg, 2005), but that mothers do not differentiate much based on the child's sex (Brody & Steelman, 1985; Yeung et al., 2001). Kendrick and Dunn (1980) found no sex effect in maternal attention to sibling children.

From an economic perspective, time spent by mothers with their children is seen as an investment decision. As Becker and Tomes (1976, 1986) argued, parents invest differently in their children to maximize the family's utility, not only according to their own preferences and income but also according to their children's endowments. The maximization process implies a quality-quantity trade-off. This means in general that the higher the sibship size (the quantity of children) the lower their average "quality" (child wellbeing) will be. This causal connection does not always result in the same predictions as those made by the resource dilution theory, although it can. With parents acting in a rational way to maximize, inter alia, the future outcomes of their children, the patterns of resource distribution may vary under different circumstances. One can imagine parents in one family favoring the child with the highest endowments, while others might try instead to equalize the amount of resources among their children. It might even seem profitable to invest in the less endowed child to bring all child outcomes into line. In short, although an additional sibling could lead to lower resource investments for the other siblings, the decrease depends on family characteristics. As a result, predictions about the resource allocation within families cannot be made with certainty with-

out knowledge of child endowments, family resources, and parents' general investment strategies.[3]

Despite an enormous theoretical as well as empirical interest in the theory, its assumptions have rarely been tested within the context of one family and with respect to different investments in siblings (Black et al., 2004). Research aimed at testing the family-maximization model has shown mixed results. Studies for the United States and Ecuador (Datar, Kilburn, & Loughran, 2010; Bagby, 2011) found that parents invest in a reinforcing manner in early health well-being, meaning that healthier children receive more resources than children with relatively lower health. Similar results were obtained regarding investments in education and the cognitive ability of siblings in Burkina Faso (Akresh, Bagby, Walque, & Kaziang, 2010). Behrman, Pollak and Taubman (1986) documented a comparable reinforcing allocation pattern for human capital investments. In contrast, earlier work by Behrman, Pollak and Taubman (1982) suggested that parents invested educational resources in a compensatory way—less able children received more parental resources than more able children. Hsin (2006) offered more differentiated findings. Driven by the birth weight of their children, less educated mothers invested in a compensatory way, whereas better educated mothers invested in a reinforcing manner. Not only parents' education level seemed to be an important factor for parental investment decisions, but also their income. Assuming no differences in the ability of children, Dahan and Gaviria (2003) reported that low and middle income parents in Latin American countries made human capital investments in only a few children to maximize those children's outcomes.

In sum, because of the diversity of data and methods used in studies on stereotypes, norms, and family utility maximization, their results are often difficult to compare and even more difficult to generalize. Nevertheless, empirical evidence gathered so far suggests that siblings are indeed treated differently and hence receive varying amounts of resources from their parents according to birth order and sex of the child.

3. Hypotheses

Based on the foregoing discussion, we now derive three hypotheses about the frequency of mothers' activities with their children as a function of birth position, sex, and number of siblings. The object of study is not the total frequency of activities by mothers with *all* their children, but rather the attention received by *a given child*. Thus, we can formulate our hypotheses in at least two ways. First, we can ask how the *level* of mothers' frequency of activities varies for children of a given age across families. Fixing the age of the child and controlling for each family's socio-economic characteristics, we can measure whether the frequency of activities in different families varies depending on a child's sex, number of siblings, and birth order. Second, we can concentrate on one particular family and compare it with itself across

[3] As summarized previously for the resource dilution theory, there is evidence that with increasing sibship size the resources each child receives within a family decrease. Assuming equal levels of income, fixed parental preferences, and comparable child abilities across families, the prediction of the resource dilution hypothesis can be reconciled with an economic explanation. These assumptions, however, are too strong; one cannot suppose that parents and children are all equal across or even within families.

time. We can then ask about *changes* in the frequency of activities for a given child caused by the birth of a younger sibling. We take both perspectives and investigate how mother-child activities are affected by family size, sex of the child, and birth order, not only as differences in levels across families but also as changes across time.

To start with, the resource dilution hypothesis predicts that limited familial resources are distributed equally among children, and have to be divided in ever smaller amounts as sibship size grows. From this, a simple first hypothesis follows.

> *H1*: The frequency of mother-child activities tends to be smaller for each child with an increasing number of siblings.

This hypothesis implies both that children in families with more siblings tend to undertake less activities with their mothers than children in families with less siblings (different levels across families), and that in the same family, the frequency of activities a mother does with her child tends to shrink with each additional sibling (changes across time).

Child characteristics, in particular birth order and sex, may be further reasons for mothers' unequal activity allocations. As summarized above, the way these differences are explained, or the direction in which they can be predicted to develop, depends on the theoretical perspective assumed. Cultural norms and stereotypes may influence parental allocation decisions along the lines of birth order and sex just as much as parental maximization of family utility. As a result, the simple observation that, for example, first-born children receive more attention than those born last tells nothing about whether this bias is the consequence of social norms about first-born over later-born children, whether it is the outcome of parents' family utility calculations using birth order as proxy for children's future payoffs, or maybe even something else entirely. The only way to disentangle both cultural and economic explanations and predict the exact direction of the effect would be to measure parental attitudes and stereotypes as well as child endowments and parental decision strategies. Unfortunately, none of this information is available in our data. Accordingly, we formulate a general hypothesis about the importance of these two dimensions without making any exact prediction about the direction or magnitude of the effect.

> *H2*: Child birth order and sex have an impact on the frequency of activities undertaken by mothers with their children over and above the effect of number of siblings.

Despite the many studies that have investigated number of siblings, sex of the child, and birth order separately, there is to our knowledge no systematic empirical evidence on how they interact to influence the frequency of mothers' activities with children. It is plausible to assume that children experiencing different frequencies of activities undertaken with their mothers due to their sex or birth position are affected differently by sibship size. For one thing, categories are relational. Being the firstborn becomes a significant category for the distribution of resources only after younger children are born. Similarly, sex stereotypes might be more salient when parents have children of different sexes. In both cases, the number of siblings is confounding and not the explanation for the apparent dilution of resources. These, however, are mere speculations that need to be investigated further in future research. Our third hypothesis is therefore exploratory and suggests an interaction between H1 and H2.

H3: A child's birth order and sex modulate the effect of number of siblings on the frequency of mother-child activity both across families and time.

With these hypotheses in mind, we now turn to our data and methods.

4. Data and methods

4.1. Data: The German Socio-Economic Panel (SOEP)

Our data consist of a sample of children obtained from the German Socio-Economic Panel (SOEP, v27). The SOEP is a broad-based longitudinal survey conducted yearly since 1984 with an emphasis on the subjective and economic well-being of private households over the life course (Wagner, Frick, & Schupp, 2007). Since 2003, a new series of mother-child questionnaires was introduced to gather detailed age-specific data on children. Every two years, starting with the birth of a child, mothers report on various aspects of their children, including health, temperament, and personality. Depending on the age of the child, additional information is gathered on parenting practices, childcare, and school. Up to 2011, four age-specific mother-child questionnaires were collected (ages 0 to 1, 2 to 3, 5 to 6, and 8 to 9). For our analysis, we pooled all completed SOEP mother-child questionnaires on children ages 2-3 and 5-6 between 2005 and 2011, when data on mother's frequency of activities were collected.

Figure 1 summarizes our sample, grouping children by age bracket and year of observation. Between 2005 and 2011, roughly 215 children on average were surveyed yearly in each age group. This amounts for a total of 1,622 children in the pooled data, of whom 1,505 children were observed at ages 2 to 3 and 863 at ages 5 to 6.

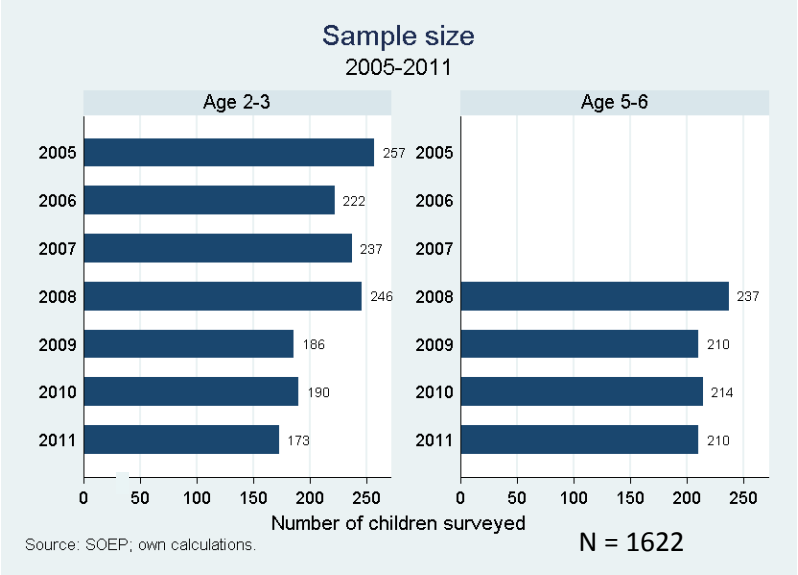

Figure 1: Sample size, pooled data

While almost half of the children in our sample were surveyed in both age brackets (N=746), one third of children observed at ages 2 to 3 were still too young to be surveyed in the next age bracket and will be surveyed in future waves of the study. An additional 20% of children appear in the sample only once due to attrition (**table 1**). Our data are thus unbalanced both regarding design and due to missing values.

Table 1. Number of children by measurement point. Missing due to attrition and design.

Number of Children		N	%
Age 2-3	Not yet measured at Age 5-6	544	33.5%
	Attrition at Age 5-6	215	13.3%
Age 2-3 & 5-6	Measured at 2-3 & 5-6	746	46.0%
Age 5-6	Attrition at Age 2-3	117	7.2%
Total		**1622**	**100**

4.2. Measures

To gain information about the cause of sibling differences, researchers usually opt for one of two approaches. First, siblings themselves can be asked about their individual and typically different perceptions of their family (for more see Plomin & Daniels, 1987; Turkheimer & Waldron, 2000). Alternatively, parents can be queried about differential treatment of siblings at a given point in time (e.g., Price, 2008). Here we take a third approach. In our data, siblings were not asked about their families nor were parents surveyed about differential treatment of siblings. The data collected by the mother-child questionnaire in SOEP refer to one particular child. Hence, unlike most sibling studies that collect data on a cross-section of all siblings in a family at a given point in time, we compare children living in different families under varying sibling constellations at a fixed age, even if we sometimes observe two children with the same mother at the same age, surveyed at two different points in time.[4] Despite looking at children of the same age, we are still able to observe children in different birth positions and with varying number of siblings. Our design should therefore render comparable results to those expected from age-specific sibling cross-sectional studies.

- *Mothers' frequency of activities with their children*

Our dependent variables were constructed based on a self-reported, multi-item, age-specific battery about mothers' activities with their children. Frequency was measured on a 4-item, ordinal scale (daily, several times per week, at least once a week, and never).[5] We assume that the frequency of activities should be positively correlated with time spent by mothers in those activities, even if the correlation may only be moderately high. For example, reading daily to a child for a few minutes amounts to the same time per week as reading only once a week, but longer. Despite these possible discrepancies, we expect that mothers that undertake more and

[4] We have data on two siblings with the same mother at age 2 to 3 observed at different time points for a total of 240 households, on three siblings for 25 households and on four siblings for 3 households . For children ages 5 to 6, these figures are reduced to 90 household, 4, and zero households respectively.

[5] The exact wording of the question is "*How many times in the last 14 days have you or the main caregiver done the following activities together with your child?*". Admittedly, the fact that the identity of the main caregiver cannot be established with certainty introduces some ambiguity about who is doing these activities with the child. Despite the ambiguity of the question, it is probably safe to assume that mothers are the main caregivers and that the time reported by mothers refers to their own time investments.

more frequent activities with their children as reported on an ordinal scale spend more time in these activities than those who do less, at least on average. As discussed in section seven below, there are reasons to think that the relationship between frequency of activities and time spent by the mother may be nonlinear, so that higher frequencies are not necessarily related to higher time inputs. To analyze our data, however, this assumption seems reasonable. To be sure, our measure of maternal time and attention is only approximate. However, it is an improvement over common operationalizations found in the literature. Numerous previous studies investigating maternal time spent with children measure childcare-time indirectly by assuming that parents use non-employment-time completely for childcare and using employment status or working hours as a proxy for child-care time (Kang, 2010; Booth & Kee, 2009; see also Price, 2008).

We first analyzed the items using factor analysis. Based on the eigenvalue and BIC a two-factor model for the first age bracket and a three-factor model for the two age brackets were chosen. An orthogonal rotation was used. The list of activities and the results of factor analysis are displayed in **table 2**.

Table 2. Factor loadings and communalities.

	Age 2-3			Age 5-6			
Item	**Factor 1**	**Factor 2**	**Comm.**	**Factor 1**	**Factor 2**	**Factor 3**	**Comm.**
Singing children's songs with or to the child	**0.50**	0.08	0.25	**0.58**	0.10	-0.06	0.35
Taking walks outdoors	0.18	**0.48**	0.26	0.31	**0.49**	-0.09	0.35
Painting or doing arts and crafts	**0.39**	0.29	0.23	**0.74**	0.15	0.12	0.58
Reading or telling stories	**0.79**	0.02	0.63	**0.43**	0.09	-0.16	0.22
Looking at picture books	**0.73**	0.08	0.54				
Playing cards/board games	-	-	-	0.46	0.00	0.09	0.22
Going to the playground	0.06	**0.56**	0.32	0.22	**0.44**	0.10	0.25
Visiting other families with children	0.06	**0.44**	0.19	0.14	**0.29**	0.13	0.12
Going shopping with the child	0.01	**0.37**	0.14	0.15	0.08	**0.30**	0.12
Watching television or videos with the child	-0.08	0.14	0.03	0.07	0.02	**0.34**	0.12
Playing PC/Internet games together	-	-	-	0.06	0.00	**0.64**	0.41
Going to children's theater/circus/museum	-	-	-	0.17	0.23	0.11	0.09

Despite the similarities in items and factor loadings across measurement points for the first two factors, explained variance is very low. To overcome the poor fit of the factor model and given the ordinal character of the 4-item scale used to measure frequency, we turned to non-parametric methods for categorical data. The method chosen was Mokken scale analysis, an item response theory (IRT) model that allows testing the scalability of categorical items on a cumulative scale (Mokken, 1971; Molenaar, 1997). The model is probabilistic and non-parametric, and can be understood as a non-determinist extension of Guttman scaling. It poses the existence of a unidimensional latent trait related to observed items in a hierarchical way. Popular item scores or "easy" items are associated with lower scale values, while uncommon or "difficult" item scores are related to higher scale values. So, for example, if all mothers read to their children daily but only a few sing songs with them, reading to children alone would be an indicator of low activity frequencies while reading *and* singing songs would de-

note high frequencies. Scale reliability is defined as a consistent progression from easy to difficult items associated with non-decreasing probabilities on a latent dimension (monotonicity), rather than a linear correlation among equally distributed items as in factor analysis. This implies that two items, an easy item and a difficult item, may belong to the same cumulative scale even if their correlation coefficient is low.

Using Mokken scaling, the underlying latent traits we assume we are measuring by analyzing the items about activities mothers engage in with their children are two groups of qualitatively different activities. For each combination of items, a Loevinger H coefficient of scalability was computed to determine the adequacy of any given item on a cumulative scale (Loevinger, 1948). The maximum value H=1 denotes perfect consistency. Values above 0.3 are acceptable (Mokken, 1971). We analyzed all items on activities for each age bracket using Stata (Hardouin & Bonnaud-Antignac, 2011). The Loevinger H coefficient for the items on each scale is summarized in **table 3**.

Table 3. Loevinger H coefficient

Scale 1: Activities at home	**Age 2-3**	**Age-5-6**
Painting or doing arts and crafts	0.34	0.41
Singing children's songs with or to the child	0.38	0.41
Reading or telling stories	0.47	0.31
Looking at picture books	0.47	-
Scale 2: Outside activities	**Age 2-3**	**Age-5-6**
Taking walks outdoors	0.42	0.38
Going to the playground	0.42	0.38

Similar to the results obtained from factor analysis, exploratory Mokken scaling suggests two scales. Based on the types of activities identified on each scale, children in both age brackets spend time with their mothers doing either activities at home or outside activities. The only difference in the scale composition across age brackets is the item on picture books, not asked for children age 5-6 year old and hence missing in scale 1 for that age group.[6] To make scales comparable across time despite having one item less in the first scale for 5 to 6 years old children, we built standardized sum indices for each measurement point. This procedure also reduces the potential bias introduced by higher or lower age-specific frequencies of activities that lurks in raw scale scores. In our sample, this is particularly true for activities at home, which mothers tend to undertake more often with 2 to 3 years old children than with 5 to 6 year old children. After standardizing raw scores, the correlation coefficient between the two scales is positive but small (r=0.25). Thus mothers not only differ in the frequency of activities they undertake with their children, but also in the activities they prefer.

[6] For the age group 5 to 6 a third scale was identified. It consists of items on media consumption, watching television or videos with the child and playing PC/Internet games together. Since the latter item is not asked to children in the age bracket 2-3 years, it would not be appropriate to construct a third scale for the two measurement points consisting of one single item.

- *Number of siblings and birth order*

Our main explanatory variables, number of siblings and birth order, were obtained from the information reported by mothers on number and birthdates of biological children living in the household. Siblings living outside the household were not considered in this analysis. We assume that siblings who do not sharing the same household do not compete directly for maternal resources.[7] The median sibship size in our sample is 2. The majority of children in both age brackets are either only children or children with one sibling (see **figure 2**). Since by definition, birth order is the *ith* child born to a mother, where i = first, second, third, etc., it is not well-suited for comparisons across families. Aside from firstborn children, whose position among siblings' ranks is unambiguous, being the second-born child has a different meaning depending on sibship size. For example, in a family of two children, the second-born is the youngest, while in a family of four it is the middle child. To make birth order amenable to quantitative comparisons across families, we transformed the variable into a relative rank scale that classifies children into four fixed categories, "no siblings", "youngest", "middle" and "oldest". Despite the small family size in our sample, in which most children are either the youngest or the oldest (see **figure 3**), the data allow us to identify a fair share of middle children or children with both younger and older siblings.

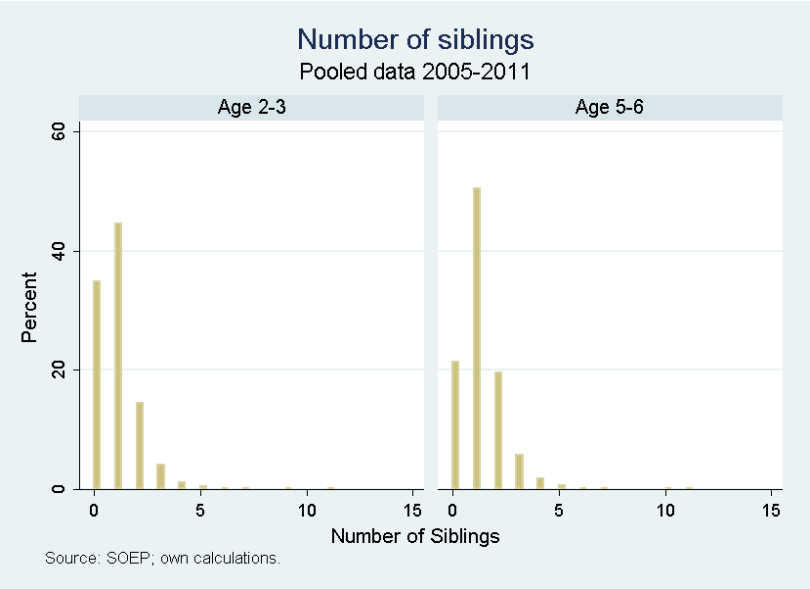

Figure 2. Number of siblings

[7] We test the stability of our results regarding this assumption by fitting the models using the total number of biological children, which also includes those children living outside the household. Results are discussed below under the heading "sensitivity analysis."

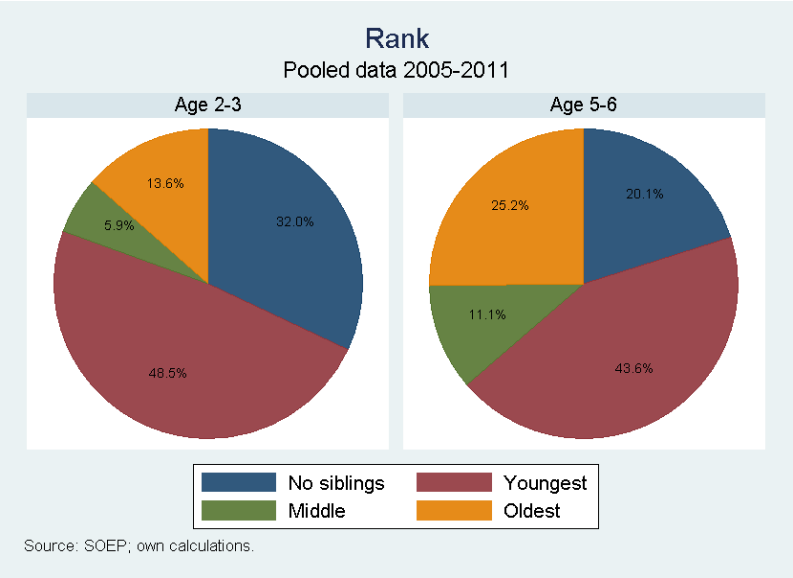

Figure 3. Distribution of children by birth order (categorical)

- *Family resources*

While family resources such as money or space are strongly related to socio-economic status, the frequency of engaging in different activities with children may not. Parents can—and do (Raley & Bianchi, 2007)—undertake certain activities with children independent of their material resources. Additionally, given the simple fact that a day consists of 24 hours, time is a naturally limited resource and therefore equally available to all parents (Hertwig et al., 2002). As a result, frequency of activities should be readily comparable across families without any problematic confounding with familial socio-economic standing; at least in theory. Empirical research, however, does not lend much support to this conjecture.

There is ample evidence that higher educated mothers not only spend more time with their children than less educated mothers (Guryan, Hurst, & Kearney, 2008; Sayer et al., 2004), but they do so in qualitatively different activities, such as reading instead of watching TV (Bianchi & Robinson, 1997; Hofferth & Sandberg, 2001). Household income has also been shown to correlate with more time spent by parents with their children (Guryan et al., 2008; Hill & Stafford, 1974; Zick & Bryant, 1996). Only working time, especially of women, appears not to have a large impact on time spent with children. It has long been documented that employed mothers somehow manage to compensate for their working time by spending more time with children during non-working hours, including weekends (Hill & Stafford, 1985; Nock & Kingston, 1988; Zaslow, Pederson, Cain, Suwalsky & Kramer, 1985; Booth, Clarke-Stewart, Vandell, McCartney, & Owen, 2002), or by reducing time spent in other activities not related to childcare such as leisure or sleep (Bianchi, 2000; Bianchi & Raley, 2005; Hofferth & Sandberg, 2001). Paternal childcare also plays an important role in compensating for mothers' time constraints, but this has been shown to be true mostly for families without nonmaternal child care (Booth et al., 2002). Studies on mothers using non-parental, out-of-home child care showed the importance of social support (Bianchi, 2000; Lamb & Ahnert, 2007), but their results are discordant. While some studies indicate that mothers who are using out-of-home child care spend less time with their children compared to mothers whose chil-

dren are only at home (Booth et al., 2002), others suggest that there is no difference between mothers with and without external child care (Craig, 2007; Hallberg & Klevmarken, 2003; Walter & Künzler, 2002).

In short, even if time can be assumed to be equally available across families irrespective of socio-economic standing, other factors such as financial resources, parental education, working hours, and social support in the form of childcare might facilitate or constrain the frequency of activities undertaken by mothers with their children. To take these resources into account we control for each of these facets of family resources in our multivariate analysis (see **table 4**).

Table 4. Family resources

Financial resources • Equivalent net post-government income (annual, in 000 €)[8]
Mother's education • Categorical (general secondary school, intermediate secondary school, upper secondary school, tertiary education)
Working time • Working time hh/week and categorical (0-10, 11-20, 20-40, 40 or more)
Childcare Childcare yes/no (daycare, partner/father, grandparents)

- *Control variables*

Given the broad scope of the SOEP, additional data on family type (couple, single mother, multiple generation household) and children's diagnosed health conditions or impairments (yes/no) were included as control variables. We also controlled for the child's and mother's age (in months and years, respectively) as well as for twin siblings (yes/no). Summary statistics are found in the appendix in **table 7**.

4.3. Model specification

To estimate the effect of sibship size and birth order on mothers' frequency of activities (*A)* for each child (*i)*, a panel model for two time periods with child-specific intercepts (ζ_i) was specified. The model is described by equation 1 and was fitted both as a random effects (M1) and fixed effects model (M2).

$$\mathrm{A}_{i,t} = \beta_0 + \zeta_i + \beta_1 \cdot \mathrm{x}_{1,i,t} + \ldots + \beta_n \cdot \mathrm{x}_{n,i,t} + \epsilon_{i,t}, \text{ for } \mathrm{t} = \mathrm{age}_{2,3}, \mathrm{age}_{5,6}. \quad (1)$$

Perhaps more interesting than the statistical properties of M1 and M2 are the different questions that can be answered using these models. While M1 allows the measurement of differences in the *level* of mother-child activity among children with varying numbers of siblings

[8] Equivalent post-government income measures household disposable income after taxes by correcting for household composition, in particular number of individuals and age. For more information on equivalent income, see http://ec.europa.eu/eurostat.

and different positions in the birth rank, M2 quantifies the extent to which mothers' frequency of activities *change* between t1 and t2 with the birth of a new sibling.[9] In a way, M1 can be interpreted substantively as an inter-individual comparison that pools all children from both age groups and compares their levels of mothers' activities, even if sometimes the children compared are one and the same child observed at two time periods.[10] By contrast, M2 is an intra-individual comparison that considers only what happens to children between measurement points. These two model variations correspond to the two perspectives we briefly discussed above when formulating our hypothesis (see Section 3).

Moreover, the differences in the questions addressed by each model are associated with certain statistical properties worth mentioning. By fitting equation 1 as a random effects model (M1) we make the most out of our very short and unbalanced panel, using both cross-sectional and longitudinal information to estimate the coefficients. The downside of M1, unfortunately, is its vulnerability to heterogeneity bias. If the unit-specific error term ζ_i correlates with the explanatory variables, random effects estimates are biased and no longer consistent (Halaby, 2004; Wooldridge, 2010). This might be the case if, for example, unmeasured characteristics of the children, such as hyperactivity, which may affect the type and intensity of maternal time spent in activities with them, correlate with socio-economic status. As commented briefly below, to assess the plausibility of the random effects assumption of no correlation we conducted a Hausman test for each variation of M1.

A further issue that needs to be addressed when equation 1 is fitted as a random effects model is the unbalanced structure of our panel. To ensure that parameter estimates using M1 are not biased, the missing observations in the panel must be random as regards the dependent variable (Wooldridge, 2010). Methods to test the randomness of missing values in unbalanced panels usually require more than two measurement points. In our data, a simple way to assess the randomness of missing measurement points is to compare the means of the dependent variable for children with one observation and those with complete cases for each age group. If the frequency of activities undertaken with children observed once differs from those observed twice, the assumption of randomness would be problematic. The results of this simple comparison are reported in **table 5**. Mean values between the two groups are not different from

[9] With t=2 a fixed effects model is equivalent to a first differences model in which changes in mothers' frequency of activities are explained by changes in the covariates, as given in the following equation (Allison 2009: 7):

$$A_{i,2} - A_{i,1} = (\beta_{02} - \beta_{01}) + \beta_1(x_{1,i,2} - x_{1,i,1}) + \ldots + \beta_n(x_{n,i,2} - x_{n,i,1}) + (\epsilon_{i,2} - \epsilon_{i,1}) \qquad (2)$$

Compared to equation 1, the child-specific intercept or time-invariant child-specific characteristics in equation 2 cancel out by differentiating between t1 and t2. Other time-invariant covariates cancel out as well.

[10] This is not to say that random effects models are the same as pooled OLS models. Compared to pooled OLS models, random effects models explicitly address the correlation of observations for the same individual across time (Wooldridge 2010). Nor is it to say that M1 uses only between-individual variance to estimate parameter effects. Random effects models in fact use both within and between variance to estimate parameters (Halaby 2004).

each other, and hence there appears to be no systematic discrepancies between the frequency of activities undertaken with children assessed at one or two measurement points.

Table 5. Missing at random?

	1 measurement point	2 measurement points	Ha: diff < 0	Ha: diff != 0	Ha: diff > 0
	(observed mean values)			(p-values)	
Age 2-3					
Activities at home	-0.02	0.02	0.23	0.97	0.77
Outside activities	0.01	-0.01	0.61	0.78	0.39
Age 5-6					
Activities at home	-0.02	0.00	0.41	0.82	0.59
Outside activities	0.09	-0.01	0.85	0.31	0.15

Compared to M1, the fixed effects model M2 avoids heterogeneity bias altogether by allowing the unit-specific error term to correlate with the covariates. This in turn controls for child-specific time-constant and effect-constant factors, both measured and unmeasured (Halaby, 2004). This comes at a cost, however. First, fixed effects models require at least two measurement points, which reduces our sample to a balanced panel with only those children with observations at ages 2 to 3 and 5 to 6, or roughly half the original sample. Second, with fixed effects it is not possible to estimate the coefficients of time constant covariates such as sex or, most critically for our purposes, birth order. Although birth order measured as the fixed set of categories explained above can change over time with the birth of a new sibling, as when youngest children become the middle children and single children become the oldest, it remains constant for the oldest and middle child. In those cases the effect of birth rank for these two categories would be absorbed by the unit-specific effect.

To remedy the latter, a new categorical variable was created based on birth rank at t1 (see **table 6**). This new variable allows distinguishing between oldest and middle children in t2 depending on their starting rank position in t1 and can be interpreted as an interaction term between birth rank and changes in the number of younger siblings. So, for example, even if categories 1 and 4 in t2 are both “oldest” children, 1 refers to children with no siblings in t1 while 4 denotes children who were already the oldest before the birth of a new sibling. Roughly 23% of children for which information is available at two measurement points experienced the birth of a new sibling. For the remaining 77% of the cases, the variable takes the value of zero.

Table 6. Birth rank after birth of a younger sibling

t1		t2	N
(0) No siblings		(1) Oldest	**95**
(1) Youngest	Birth of a younger sibling	(2) Middle	**42**
(2) Middle		(3) Middle	**12**
(3) Oldest		(4) Oldest	**26**
		No new siblings since t1	**571**

5. Results

Results for each model and each hypothesis are discussed separately.[11]

5.1. Random effects model (M1): Differences in levels

Three model variations of M1 for each dependent variable—activities at home, and outside activities—were specified to answer the three hypotheses considered. Model 1a controls only for number of siblings living in the household, leaving out birth order. Model 1b adds birth order, while model 1c includes an interaction term between number of siblings, birth order, and sex of the child. All three models share the same covariates, including family resources and other control variables. Parameter estimates using maximum likelihood and robust standard errors are reported in **table 8** in the appendix.[12]

H1: Model 1a shows that a higher number of siblings is associated on average with less frequent activities at home, and to some extent with less frequent outside activities. The one-sided hypothesis that the coefficient for number of siblings is equal to or greater than zero can be rejected for activities at home, but not for outside activities. Despite the fact that it is statistically smaller than zero, the size of the coefficient of activities at home is only -0.10. Referring back to the raw scores of the scale, a decrease of 0.10 on the standardized scale for each additional sibling means that the mother of an only child would have to give birth to at least 5 children in order for the frequency of one of the four activities at home (as summarized in the

[11] We fitted both models using Stata/MP version 12.0.

[12] When individual level weights are included in the model, the maximum likelihood iterative process does not reach convergence and parameter estimates are not reliable. Observations were therefore not weighted. To make sure that this decision does not affect our conclusions, we took advantage of the fact that random effects estimates can be approximately obtained through pooled OLS methods with clustered robust random error estimates and fitted to the model using this alternative method. Results show that pooled OLS estimates of M1 with weighted data are comparable with and for some parameters even identical to estimates for unweighted data. For this reason, it is safe to assume that reported estimates in **table 8,** using maximum likelihood, are approximately the same as those we would have obtained with weighted data. On the other hand, we tested the adequacy of the random effects assumption using a Hausman test. Results suggest that for activities at home obtained estimates are not only efficient but also consistent. For outside activities, however, the test indicates that estimates might be inconsistent. To further explore this issue we fitted models for outside activities using the person-specific means (between effects) as well as deviations from means (within effects). We then tested the equality of the parameters for mean deviations and means of each variable, as suggested by Allison (2009, p. 23-25). None of the tests is statistically significant, suggesting that the random effects assumption of no correlation of unit-specific effects with covariates is appropriate.

index), for example reading stories, to drop from "daily" to "more than once a week." Only after an additional 15 children and a total of 20 siblings would a mother who reads stories to her firstborn on a daily basis stop doing so altogether. Statistically, then, a higher number of siblings is on average associated with a reduction of the frequency of activities as measured by activities at home, which could be taken as evidence supporting the dilution hypothesis. Nonetheless, according to the parameter estimates, the reduction of frequency is so small in magnitude that it would only be consequential for children with an exceptionally high numbers of siblings. In other words, the effect is *statistically* significant but *substantively* insignificant.[13] For outside activities, evidence favoring the dilution hypothesis is even more scant.

H2: In both in Model 1a and 1b, being male is associated on average with lower activity frequency. Again, this only applies to activities at home and not to outside activities. Similar to the coefficient of number of siblings in model 1a, the effect of being male in model 1b is statistically less than zero, but small in magnitude. Interpreting the coefficient in terms of raw scores, being male reduces the frequency to a lower degree than going from engaging in a particular activity at home daily to more than once a week. Birth order also proves to make a difference, though a small one. In model 1b a combined test of the equality of coefficients for each category of the birth rank variable is rejected. While statistically there is no difference between being the youngest or middle child, being the oldest sibling is on average associated with a higher frequency both for activities at home and outside activities. Interestingly, even if for outside activities the coefficients for oldest sibling and only child are statistically the same, for activities at home, being the oldest secures higher frequencies than having no siblings. The magnitude of the positive effect favoring the firstborn is, however, small and comparable in size to the negative effect of being male.

H3: In model 1c we added all possible interaction terms between number of siblings, sex of the child, and birth order. To better visualize the interaction terms, we used predicted values. To compute these values, birth order, sex, and number of siblings are changed one at a time, averages are used for all other covariates. The results are shown in **figure 4**, each dependent variable and sex of the child is plotted separately. As expected, number of siblings interacts with birth order and sex. Consistent with the results of model 1b, the frequency of activities undertaken with the oldest siblings tends to be higher and, except for boys and outside activities, tends to grow with an increasing number of siblings. Being the youngest or the middle child interacts negatively with increasing number of siblings for activities at home and positively with outside activities. Except for the top line (older siblings), predicted values are very close to each other. Confidence intervals (not displayed on the graphs) are broad, a result that can be explained by the relatively small number of children in each combination of the attributes sex, sibship size, and number of siblings. Nonetheless, effects are sizable, especially when comparing the uppermost line of firstborns with the bottom lines of youngest and mid-

[13] Admittedly, it might still be possible that even very small changes in the frequency of maternal activities with the child have substantial effects on the latter's developmental, educational or other outcomes. To test this possibility, however, we will have to wait until enough children have been surveyed in later waves of the SOEP mother-child questionnaire or until they have reached adolescence or even adulthood.

dle children and even with the horizontal line for only children, outside activities for boys being the exception. So, for example, the predicted value of activities at home for firstborn boys with two siblings is roughly 0.7 higher than for the youngest boy with the same number of siblings. The size of this positive effect in favor of firstborn males is almost 7 times bigger than the very small negative effect found in model 1a for number of siblings. A difference of 0.7 on the standardized scale of frequency of activities is equivalent to a change from never reading to a child to reading more than once a week.

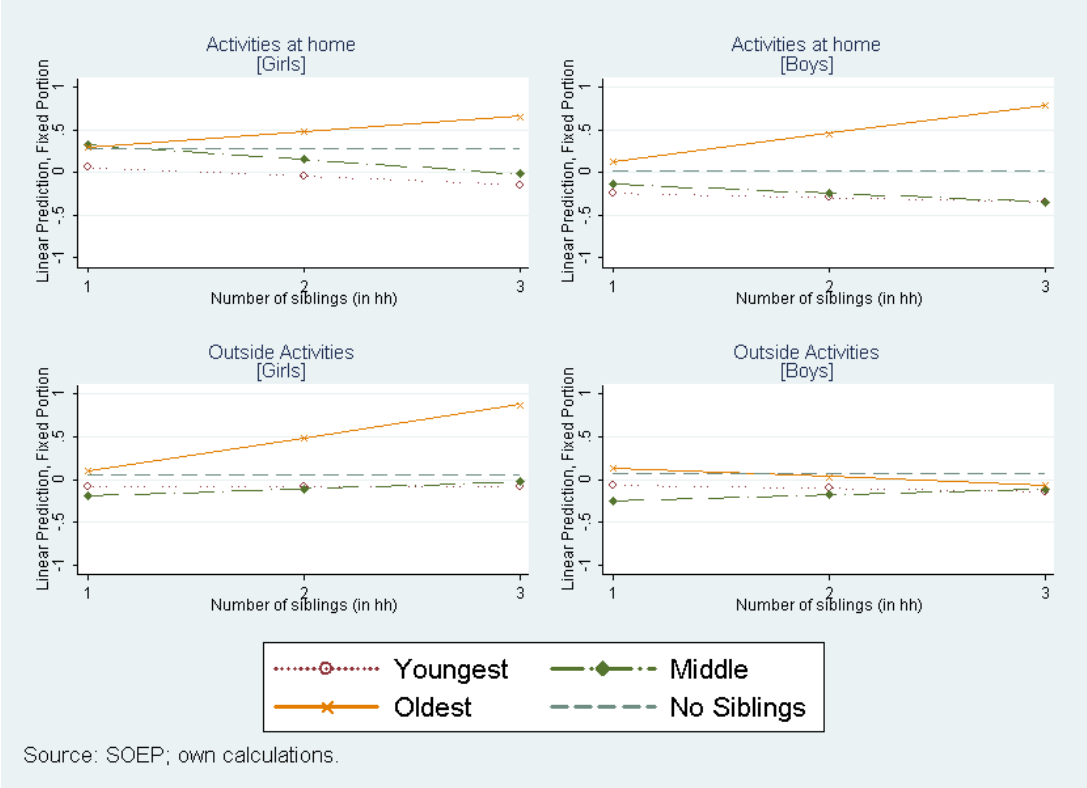

Figure 4. Predicted values model 2c

Other child covariates that are constant across models show no age or health effects. A dummy for having a twin sibling suggests that mothers of twins reallocate outside activities to home activities, with a net effect in the frequency of activities that should be positive but close to zero. Concerning between-family differences in mothers' frequency of activities with their children, covariates in all three models provide interesting insights. Particularly noteworthy is the insensitivity of outside activities to most attributes of the mother and the household. Large differences are only visible for activities at home. While the coefficients for household income, mother's age and working hours, daycare and childcare by the partner and relatives are all near zero, the mother's education level and being a single mother display sizable effects. The frequency of activities at home undertaken by mothers with tertiary education is higher than for mothers with only a general secondary school degree. By contrast, single mothers tend to spend less time with their children at home, while fathers' help in childcare, when they do not share the same household with the mother, has a large and positive impact.

Regarding maternal working time and education, results are partially consistent with previous research. Household income has been shown to correlate with higher time resources by par-

ents, which is not supported by our results. The irrelevance of income for the frequency of activities in our data might be explained by the different measurements of both the frequency scale and the list of activities in existing studies. Cross-country data with comparable measures is needed to further explore the effect of household income and financial resources on the level of activities.

5.2. Fixed effects model (M2): Time changes in frequencies.

Having analyzed the levels of activities, we now turn to *changes* over time. Two model variations of M2 for each dependent variable—activities at home and outside activities—were fitted. Model 2a controls for number of siblings without considering birth order, which is included in Model 2b as a categorical variable measuring the transition in birth rank after the birth of a sibling (see **table 6** above). Each model was fitted separately for the whole sample and again for each sex using longitudinal sample weights. To control for time effects we used a dummy for the second measurement point. Since the magnitude of the change in mother's and child's age between t1 and t2 is constant across individuals, both variables are necessarily confounded and absorbed by the time dummy. We therefore can only observe that the frequency of activities changes over time without being able to tell whether this change is a consequence of children growing up, mothers growing older, or both.

Since the model measures changes in number of siblings, it is important to recall that only 23% of the total or 175 children in our balanced panel sample experienced the birth of at least one sibling between t1 and t2. Of these, only 12 children or less than 9% were joined by two younger siblings, while most were joined by only one. This is not surprising given that only 3 years separate both measurement points. For this reason it is safe to interpret the results as the effect of the birth of *one* sibling and not as the marginal effect of the birth of one or more siblings. Results of model 2 and its variations are displayed in **table 9** in the appendix.

H1: For the complete sample (2a, *all* in **table 9**) and in line with results found for M1, the coefficient for the birth of a younger sibling is positive and small for activities at home, and almost zero for outside activities. Confidence intervals are wide, which is not surprising given the size of the sample, and suggest that the coefficients for both types of activities might lie somewhere in the vicinity of zero; neither too positive, nor too negative. Acknowledging that estimation precision is an issue in interpreting the results, the magnitude of the coefficients is small, and in the case of activities at home, only slightly larger than in M1 in absolute terms (0.12 vs. -0.10). Most importantly, the coefficients are not strongly negative, thus challenging once again the validity of the dilution hypothesis.

H2: Model 2a (girls, boys) shows the effect of the child's sex on the frequency of activities. Since birth order was operationalized in combination with changes in number of siblings, its effect can only be interpreted from the perspective of hypothesis 3. When comparing girls and boys, parameter estimates remain virtually unchanged for activities at home (girls 0.07, boys 0.19). For outside activities there are clear differences. Girls' frequencies increase after the birth of a sibling (0.3), while boys' remain unchanged. So while boys end up doing more at home after the birth of a sibling, girls do more outside.

H3: Model 2b adds birth order to the analysis and combines it with the child's sex. As shown in **figure 5**, birth order matters, and it matters in combination with child's sex. The biggest changes in the frequency of activities are found for children who were oldest or middle at t1. For children with no siblings or those who were the youngest, effects are much smaller or even zero. Being the oldest at t1 and receiving a younger sibling has positive and large effects on activities at home regardless of sex, and on outside activities for girls. The size of the coefficients is around 1, which corresponds to a whole standard deviation on the frequency index. With a new born sibling, a firstborn will experience a change in the frequency equivalent to, for example, going from reading to the child once a week to daily. This is a substantively significant change.

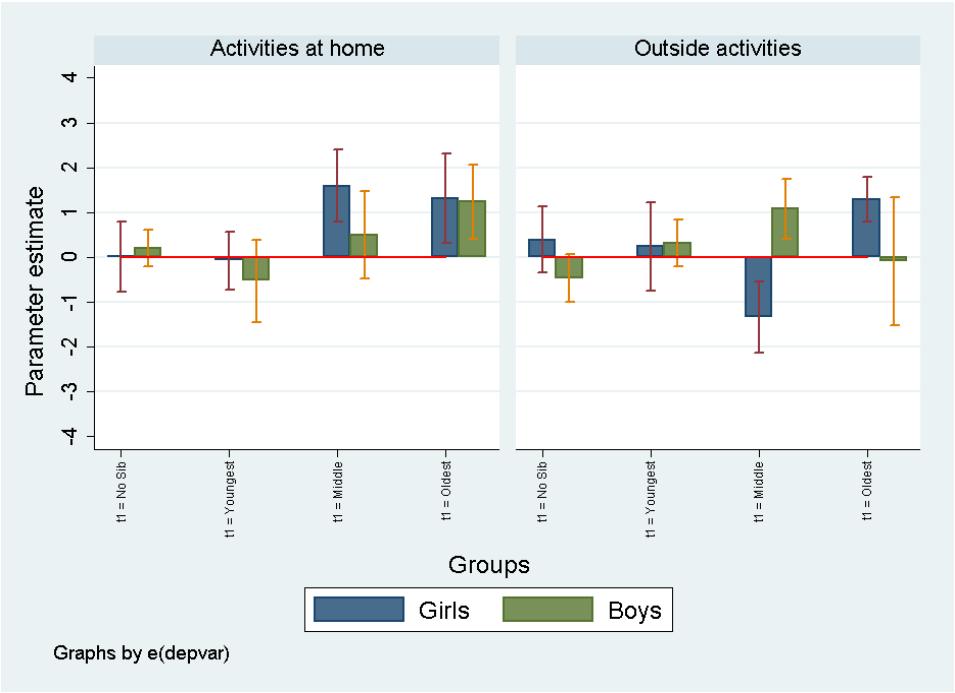

Figure 5. Parameter estimates and error bars model 2b (girls, boys)

Comparable high gains for both types of activities are observed for boys in the middle birth position, especially for outside activities. This is also true for girls who were the middle child at t1, but only for activities at home (1.2). This highly positive effect, however, is offset by an equally sizable loss in outside activities. Thus is seems as if activities of middle girls are reorganized from outside to home activities with no net gain or loss in frequency aside from qualitative changes in the type of activity. The same reallocation of activities, but on a smaller scale, can be observed for both boys and girls who had no siblings and those who were the youngest.

Maternal and household covariates tell a story similar to that told by the random effects models. Even if M2 measures changes of activity frequency and not levels, coefficients for working time and income are still near zero. Education level, measured as years of education to better capture changes in time, has no effect on the frequency of activities, except for the small negative coefficient on outside activities for girls, which is compensated by a positive effect of home activities of approximately the same magnitude. The strongest effects are

found in changes of variables associated with household composition and, to a lesser extent, childcare. Children whose mothers switched to living with a partner experience higher frequencies in both types of activities. Childcare arrangements, too, make a difference, even if only a small one judging by the size of coefficients. While daycare and childcare by the father if he is not living in the same household affect mother's activity frequencies positively, childcare by the partner and grandparents seem to divert maternal attention and reduce it.

By combining the results of the random effects and fixed effects models, a clear picture emerges. Comparing both levels (M1) of activities with children across families and their changes across time (M2), mothers do more with firstborn, and in particular with firstborn girls, than with children of the same age in other birth-order positions. Firstborns display higher frequencies of activities undertaken with their mother relative not only to middle and youngest children, but also to children with no siblings. They also receive more than other children when joined by a small sibling. By contrast, children with no siblings and those who were the youngest at t1 experience a reallocation of frequencies among types of activities with the birth of a new sibling. In sum, birth order and sex of the child matter for the type and frequency of activities undertaken by mothers with their children.

5.3. Sensitivity analysis

Results remain virtually unchanged if all biological children of a mother and not only those living in the household are considered in the measure of number of siblings. The same applies when taking all children in the household into consideration, and not only biological siblings, or when using single items for each activity instead of the additive standardized index. We also experimented by changing maternal education from categorical to continuous in random effects models and from continuous to categorical in fixed effects models. Education still played the same important role. Working time was also tested as a categorical variable to search for non-linearities in its effects on frequency of activities. Effects remained close to zero. In sum, results seem robust to modifications in measurements.

6. Discussion

The aim of this study was to investigate differences in the frequency of activities both across families and over time as a function of birth order and sex of the child. Our results indicate that the investigation of the effects of sibship size on different activities engaged in by mothers with their children is only fruitful if birth order and sex of the child are considered as moderator factors. All in all, when comparing mother's frequencies of activities with children with different sibling constellations, there appears to be no evidence for resource dilution with growing sibship size. Quite the contrary: our data suggest that a larger number of siblings may even be associated with a *higher* frequency of activities.

To better understand the implications of our results for the study of siblings and inequality at early stages of the life course, several caveats are necessary. First, our measure of maternal frequency of activities as a proxy for time and attention given to children may be too rough. Just as a high frequency of activities does not guarantee that mothers spend more time with their children, less frequent activities are not synonymous with less time. Moreover, we operationlized frequency of activities using a self-reported measure. Such measures may only

capture approximately the exact frequency spent by mothers with their children and may be subject to bias due to social desirability. Using time budget data on different activities could certainly provide a more accurate picture in future studies than the one obtained with our measures and both clarify a potential discrepancy between frequency of activities and time, and reduce reporting bias. Second, given the scope of our data we only considered maternal activities with the child. This ignores the fact that fathers, grandparents and other relatives, peers, and even older siblings are also engaged in activities with the child. It is reasonable to think that the frequency of activities by the mother may be substitued or complemented by activities with other individuals in the child's social network both inside and outside the household. Third, we did not take the perspective of children into account. Children, however, are by no means passive actors. Although our fixed effects models control for child attributes that remain constant over time, other child characteristics that vary over time may affect our results. For one thing, not all children need the same amount of activity. A hyperactive child may demand more attention from the mother than a passive child, and a child with physical disabilities more than a child with no disabilities. In addition, children might deliberately prompt their mothers to engage with them in activities, competing more or less successfully with other siblings for maternal attention. Including child characteristics measured longitudinally such as temperament or personality could greatly enhance the robustness of our analysis. Moreover, not only the children's but also the mothers' characteristics and their preferences concerning the balance of work and childcare could have an impact on the frequency of activities with children. Finally, the results of our study cannot be detached from its national context. Total fertility rates in Germany have remained below 1.5 children per mother for the past two decades, and as far back as 1975 for West Germany.[14] At the same time childbearing has gradually moved to later stages in the life course. As a consequence, family size tends to be smaller and mothers tend to be older than in other countries. How these two particularities of the German case affect the frequency of maternal activities with children and how they relate to the mostly US-centered empirical studies on the subject conducted so far remains an open question to be answered using cross-country data.

7. The resource augmentation hypothesis

Caveats aside, how can we explain our results? As summarized above, social norms, sex stereotypes, or particular utility-maximazing strategies that align child endowments with parental preferences are all plausible explanations of birth order and sex differences in the frequency of activities undertaken by mothers with children. Again, deciding among these competing explanations is not possible using our data, since no measures of norms regarding birth order, sex stereotypes or parental investment strategies are available. However, even if we had measures for these dimensions, none of them could fully explain why the amount of activities engaged in by mothers with their firstborn is higher than with only children, who are in fact also firstborns.

[14] German Federal Statistical Office, http://www.destatis.de/EN/.

This puzzling result calls for an explanation that is not linked to parental preferences or child attributes and behavior.[15] One possible answer is that siblings are not a source of competition for scarce time resources, as the dilution hypothesis asserts, but a source of resource gains. With increasing sibship size, mothers might learn how to spend time more efficiently with their children, thus maintaining or even raising the level of activities with each child despite a fixed time budget.

For one thing, activities with children are not necessarily exclusive to one child. They might, in fact, take the form of a public good, from which all siblings benefit. Reading a book or going to the park can be done simultanesouly with more than one child without losses to each individual child. Moreover, activities can also be combined. Being at the park with one child should not prevent the mother from nursing a smaller child at the same time. So in a way, mothers might experience what could be described as increasing returns of scale, multiplying the output in terms of frequency of activities by a factor larger than one for each unit of total time spent.[16] On top of that, efficiency gains may also go hand in hand with spillover effects, favoring larger sibship sizes over smaller ones. If the youngest child asks her mother to read her a story, her older brother might also benefit from the reading session even if he did not ask for it and would not have asked for to be read to on his own. Thus, more children at home should translate into a higher frequency of activities for *all* siblings even if the overall time spent by mothers with their children remains constant.

In sum, we argue that with growing sibship size, efficiency gains combined with positive spillover effects might explain why the frequency of mother's activities with children in fact *increases*. In direct contrast with the resource dilution hypothesis, we call this the resource *augmentation* hypothesis. The key to understanding this apparently puzzling hypothesis is to distinguish between the actual input of parental resources, such as time, and what these resources produce from the perspective of the child, how they experience these resources in the form of, for example, activities undertaken with the mother. This fundamental distinction between parental inputs and child-care outputs as experienced by the child has been neglected in previous theories on the distribution of resources inside families and should be a part of any explanation about resource allocation inside the family (see Section 2 above).

8. Suggestions for future research

By unveiling disparities within the family as regards the frequency of mothers' activities with preschool children, we have contributed to continually expanding the focus of inequality research both beyond between-family comparisons and towards early stages of the life course. At the same time, by pinpointing differences in the frequencies of mothers' activities, we have made intra-family processes visible that are likely responsible for the correlations observed,

[15] One simple explanation for the apparent advantage of firstborn compared to only children is that children with younger siblings are better at drawing maternal attention. Older siblings learn how to get what they want after being exposed to sibling competition. This explanation, however plausible, suffers the same measurement difficulties as explanations based on parental preferences. Data on individual characteristics, in this case the ability of children to draw maternal attention, would have to be collected.

[16] A similar efficiency argument was already suggested but not tested by Price (2008).

and documented in previous research, between number of siblings, birth order, and status attainment. This, of course, is not enough. In particular, an emphasis on the mechanisms whereby resources are distributed inside the family is needed.

Future research should test the cultural and economic perspectives on sibling differences by explicitly investigating parental attitudes toward social norms and sex stereotypes as well as child and parent characteristics that potentially condition investment strategies. Moreover, the augmentation hypothesis should be investigated in more detail, considering not only child characteristics such as age and spacing between siblings, but also the quality of activities. In general, combining the frequency with the quality of certain activities should lead to more differentiated results concerning activity allocation within families as well as impact on child outcomes. The connection between the frequency of activities undertaken with children in early life stages and later individual outcomes such as child development, educational attainment, and labor market success should be studied further. For example, Price (2008) suggested that reading to children has a positive effect on their development as well as performance in school, but time spent watching TV has a negative effect on child outcomes or at least takes away time in which more stimulating activities could be done. Only by unveiling the causal connection between activities undertaken with children and later life outcomes will the study of resource allocation within the family prove its relevance for understanding the emergence and persistence of social inequality.

Appendix

Table 7. Summary statistics

	Age 2-3				Age 5-6			
	Mean	**Std. Dev.**	**Min.**	**Max.**	**Mean**	**Std. Dev.**	**Min.**	**Max.**
Child								
Age (months)	33.27	3.91	26	45	69.42	3.92	62	82
Sex	0.50				0.49			
Health	0.45	0.50	0	1	0.56	0.50	0	1
Childcare: Partner (h/week)	12.50	16.37	0	162	10.87	12.73	0	110
Childcare: Father (h/week)	0.92	6.08	0	100	1.32	6.76	0	72
Childcare: Grandparents (h/week)	4.89	7.74	0	72	3.98	6.56	0	72
Childcare: Daycare (h/week)	10.41	14.33	0	50	20.77	14.57	0	52
Number of siblings	0.97	1.05	0	11	1.21	1.07	0	11
Twins (yes/no)	0.02				0.02			
Mother								
Age (years)	33.39	5.62	13	56	36.68	5.61	22	67
Education (years)	12.90	2.84	7	18	13.01	2.84	7	18
Working time (h/week)	11.89	15.63	0	72	17.33	16.39	0	80
Household								
Annual equivalent income	39.101	23.509	4.004	339.331	43.795	24.035	1.863	199.167

Table 8. Parameter estimates random effects models.

(Standard error in parenthesis)	Activities at home			Outside activities		
Variables	**1a**	**1b**	**1c**	**1a**	**1b**	**1c**
Children Covariates						
Age	-0.014	-0.016	-0.016	0.012	0.011	0.010
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Child's sex (male)	-0.259	-0.253	-0.525	-0.006	0.001	-0.042
	(0.044)	(0.043)	(0.398)	(0.047)	(0.047)	(0.363)
Health	0.017	0.031	0.030	-0.069	-0.059	-0.056
	(0.041)	(0.041)	(0.041)	(0.044)	(0.044)	(0.044)
Twins?	0.439	0.357	0.371	-0.104	-0.154	-0.142
	(0.096)	(0.099)	(0.101)	(0.138)	(0.137)	(0.137)
Number of siblings in HH	-0.105	-0.074	-0.169	-0.022	0.024	0.084
	(0.024)	(0.035)	(0.129)	(0.027)	(0.039)	(0.091)
Sibling Rank						
No siblings		0.095	-0.214		0.218	0.325
		(0.126)	(0.332)		(0.138)	(0.286)
Youngest		-0.072	-0.330		0.051	0.198
		(0.097)	(0.336)		(0.105)	(0.294)
Middle (ref.)						
Oldest		0.242	-0.382		0.255	-0.010
		(0.106)	(0.375)		(0.115)	(0.341)
Interactions						
Child's sex x sibling rank						
No siblings - male			0.272			0.060
			(0.405)			(0.372)
Youngest - male			0.173			0.089
			(0.411)			(0.389)
Middle (ref.)						
Oldest - male			0.215			0.552
			(0.482)			(0.449)
Child's sex x # sibling in HH						
Male			0.067			-0.015
			(0.143)			(0.122)
Sibling rank x sib in HH						
No siblings			(omitted)			(omitted)
Youngest			0.068			-0.086
			(0.134)			(0.109)
Middle (ref.)						
Oldest			0.352			0.304
			(0.214)			(0.196)
Child's sex x sibling rank x # siblings in HH						

(Standard error in parenthesis)	Activities at home			Outside activities		
Variables	**1a**	**1b**	**1c**	**1a**	**1b**	**1c**
No siblings - male						
			(omitted)			(omitted)
Youngest - male						
			-0.016			-0.020
Middle (ref.)			(0.157)			(0.158)
Oldest - male			0.080			-0.468
			(0.281)			(0.253)
Time						
Age 5-6 (ref.)	0.474	0.500	0.464	-0.346	-0.329	-0.322
	(0.220)	(0.218)	(0.218)	(0.213)	(0.215)	(0.215)
Household covariates						
Annual income (€ 000)	0.002	0.002	0.002	-0.002	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Family type						
Single mother (ref.)						
Couple with children < 16	0.235	0.201	0.196	0.096	0.085	0.073
	(0.098)	(0.099)	(0.098)	(0.092)	(0.092)	(0.092)
Couple with children < 16 & =>16	0.264	0.234	0.238	0.027	0.006	0.010
	(0.134)	(0.136)	(0.137)	(0.132)	(0.134)	(0.133)
Extended family household	-0.318	-0.397	-0.387	0.017	-0.118	-0.134
	(0.271)	(0.281)	(0.279)	(0.265)	(0.261)	(0.262)
Childcare						
Partner	0.075	0.073	0.077	-0.016	-0.010	-0.006
	(0.060)	(0.061)	(0.060)	(0.060)	(0.060)	(0.060)
Father (not living in HH)	0.172	0.178	0.181	0.066	0.077	0.078
	(0.091)	(0.091)	(0.092)	(0.089)	(0.090)	(0.090)
Grandparents	0.040	0.037	0.038	-0.034	-0.040	-0.040
	(0.043)	(0.043)	(0.043)	(0.046)	(0.046)	(0.046)
Daycare	0.092	0.090	0.088	-0.074	-0.082	-0.087
	(0.043)	(0.043)	(0.043)	(0.047)	(0.047)	(0.047)
Mother's Covariates						
Age	0.006	0.010	0.011	-0.010	-0.009	-0.009
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Education						
General secondary school (ref.)						
Intermediate secondary school	0.291	0.268	0.273	-0.064	-0.077	-0.080
	(0.071)	(0.071)	(0.071)	(0.070)	(0.071)	(0.071)
Upper secondary school	0.330	0.279	0.280	-0.164	-0.199	-0.207
	(0.083)	(0.085)	(0.085)	(0.086)	(0.086)	(0.086)
Tertiary education	0.487	0.414	0.413	-0.032	-0.067	-0.072

(Standard error in parenthesis)	Activities at home			Outside activities		
Variables	**1a**	**1b**	**1c**	**1a**	**1b**	**1c**
	(0.076)	(0.079)	(0.079)	(0.082)	(0.085)	(0.085)
Working time (h/week)	-0.002	-0.001	-0.001	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
_cons	-0.176	-0.287	-0.025	0.081	-0.077	-0.187
	(0.261)	(0.293)	(0.414)	(0.263)	(0.293)	(0.380)
Statistics						
N	**2165**	**2151**	**2151**	**2165**	**2151**	**2151**

Table 9. Parameter estimates fixed effects models.

(Standard error in parenthesis)	Activities at home						Outside activities					
		2a			2b			2a			2b	
	All	**Girls**	**Boys**	**All**	**Girls**	**Boys**	**All**	**Girls**	**Boys**	**All**	**Girls**	**Boys**
Children Covariates												
Health	-0.078	-0.224	-0.006	-0.104	-0.209	-0.059	-0.058	-0.085	-0.074	-0.055	-0.109	-0.077
	(0.109)	(0.133)	(0.154)	(0.101)	(0.118)	(0.155)	(0.104)	(0.172)	(0.128)	(0.108)	(0.171)	(0.133)
Number of siblings in HH	0.128	0.073	0.193				0.092	0.302	0.013			
	(0.155)	(0.176)	(0.217)				(0.109)	(0.161)	(0.144)			
Birth rank after birth of sibling												
No siblings to oldest				0.073	-0.07	0.287				-0.135	0.461	-0.404
				(0.158)	(0.240)	(0.180)				(0.224)	(0.284)	(0.263)
Youngest to middle				-0.271	-0.139	-0.283				0.124	0.175	0.192
				(0.290)	(0.324)	(0.387)				(0.217)	(0.515)	(0.222)
Middle to middle				0.418	1.28	0.491				0.347	-1.197	0.881
				(0.539)	(0.322)	(0.607)				(0.348)	(0.516)	(0.237)
Oldest to oldest				1.066	1.05	1.102				0.264	0.637	-0.039
				(0.280)	(0.359)	(0.424)				(0.383)	(0.310)	(0.625)
Time												
Age 5-6 (ref.)	-0.201	-0.07	-0.386	-0.216	-0.087	-0.419	-0.018	0.123	-0.258	-0.001	0.102	-0.221
	(0.101)	(0.173)	(0.112)	(0.107)	(0.183)	(0.120)	(0.147)	(0.219)	(0.137)	(0.151)	(0.220)	(0.143)
Household covariates												
Annual income (€ 000)	-0.005	-0.004	-0.005	-0.005	-0.005	-0.005	-0.004	0.004	-0.007	-0.004	0.003	-0.007
	(0.004)	(0.006)	(0.004)	(0.004)	(0.006)	(0.004)	(0.004)	(0.007)	(0.004)	(0.004)	(0.007)	(0.003)
Family type												
Single mother (ref.)												
Couple with children < 16	0.654	0.471	0.513	0.585	0.329	0.437	1.197	0.841	1.2	1.203	0.905	1.22
	(0.267)	(0.418)	(0.274)	(0.278)	(0.349)	(0.300)	(0.271)	(0.342)	(0.287)	(0.278)	(0.340)	(0.296)
Couple with children < 16 & =>16	0.773	0.441	0.873	0.755	0.333	0.85	0.735	0.709	0.422	0.745	0.881	0.428
	(0.322)	(0.520)	(0.352)	(0.332)	(0.463)	(0.388)	(0.360)	(0.456)	(0.387)	(0.362)	(0.451)	(0.400)
Extended family household	-0.621	-2.123	-0.152	-0.604	-2.28	-0.033	0.328	0.36	0.383	0.395	0.409	0.445
	(0.652)	(0.574)	(0.376)	(0.688)	(0.514)	(0.320)	(0.441)	(0.468)	(0.578)	(0.476)	(0.491)	(0.537)
Childcare												
Partner	-0.056	-0.013	-0.056	-0.072	-0.024	-0.045	-0.258	-0.081	-0.488	-0.262	-0.106	-0.483
	(0.136)	(0.214)	(0.174)	(0.136)	(0.205)	(0.187)	(0.139)	(0.184)	(0.220)	(0.139)	(0.180)	(0.223)
Father (not living in hh)	0.309	0.255	0.304	0.253	0.13	0.229	0.295	0.041	0.315	0.287	0.133	0.323
	(0.205)	(0.245)	(0.323)	(0.201)	(0.230)	(0.313)	(0.252)	(0.332)	(0.416)	(0.255)	(0.307)	(0.423)
Grandparents	-0.137	-0.069	-0.159	-0.149	-0.126	-0.132	0.112	0.195	0.011	0.1	0.21	0.039
	(0.133)	(0.162)	(0.199)	(0.132)	(0.164)	(0.197)	(0.214)	(0.354)	(0.166)	(0.212)	(0.367)	(0.152)

(Standard error in parenthesis)	Activities at home						Outside activities					
		2a			2b			2a			2b	
	All	**Girls**	**Boys**	**All**	**Girls**	**Boys**	**All**	**Girls**	**Boys**	**All**	**Girls**	**Boys**
Daycare	0.178	0.216	0.295	0.181	0.198	0.323	-0.03	-0.208	0.303	-0.027	-0.227	0.293
	(0.107)	(0.136)	(0.140)	(0.105)	(0.137)	(0.133)	(0.180)	(0.248)	(0.148)	(0.180)	(0.249)	(0.143)
Mother's Covariates												
Years of Education	-0.055	0.412	0	-0.044	0.421	0.012	-0.15	-0.259	-0.025	-0.128	-0.345	0.018
	(0.086)	(0.194)	(0.088)	(0.086)	(0.174)	(0.091)	(0.165)	(0.169)	(0.176)	(0.157)	(0.180)	(0.157)
Working time (h/week)	0	0.004	-0.003	0	0.003	-0.003	0.005	0.014	0	0.005	0.015	-0.001
	(0.004)	(0.005)	(0.006)	(0.004)	(0.005)	(0.006)	(0.005)	(0.006)	(0.006)	(0.005)	(0.006)	(0.006)
_cons	0.247	-5.587	-0.56	0.319	-5.445	-0.477	1.09	2.065	-0.081	0.903	3.46	-0.611
	(1.117)	(2.626)	(1.136)	(1.123)	(2.280)	(1.192)	(2.123)	(2.198)	(2.235)	(2.023)	(2.284)	(2.001)
N Children (t=1, 2)	**708**	**370**	**338**	**708**	**370**	**338**	**708**	**370**	**338**	**708**	**370**	**338**

References

Akresh, R., Bagby, E., Walque, D. de, & Kazianga, H. (2010). *Child Ability and Household Human Capital Investment Decisions in Burkina Faso* (IZA Discussion Papers, Teil 5326). Bonn. Retrieved from http://ftp.iza.org/dp5326.pdf; http://d-nb.info/1010690590/34.

Anastasi, A. (1956). Intelligence and family size. *Psychological Bulletin*, 3, 187–209. DOI: 10.1037/h0047353.

Allison, P. D. (2009). *Fixed effects regression models*. Los Angeles: Sage Publications.

Bagby, E. (2011). *Child Ability, Parental Investments and Child Nutrition in Ecuador* (Job Market Paper). University of Illinois at Urbana-Champaign. Retrieved from http://www.aae.wisc.edu/mwiedc/papers/2011/Bagby_Emilie_Ecuador.pdf.

Barber, N. (2000). *Why parents matter. Parental investment and child outcomes*. Westport: Greenwood Press.

Baydar, N., Hyle, P., & Brooks-Gunn, J. (1997). A Longitudinal Study of the Effects of the Birth of a Sibling During Preschool and Early Grade School Years. *Journal of Marriage and Family*, 4, 957–965.

Becker, G. S., & Tomes, N. (1976). Child endowments and the quantity and quality of children. *Journal of Political Economy*, Working paper, 123, 143–162.

Becker, G. S., & Tomes, N. (1986). Human Capital and the Rise and Fall of Families. Journal *of Labor Economics*, 4, 1–39.

Behrman, J. R., Pollak, R. A., & Taubman, P. (1982). Parental preferences and provision for progeny. *Journal of Political Economy*, 1, 52–73.

Behrman, J. R., Pollak, R. A., & Taubman, P. (1986). Do Parents Favor Boys? *International Economic Review*, 1, 33–54.

Bianchi, S. M. (2000). Maternal employment and time with children: Dramatic change or surprising continuity? *Demography*, 4, 401–414. DOI: 10.1353/dem.2000.0001.

Bianchi, S. M., & Raley, S. (2005). Time allocation in working families. In S. M. Bianchi, L. M. Casper, and R. B. King (Eds.), *Work, family, health, and well-being* (pp. 21–42). Mahwah NJ: Lawrence Erlbaum.

Bianchi, S. M., & Robinson, J. (1997). What did you do today? Children's use of time, family composition, and the acquisition of social capital. *Journal of Marriage and Family*, 2, 332–344.

Black, S. E., Devereux, P. G., & Salvanes, K. G. (2004). *The more the merrier? The effect of family composition on children's education* (IZA Discussion Paper Series 1269), 1–48.

Blake, J. (1981). Family size and the quality of children. *Demography*, 4, 421–442. DOI: 10.2307/2060941.

Blake, J. (1989). *Family size and achievement*. Berkeley: University of California Press.

Booth, C. L., Clarke-Stewart, K. A., Vandell, D. L., McCartney, K., & Owen, M. T. (2002). Child-care usage and mother-infant 'quality time'. *Journal of Marriage and Family*, 1, 16–26.

Bowlby, John (1969). *Attachment and loss*. New York: Basic Books.

Brody, C. J., & Steelman, L. C. (1985). Sibling structure and parental sex-typing of children's household tasks. *Journal of Marriage and Family*, 2, 265. DOI: 10.2307/352127.

Conley, D., & Glauber, R. (2005). Sibling similarity and difference in socioeconomic status: Life course and family resource effects. *National Bureau of Economic Research - Working Paper Series*, 11320, 1–46.

Cunha, F., & Heckman, J. J. (2007). *The technology of skill formation*. Cambridge, Mass: National Bureau of Economic Research.

Cunha, F., & Heckman, J. J. (2008). Formulating, identifying and estimating the technology of cognitive and noncognitive skill formation. *Journal of Human Resources*, 4, 738–782.

Dahan, M., & Gaviria, A. (2003). Parental actions and sibling inequality. *Journal of Development Economics*, 1, 281–297. DOI: 10.1016/S0304-3878(03)00077-4.

Dahl, G. B., & Moretti, E. (2008). The demand for sons. *Review of Economic Studies*, 4, 1085–1120. DOI: 10.1111/j.1467-937X.2008.00514.x.

Datar, A., Kilburn, M. R., & Loughran, D. S. (2010). Endowments and parental investments in infancy and early childhood. *Demography*, 1, 145–162.

Downey, D. B. (1995). When bigger is not better - Family-size, parental resources, and children's educational performance. *American Sociological Review*, 5, 746–761. DOI: 10.2307/2096320.

Guryan, J., Hurst, E., & Schettini Kearney, M. (2008). *Parental education and parental time with children* (NBER Working Paper 13993). Retrieved from http://papers.nber.org/papers/w13993.pdf.

Halaby, C. N. (2004). Panel models in sociological sesearch: Theory into practice. *Annual Review of Sociology*, 1, 507–544. DOI: 10.1146/annurev.soc.30.012703.110629.

Hank, K., Andersson, G., & Kohler, H.-P. (2008). *Sohn oder Tochter, Natur oder Kultur? Geschlechterpräferenzen für Kinder im europäischen Vergleich* (Die Natur der Gesellschaft. Verhandlungen des 33. Kongresses der Deutschen Gesellschaft für Soziologie), Kassel: Campus Verlag. 1671–1679.

Hardouin, J.-B., & Bonnaud-Antignac, A. (2011). Nonparametric item response theory using Stata. *The Stata Journal*, 1, 30–51.

Hertwig, R., Davis, J. N., & Sulloway, F. J. (2002). Parental investment: How an equity motive can produce inequality. *Psychological Bulletin*, 5, 728–745. DOI: 10.1037//0033-2909.128.5.728.

Hill, C. R., & Stafford, F. P. (1974). Allocation of time to preschool children and educational opportunity. *The Journal of Human Resources*, 3, 323–341.

Hill, C. R., & Stafford, F. P. (1985). Parental Care of Children: Time Diary Estimates of Quantity, Predictability and Variety. In T. F. Juster, & F. P. Stafford (Eds.), *Time, goods, and well-being* (pp. 415-37) Ann Arbor: University of Michigan.

Hofferth, S. L., & Sandberg, J. F. (2001). How American children spend their time. *Journal of Marriage and Family*, 2, 295–308. DOI: 10.1111/j.1741-3737.2001.00295.x.

Hrdy, S. B., & Judge, D. S. (1993). Darwin and the puzzle of primogeniture. An essay on biases in parental investment after death. *Human Nature*, 1, 1–45. DOI: 10.1007/BF02734088.

Iacovou, M. (2001). *Family composition and children's educational outcomes* (ISER Working Paper Series 2001-12).

Jacob, M. (2010). Do brothers affect their sisters' chances to graduate? An analysis of sibling sex composition effects on graduation from a university or a Fachhochschule in Germany. *Higher Education*, 3, 277–291. DOI: 10.1007/s10734-010-9377-8.

Kendrick, C., & Dunn, J. (1980). Caring for a second baby: Effects on interaction between mother and firstborn. *Developmental Psychology*, 4, 303–311. DOI: 10.1037/0012-1649.16.4.303.

Lamb, M. E.; Ahnert, L. (2007): *Nonparental Child Care: Context, Concepts, Correlates, and Consequences*. In William Damon, Richard M. Lerner (Eds.): Handbook of Child Psychology. Hoboken, NJ, USA: John Wiley & Sons, Inc.

Lawson, D. W. (2009). *The behavioural ecology of modern families: A longitudinal study of parental investment and child development*. PhD thesis. London: University College London.

Loevinger, J. (1948). The technic of homogeneous tests compared with some aspects of scale analysis and factor analysis. *Psychological Bulletin, 6,* 507–529, DOI: 10.1037/h0055827.

Lundberg, S. (2005). Sons, daughters, and parental behaviour. *Oxford Review of Economic Policy*, 3, 340–356. DOI: 10.1093/oxrep/gri020.

Marjoribanks, K. (1989). Sibling correlates of young adults' status attainment: Ethnic group differences. *Journal of* Psychology, 123:5, 507–516.

Mokken, R. J. (1971). *A theory and procedure of scale analysis*. Mouton: The Hague.

Molenaar, I. W. (1997). Nonparametric models for polytomous responses. *Handbook of modern item response theory* (pp. 369–380). New York: Springer.

Nock, S. L., & Kingston, P. W. (1988). *Time with children: The impact of couples' work-time commitments.* Oxford: Oxford University Press.

Plomin, R., & Daniels, D. (1987). Children in the same family are very different, but why? *Behavioral and Brain Sciences,* 1, 44–59.
DOI: 10.1017/S0140525X00056272.

Price, J. (2008). Parent-child quality time. does birth order matter? *Journal of Human Resources,* 43: 1, 240–265.

Raley, S. B., & Bianchi, S. M. (2007). *Transmitting advantage: Maternal education differences in parental investment activities.* PhD thesis. University of Maryland.

Savulescu, J., & Dahl, E. (2000). Junge oder Mädchen: Sollten sich Eltern das Geschlecht ihrer Kinder aussuchen dürfen? *Reproduktionsmedizin,* 4, 274–278.
DOI: 10.1007/s004440000198.

Sayer, L. C., Gauthier, A. H., & Furstenberg, F. F. (2004). Educational differences in parents' time with children: Cross-national variations. *Journal of Marriage and Family,* 5, 1152–1169.
DOI: 10.1111/j.0022-2445.2004.00084.x.

Socio-economic Panel (SOEP), Data for years 1984-2010, Version 27, SOEP, 2011, doi:10.5684/soep.v27.

Steelman, L. C., Powell, B., Werum, R., & Carter, S. (2002). Reconsidering the effects of sibling configuration: Recent Advances and Challenges. *Annual Review of Sociology,* 1, 243–269.
DOI: 10.1146/annurev.soc.28.111301.093304.

Stewart, S. D. (2005). How the birth of a child affects involvement with stepchildren. *Journal of Marriage and Family,* 2, 461–473.
DOI: 10.1111/j.0022-2445.2005.00128.x.

Turkheimer, E., & Waldron, M. (2000). Nonshared Environment: A theoretical, methodological, and quantitative Review. *Psychological Bulletin,* 1, 78–108.
DOI: 10.1037/0033-2909.126.1.78.

Wagner, G. G., Frick, J. R., & Schupp, J. (2007). The German Socio-Economic Panel Study (SOEP) – Scope, evolution and enhancements. *Schmollers Jahrbuch,* 1, 139–169.

Wooldridge, J. M. (2010): Econometric analysis of cross section and panel data. 2. Edition. Cambridge, Mass.: MIT Press.

Yeung, W. J., Sandberg, J. F., Davis-Kean, P. E., & Hofferth, S. L. (2001). Children's time with fathers in intact families. *Journal of Marriage and Family,* 1, 136–154.
DOI: 10.1111/j.1741-3737.2001.00136.x.

Zajonc, R. B., & Markus, G. B. (1975). Birth order and intellectual development. *Psychological Review,* 1, 74–88. DOI: 10.1037/h0076229.

Zaslow, M. J., Pedersen, F. A., Cain, R. L., Suwalsky, J. T., & Kramer, E. L. (1985). Depressed mood in new fathers. Associations with parent-infant interaction. *Genetic Social and General Psychology Monographs*, 2, 135–150.

Zick, C. D., & Bryant, W. K. (1996). A new look at parents' time spent in child care: Primary and secondary time use. *Social Science Research*, 3, 260–280. DOI: 10.1006/ssre.1996.0012.

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