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Sibling structure and educational achievement: How do the number of siblings, birth order, and birth spacing affect children's vocabulary competences?

Geschwisterstrukturen und Bildungserfolg: Zur Bedeutung von Geschwisteranzahl, Geburtenreihenfolge und Geburtenabstand für die Wortschatzkompetenzen von Grundschulkindern

Abstract

Empirical evidence suggests that sibling structure influences children's educational outcomes: While the negative effect of the number of siblings is quite consistent, there are mixed findings for birth order and birth spacing. According to the resource dilution hypothesis, differences between siblings occur because siblings have to share family resources. Having a larger number of siblings, being a later-born child as well as narrow age gaps between siblings can affect the parental resources available for each child, which may thus negatively affect educational outcome. To study the effects of sibling structure, we use longitudinal data from the BiKS-8-14 study at the end of elementary school, focusing on children's vocabulary competences.

Our results indicate an expected negative effect for increasing number of siblings particularly when children originate from families with a lower educational background. Regarding birth order, we also find differential effects by parents' education, as only children from less educated families suffer from being a later-born child. No effects can be identified for children's birth gaps in relation to younger siblings as soon as number of siblings is being considered, whereas longer spacing between a child and his/her older siblings is positively related to vocabulary competences. With respect to possible changes across time, sibling effects appear to be rather stable at the end of primary education.

Zusammenfassung

Empirische Befunde weisen auf einen Einfluss von Geschwisterstrukturen auf den Bildungserfolg von Kindern hin: Während der negative Einfluss der Geschwisteranzahl als unstrittig gilt, zeigen sich unterschiedliche Ergebnisse hinsichtlich Geburtenreihenfolge und Geburtenabstand. Nach der Resource-Dilution-Hypothese können Disparitäten im Bildungserfolg darauf zurückgeführt werden, dass Ressourcen bei bestimmten familialen Strukturen aufgeteilt werden müssen. Kinder mit einer größeren Geschwisteranzahl, später geborene Kinder sowie Geschwister mit kurzen Geburtenabständen können durch geringere zur Verfügung stehende Ressourcen im Bildungser werb benachteiligt sein. Mithilfe der Längsschnittstudie BiKS-8-14 werden Geschwistereffekte bei Kindern am Ende der Grundschulzeit hinsichtlich ihrer Wortschatzkompetenzen untersucht.

Die Ergebnisse deuten auf einen negativen Effekt größerer Geschwisteranzahl hin, insbesondere bei niedrigem familialen Bildungshintergrund. Mit Blick auf die Geburtenreihenfolge können Nachteile im Wortschatz lediglich für später geborene Kinder aus Familien mit niedrigen Bildungsniveaus festgestellt werden. Hingegen zeigen sich keine Effekte beim Geburtenabstand zu jüngeren Geschwistern, sobald die Anzahl der Geschwister berücksichtigt wird, während sich ein größerer Geburtenabstand zu einem älteren Geschwisterkind positiv auf den Wortschatz auswirkt. Weiterhin erweisen sich die

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Auswirkungen von Geschwisterstrukturen am Ende der Grundschulzeit als äußerst konstant.

Keywords**:** sibling structure, number of siblings, birth order, birth spacing, educational outcome, longitudinal study, family resources

Schlagwörter: Geschwister, Geschwisteranzahl, Geburtenreihenfolge, Geburtenabstand, Bildungserfolg, Längsschnittstudie, familiale Ressourcen

1. Introduction

Empirical research has repeatedly revealed the persistence of educational inequalities caused by families' human capital, economic, and cultural resources (e.g., Baumert et al. 2001; Prenzel et al. 2004; Becker 2004). Current research increasingly focuses on characteristics influencing a child's educational success in addition to classical social background characteristics as well as on underlying mechanisms leading to resource-specific educational outcomes. From this perspective, the family structure (such as single-parent families or family size) is an important dimension worth gaining attention (e.g., McLanahan/Sandfur 1997; Ginther/Pollak 2003; Hannan/Halpin 2014). One crucial aspect of family structures concerns the role of siblings in the course of educational attainment, as components of sibling structures can generate inequalities.

Particularly U.S. studies provide evidence that children's number of siblings, their position in the birth order as well as their age gaps to other siblings exert influence on various educational outcomes, such as intelligence, school attainment, competence achievement, but also on employment, partnerships, or health outcomes (e.g., Hauser/Sewell 1985; Downey 1995; Conley 2000; Steelman et al. 2002; Wolter 2003; Black et al. 2005; Caceres-Delpiano 2005; Kantarevic/Mechoulan 2006; Buckles/Munnich 2012; Nguyen 2013). This research focus has been largely neglected in the German context so far. Although studies on diverse sibship topics, for instance relationships of siblings or rivalry between siblings, are quite elaborated (e.g., Kasten 1993a, 1993b, 1998, 2003), empirical research in the context of sibship and education is rather rare (e.g., Bauer/Gang 2001; Helbig 2013; Schulze/Preisendörfer 2013) and should therefore be pursued in a more comprehensive way.

One prominent explanation on why sibship structure should be relevant for educational outcomes has been contributed by the resource dilution hypothesis, which states that the availability of family resources is dependent on the number of children. In larger families, resources (e.g., parental time or monetary resources) have to be distributed among more children, which could negatively affect their educational outcomes. Furthermore, additional effects on family resources are expected for birth spacing and birth order, as, for instance, smaller birth gaps may additionally reduce parental attention paid to each child, and first-born children could potentially benefit more from time spent with their parents than later-born siblings.

However, from an empirical perspective the picture is not that clear. While empirical findings quite consistently show a negative effect of an increasing number of siblings on educational outcomes (e.g., Downey 1995; Conley/Glauber 2005), some studies do not identify an independent effect of sibling group size when additionally controlling for birth order (e.g., Black et al. 2005; Helbig 2013). Although birth order effects are mostly reported to advantage first-borns and disadvantage last-borns (e.g., Behrman/Taubman 1986; Härkönen 2014), these findings are inconsistent, as some studies report opposite (e.g., Ejrnaes/Pörtner 2002) or no effects (e.g., Hauser/Sewell 1985). Similarly, some studies reveal no effects of birth spacing on educational outcomes at all (e.g., Nguyen 2013), whereas others confirm a negative effect of short birth gaps (e.g., Buckles/Munnich 2012; Powell/Steelman 1990, 1993). Besides – with only a few exceptions (e.g., Hanushek 1992; Iacovou 2001) – it is longitudinal analyses that are missing in this field of research, although it should be an interesting aspect to examine the changing character of sibling effects over time.

In this paper, our aim is to analyze the effect of sibling group size, birth order, and birth spacing on the competence development of elementary school students in Germany. Using data from the BiKS research group ("Educational processes, competence development and selection decisions in preschool- and school age") allows us to study children's vocabulary competences across three biannual time points in the two German federal states of Bavaria and Hesse. Before presenting our empirical approach and results, a review of the theoretical background and current state of research on sibling structure and educational outcome is given in the following.

2. Sibling effects: Theoretical considerations and empirical evidence

Concerning the effects of siblings on educational outcomes, various theoretical assumptions and a large body of empirical research exist. However, this has mostly been conducted in the U.S. context, while in the German research literature, the role of sibling components, such as the relationships of siblings or birth order, are merely addressed theoretically (e.g., Kasten 1993a, 1993b, 1998, 2003; Pinquart/Silbereisen 2009; Keddi et al. 2010) and rarely analyzed empirically. We are only aware of five empirical studies in Germany that analyze the relationship of sibship and educational outcomes (Bauer/Gang 2001; Jacob 2010; Schulze/Preisendörfer 2013; Helbig 2013; Härkönen 2014).

From a theoretical perspective, two main approaches are prevalent to explain the influences of sibship on educational outcomes: the confluence model and the resource dilution hypothesis.

The confluence model

The confluence model of Zajonc/Markus (1975) explains the development of intellect in a family by taking the following factors into consideration: family size, birth order, and age spacing. The authors argue that all three factors influence the intellectual development altogether. The confluence model assumes a decreasing intellectual environment with increasing family size as the family intelligence level is divided by the number of family members[1]. Consequently, Zajonc/Markus (1975) presume that first-born children tend to have a better intellectual development, because they share the intellectual environment only with their parents. In contrast, a newborn (additional) child is born into a lower intellectual environment that must be shared with the parents and the older sibling. Besides, birth spacing is regarded as relevant: longer spacing supposedly signifies an advantage, as the intellectual environment of the whole family rises – even though the overall family size increases – during longer periods of birth gaps, which should, in turn, be beneficial to the newborn child. However, this approach cannot be tested with our data and also needs to be criticized. Since the model entirely concentrates on intellectual development, it does not sufficiently explain in which way the intellectual environment influences educational outcomes (Powell/Steelman 1990; Steelman et al. 2002), and while family size effects are consistent with the theory's assumption, there is criticism that birth order or birth spacing are not (Steelman et al. 2002).

The resource dilution hypothesis

In our study, we therefore primarily focus on the second approach: the resource dilution hypothesis. This hypothesis was first brought up by Dumon (1890) and was further developed e.g., by Blake (1989) and Steelman et al. (2002). The underlying mechanism can be explained easily: In each family, resources are available that need to be shared between children. Family resources include several kinds of resources such as parental time spent with children (e.g., Blake 1989; Hanushek 1992), material goods (e.g., Powell/Steelman 1989, 1991, 1993), cultural opportunities (e.g., Blake 1989; Downey 1995), intellectual stimulation (e.g., Powell/Steelman 1990), and human capital (e.g. Bagger et al. 2013), to mention just a few examples.

1 Zajonc/Markus (1975) calculate the intellectual environment of families the following way: Each parent has an intellectual value of 100, whereas newborns have a value of near zero. The value of newborns increases with age, which leads to an increase of the intellectual environment within the family. Considering this assumption, the intellectual environment for a family with two parents and a newborn is calculated as follows: (100 + 100 + 0)/3 = 67. However, for a family with two parents, a first-born child that has reached an intellectual value of 40 and a second born child with a value of near zero, the intellectual environment decreases to (100 + 100 + 40 + 0)/4 = 60.

Number of siblings

"The amount of resources that can be allocated to any given child, though, depends not only on the amount of resources in the family (e.g., parental income) but also upon the number of children (and, collaterally, how they are spread out in age). In other words, the larger the family, the greater the dilution of resources, and in turn the lower the educational progress of the child" (Steelman et al. 2002: 251). Therefore, the driving factor in this model is the number of children, which influences the amount of resources available within a family.

Since the mid-1960s the function of sibship size has been conclusively proven empirically, revealing a quite consistent picture and confirming the model's assumption: With a rising number of siblings, educational outcomes decrease (e.g., Blau/Duncan 1967; Featherman/Hauser 1978; Blake 1981, 1985, 1989; Hanushek 1992; Powell/Steelman 1993; Downey 1995; Conley/Glauber 2005; Jaeger 2007; Bagger et al. 2013; Helbig 2013), and this negative effect of sibling group size remains robust also when families' socioeconomic positions are being considered (e.g., Blake 1989; Iacovou 2001). However, Bauer and Gang (2001) did not identify an overall sibship size effect with respect to years of schooling in the German context, expect for the group of West German males and foreign-born females both having only sisters in the family. The authors attribute the non-significant main effect of sibling size to comparatively low costs of schooling in Germany.

Birth order

Linking the resource dilution model to birth order, it is assumed that children born in different sibling ranks should be affected by the resource distribution. For example, first-borns do not have to share family resources, such as parental time or parental involvement, with other siblings – at least for a certain amount of time – a condition from which first-born children particularly benefit (e.g., Behrman/Taubman, 1986; Steelman et al. 2002; Jaeger 2007) early in life and which they may maintain even later on (e.g., Kantarevic/Mechoulan 2006), whereas later-born children have to share these kind of resources with their older siblings right from the beginning.

Although empirical evidence with regard to birth order is quite mixed, it is mostly first-born children that are found to have better educational chances than later-borns, as shown by Behrman/Taubman (1986), Iacovou (2001), Kantarevic/Mechoulan (2006), Bagger et al. (2013), Schulze/Preisendörfer (2013), and Härkönen (2014) for different educational outcomes (such as years of schooling, school grades, or test scores). However, other researchers could not discover the theoretically expected positive effects for first-borns (e.g., Jaeger 2007; Ejrnaes/Pörtner 2002). According to Hauser and Sewell (1985), there is no independent influence of birth order on educational attainment as soon as relevant variables (such as parental education) are controlled for, as "[…] the effect of the socioeconomic variables, particularly parents' education, eliminates the suppressor effect that led to the appearance of birth order differentials in schooling" (Hauser/Sewell 1985: 19).

For Germany, recent studies by Helbig (2013) and Schulze/Preisendörfer (2013) have also revealed mixed results: According to Helbig (2013), the fact of having older siblings who attended the academic secondary school track ("Gymnasium") or acquired the German university entrance qualification ("Abitur") increases children's chances to attend the academic track themselves. If this is not given, transition probabilities are negative for the younger child. The positive finding could be explained by parents' higher educational aspirations for their children when older children attended "Gymnasium" or acquire "Abitur" (Helbig 2013). Schulze/Preisendörfer (2013) show that parents of high socioeconomic status show lower educational aspirations for their later-borns if older children have already reached a higher secondary educational degree. The contrary is the case in less privileged families: Here, older siblings' participation in higher secondary education leads to more ambitious educational aspirations for the younger child. These results are explained by the family's motive for status maintenance, which in families of high socioeconomic status is already achieved as soon as an older child reaches a higher level of education, whereas in families of lower socioeconomic status parents "learn" from their older children and therefore increase their educational aspirations for the younger children (Schulze/Preisendörfer 2013).

Birth spacing

Besides the number of siblings and birth order, birth spacing can influence the dilution of resources as well. Larger birth gaps can positively influence economic investments in children, as parents with children born in wider intervals have the opportunity to recoup their capital for expensive investments in all their children (Steelman et al. 2002). Close spacing, on the one hand, is assumed to be disadvantageous, as families – for example – might not be able to afford tuition fees for each child during their school years (e.g., Powell/Steelman 1993) or parents have to limit their time spent with each child (e.g., reading and playing; Powell/Steelman 1990, 1993; Buckles/Munnich 2012). On the other hand, short birth gaps can also be positive in some respect, as parents have the opportunity to share the costs of clothes or toys between closely aged children (Steelman et al. 2002).

Generally, research on birth spacing and educational outcomes appears to be less prominent when compared with analyses on number of siblings and birth order, which is mainly a problem of data availability on birth gaps. Due to data constraints, birth spacing is often measured inappropriately (Powell/Steelman 1993; Petterson-Lidbom/Thoursie 2009) and is sometimes even replaced by the use of birth order or family size (Powell/Steelman 1993).

The few existing studies are mainly supporting the theoretical assumptions: For example, Powell/Steelman (1990, 1993) found negative effects of short birth gaps on verbal and math abilities, school grades, and high school completion, as well as attending postsecondary education, and closer birth spacing negatively affects the dilution of family resources, such as reading to children in preschool, verbal interaction with parents, and economic investments in children. Black et al. (2005) also identify a significant effect of birth spacing for earlier born children in families having lower educational outcomes when two closely spaced younger siblings are present. Buckles/Munnich (2012) show positive effects of longer spacing on math and verbal test scores for older – but not for younger – siblings and find higher parental investment in older siblings when birth gaps are larger: The likelihood of daily reading to the older child at preschool age increases with longer spacing, whereas the older child's time spent watching television decreases with larger birth gaps. Furthermore, the likelihood of having more books in the household increases with longer spacing. Nguyen (2013)[2] shows positive as well as no effects of birth spacing for different stages in the life course considering various educational outcomes. In young adulthood, both younger and older siblings profit from longer spacing with regard to years of education; however, concerning the likelihood of college enrollment only younger siblings are found to benefit from larger gaps. No birth spacing effects could be identified for the groups of adolescents and young adults on test scores as well as for the group of adults on the outcomes of years of schooling, college degree, and labor earnings. These findings suggest that the effect of birth spacing on educational outcomes and family resources changes across the life course (Nguyen 2013).

Extensions to the resource dilution model

Although the resource dilution hypothesis easily explains the mechanism of sibling structure on educational success, the theory's assumptions can be further extended, as they do not regard specifications such as interdependencies of sibling structure components, group effects or a longitudinal perspective.

Interdependency of sibling structure components

First, the model does not consider the interdependency between sibling size, birth order, and birth spacing influencing the distribution of family resources and thus affecting children's educational outcomes. For example, Hanushek (1992) found no birth order effects for small families and a U-shaped effect for children in larger families, as first- or last-born children achieve a higher educational performance. Additionally, Härkönen (2014) and Hauser/Sewell (1985) found smaller birth order effects in larger families. These results indicate advantages for first-born children early on in life when living in a larger family and therefore receiving more attention – just as later-born children who enjoy these advantages later on in their life course (e.g., Hauser/Sewell 1985; Hanushek 1992; Härkönen 2014). However, Black et al. (2005), Conley/Glauber (2005), and Helbig (2013) could not identify sibship size effects when birth order is controlled for. In these studies, the sibling effect on educational outcomes refers back to having older siblings.

2 The author examined three different life stages, divided into adolescence (12 to 18 years), young adulthood (19 to 24 years), and adulthood (25 to 32 years). Depending on these life stages, different educational outcomes were being considered: test scores for the groups of adolescents and young adults, years of schooling for the groups of young adults and adults, or labor earnings for the group of adults.

Moreover, the interrelation of birth order and birth spacing can also be assumed to affect the distribution of family resources: Assuming that first-born children per se benefit of family resources until another newborn arrives, this positive effect should increase with wider age gap to the next sibling. Price (2008, 2010), for example, found a higher investment of parental time in first-born children when birth gaps are large, as differences for birth order additionally increase with wider age spacing. In contrast, even negative effects for first-born children are conceivable. For example, later-born children may profit from higher financial resources as family income increases with parents' age (e.g., Kalmijn/ Kraaykamp 2005; Jaeger 2007; Zerle et al. 2012), moreover so when birth spacing among children is larger (e.g. Behrman/Taubman 1986). As shown by Powell/Steelman (1995), lower financial investments are made for older siblings when children are closely spaced. The authors generally suggest that later-born children have advantages in terms of parental support, as they benefit from parents' later life cycle and furthermore from the self-reliance of their older siblings (e.g., moving out from the household).

Another assumption, which has been neglected in the resource dilution model, is the important role of older siblings, particularly those with larger birth gaps: older siblings can also function as role models and teachers, because with larger gaps the older siblings' competences and knowledge become more advanced – hence, turning into a resource per se, from which the younger sibling can benefit. For example, Helbig (2013) found that older children increase the competences of their younger siblings by teaching them, which becomes especially evident in single-parent households.

Differential group effects

Additionally, the resource dilution model cannot successfully explain why the effect of sibship size on educational outcomes differs for various groups (e.g., high-income versus low-income families or different religious groups; Steelman et al. 2002) as evidenced by some studies. For example, Downey/Neubauer (1998) found a larger number of siblings to negatively affect educational success of children from high-income, but not from low-income families. This finding suggests that an increasing number of siblings especially affects surplus resources (e.g., resources for long-term opportunities, which are not necessary for survival), as parents invest in surplus resources only when the base resources (e.g., resources necessary for survival) are ensured (Downey 2001; Steelman et al. 2002). However, Iacovou (2001) showed the opposite effect, as children with non-manual family background face fewer disadvantages than children originating from families working in manual occupations or families with financial problems when the number of siblings increases. For birth order, Iacovou (2001) found no overall effect assuming that families with varying financial constraints are differently affected by the number of children, because families with a higher social background are better able to take out a loan for investments in their children.

Longitudinal perspective

A further point of critique of the resource dilution hypothesis concerns the lack of assumptions regarding children's development, and thus refrains from taking a life course perspective. For example, first-born children should profit of both longer birth spacing and an initial advantage, supposedly lasting for a lifetime, while the further skill development of siblings is assumed to run parallel. The same holds true for empirical work on sibling structure effects: although often panel data sets are used (e.g., National Longitudinal Survey of Youth 1979 (NLSY79), National Longitudinal Study of Adolescent Health (Add Health), Wisconsin Longitudinal Study (WLS)), it is cross-sectional methods that are mainly applied, studying educational outcomes at one point in time. Possible changes in the effects of sibling structure on educational outcomes or even on later life outcomes are therefore not being considered (e.g., Kantarevic/Mechoulan 2006; Buckles/Munnich 2012).

To our knowledge, only two studies exist that employ longitudinal analyses (Hanushek 1992; Iacovou 2001). Hanushek (1992) focused on vocabulary and reading competences from school grade two to six in the US, indicating that achievement growths weaken with a rising number of siblings. No effects on achievement outcomes were identified for birth order, spacing or age structure of the family when family size was controlled for. Hanushek (1992) concluded that achievement growth during school time particularly is ascribed to the number of (competing) siblings and the quality of parental time. Likewise, Iacovou (2001) analyzed the relationship between the number of siblings and birth order on mathematics and reading test scores at age 7, 11, and 16 for the UK. Overall, results show lower performance in mathematics and reading over time with increasing number of siblings and for later-born children.

To sum up, the theoretical assumption of the resource dilution hypothesis can substantively contribute to the explanation of sibling structure effects on educational outcome and is largely supported empirically. However, the model needs to be extended with respect to the interdependency of sibling structure effects, mechanisms leading to differential group effects, and assumptions concerning varying effects over the life course.

3. Research questions and hypotheses

Studying the role of sibship size, birth order position, and birth spacing for children's competence development, we pose the following questions:

1. Does a larger number of siblings negatively affect educational achievement?
In line with the resource dilution hypothesis, most studies on sibship size confirm a negative effect on educational outcomes with an increasing number of siblings (e.g., Downey 1995; Härkönen 2014), as family resources decrease with every additional child. Children from larger families receive less parental time (e.g., reading), fewer material investments

from their parents, or fewer cultural activities (e.g., Blake 1989; Powell/Steelman 1989, 1991, 1993) from which they can benefit. Therefore, we expect lower educational outcomes for children with a higher number of siblings.

2. *Do first-born children show better educational outcomes compared to later-born children?*

Consistent with the resource dilution hypothesis, most empirical findings on birth order show an educational advantage of being a first-born child (e.g., Behrman/Taubman 1986; Schulze/Preisendörfer 2013), as to be explained by the advantage of being an only child before a newborn arrives. In this phase, first-born children benefit from the undivided family resources in terms of parental time (e.g., reading to or playing with child) or having stronger endowment effects (e.g., Price 2008). Thus, we expect first-born children to reach higher achievement levels than later-borns.

3. *Do children's educational outcomes vary by the size of the age gap to their younger or older siblings?*

Beyond effects of sibship size and birth order, we are interested in whether or not differences in educational achievement are linked to birth spacing. As assumed by the resource dilution hypothesis and indicated by some previous research, educational outcome decreases with smaller birth gaps (e.g., Powell/Steelman 1990). Therefore, we expect longer birth spacing to have positive effects on children's achievement, as with larger birth gaps the available parental resources can be distributed more evenly between the children. In addition to this assumption of the resource dilution hypothesis, we further expect an interdependent sibling structure effect: For earlier born children, a small birth gap to a younger sibling may be of particular disadvantage, as the newborn demands special attention, which might be provided at the cost of the older child. As with regard to later-born children, a larger age gap to the older siblings could be particularly beneficial, because the latter could function as role models and teachers to the younger sibling and therefore become an additional family resource per se. Alternatively, older siblings do not need the same amount of parental attention (e.g., in doing homework) as do younger siblings because of their higher degree of self-reliance (e.g., Powell/Steelman 1995).

4. *How does families' socioeconomic and cultural background influence sibling structure effects?*

As theoretically assumed, some studies show the independent relevance sibling structure exerts on children's educational outcomes above and beyond the families' socioeconomic status (e.g., Blake 1989; Iacovou 2001). Besides, studies revealed differential sibling structure effects with respect to family background. For example, interaction effects are found for families' social status and sibling size, indicating positive effects for higher status families with increasing number of siblings, whereas lower social status families evidence negative effects when having more children (e.g., Iacovou 2001). This suggests that families with different social backgrounds vary in their opportunities to compensate sibling structure effects. According to these results, we first assume sibling structure effects to be relevant even when family background is held constant and second, as an extension of the resource dilution model, we expect an additional disadvantage of having a larger number of siblings, being a later-born child, and of close birth spacing for children from lower socioeconomic and cultural background.

5. *If there is evidence for sibling structure effects on educational outcomes, do they remain stable or vary across the two school years under study?*

Up to now, only little is known about any possible time-varying influences of sibling structure (Hanushek 1992; Iacovou 2001). Therefore, no general hypothesis is formulated in this regard. However, when looking at the specific educational stage under study – the end of primary education – this is well known to be an important time in children's educational career, as the transition to secondary school is most crucial in the German school system. It largely determines children's further educational opportunities, as the hierarchically organized secondary school types strongly vary in curricula and performance requirements. Hence, one could assume that family resources become increasingly relevant with the approaching transition to secondary school as the pressure on children's academic achievement rises. Thus, parental time and effort spent on the child may gain importance during this particular space of time, which could imply stronger effects of sibling structure. However, there is also reason to assume stability of sibling effects at the end of elementary school, as – for instance – the initial advantage of being a first-born (receiving undivided attention from the parents) should be established in early childhood and might constantly persist during the later course of childhood, as siblings' further development may run rather parallel.

4. Data and variables

To answer our research questions, we use data from the interdisciplinary longitudinal study BiKS ("Bildungsprozesse, Kompetenzentwicklung und Selektionsentscheidungen im Vorschul- und Schulalter [Educational processes, competence development and selection decisions in preschool- and school age]"). The BiKS study is composed of two longitudinal surveys running from 2006 to 2012: BiKS-3-10, following kindergarten children (from age 3 up to age 5) into elementary school (from age 6 up to age 10), and BiKS-8-14, following children from age 8 up to age 14 (von Maurice et al. 2007).

In our analysis, we concentrate on the first three waves of BiKS-8-14, which were conducted biannually when children attended third and fourth grade of elementary school in the years 2006 to 2007. The sample consists of overall 2,395 children distributed across 155 classes within 82 schools in two German federal states (51 schools in Bavaria, 31 schools in Hesse). Different research instruments were implemented: competence measurements, paper-and-pencil questionnaires for children as well as for teachers, and telephone interviews with the parents (von Maurice et al. 2007).

Besides the achievement measures of children's vocabulary competences repeated in all three waves, we use data from the parents' questionnaire providing information on the target child, the siblings, the family structure, and family resources. Thus, in comparison with many other data sources applied for sibling structure research, the BiKS study offers a wide range of research potential, as the longitudinal design allows analyzing children's competence developments over time and provides very specific information both on the target child and on all the siblings.

In the first wave, our analytical sample comprises 2,009 children after case-wise deletion of children with missing values on relevant indicators. Due to panel mortality, the sample has been reduced down to 1,807 at the second and to 1,607 at the third wave. We consider all children participating in at least one of the three waves, which results in a total case number of 2,098.

As we pursue to capture actual differences in achievement rather than performance subjectively affected by teachers' judgments (such as school grades), we focus on children's competence test scores in vocabulary. Children are found to vary in their vocabulary development during school time (e.g., Nagy/Herman 1987), also depending on their parents' educational and socioeconomic background (e.g., Chall et al. 1990; Chall/Jacobs 2003; Hart/Risley 1995, 2003). The German version of the vocabulary subtest of the culture fair intelligence test (CFT 20, WS; Weiß 1998) measures the vocabulary of the vernacular, comprising 30 words for which children have to select synonyms that are presented to them as predefined response options[3]. The mean test scores in the sample increase from 14.62 at wave one to 19.35 in wave three.

Sibling structure is measured as follows[4]:

The number of siblings is given by the absolute number of a child's siblings including biological, adopted, foster, and stepchildren. The number of the target child's siblings ranges from 0 to 10, with a mean of 1.31.

Birth order was generated by the birth dates of all children in the family. As most of the children are either first- (47%) or second-born (37%), with only 13% being third-born and 3% fourth- or later-born children, we coded the birth order as a dummy variable: 0 for first-born and 1 for later-born target children.

Birth spacing is defined as the difference in age of the target child in relation to the next older and next younger child in years. We categorized birth spacing into small birth gaps (range: 0 to 2 years), middle range birth gaps (range: more than 2 up to 6 years) and large birth gaps (range: more than 6 years). The intermediate category is chosen as refer-

3 Note that the processing time for vocabulary measure was 10 minutes in the first wave and 8 minutes in the second and third wave; however, this should not affect our results concerning sibling-structure effects in any substantial way.

4 Changes in sibling structure across waves occurred in only about 1% of all families in the sample and are therefore neglected.

ence. Furthermore, we operationalized two dummy variables, indicating whether or not any older or younger siblings are present (0 = an older or younger sibling is present and 1 = no older or younger sibling is present). In total, 54% of the target children have older siblings with a mean birth gap of 2.33 years, and 45% have younger siblings with a mean gap of 1.49 years.

Family resources were measured by the following indicators:

First, the highest ISEI (International Socio-Economic Index of Occupational Status) score in the household (Ganzeboom et al. 1992) represents the families' socioeconomic resources. On average, parents hold a score of 50.75 in the sample.

Second, families' human capital is measured by parents' highest educational level (1 for high educational level = at least higher secondary educational degree "Abitur" and 0 for lower educational level = intermediate secondary educational degree "Mittlere Reife" or less). Overall, 43% of all children are from families with a high educational level.

Third, cultural capital in the family is captured by parents' activities with the target child. The main caregivers were asked "In the past year, how many times did you visit the following places together with [target child]?", containing the following five options of "museum", "library", "children's theater", "children's concert", and "zoo or wildlife park". Parents could respond with "at least once a week", "at least once a month", "several times a year", "less than several times a year", "never". The items are considered as a composite measure derived from factor analysis with an alpha of .55.

Additionally, the age of the main caregiver at the target child's birth is considered (in years) with a mean age of 29.48 in the sample. In 92% of the cases, the main caregivers are mothers.

In all models, the following control variables are considered:

A dummy variable indicating whether the target person is an only child, the child's age, gender, and whether he/she has a migration background.

Table 1 provides a descriptive overview of the indicators used.

Table 1: Description of variables

Variable	Description of variable	N	Mean	Std. dev.	Min.	Max.
			Dependent Variable			
Vocabulary	CFT 20, WS, range 0-30 Wave 1 (2nd semester grade 3)	2009	14.62	4.93	0	29
	CFT 20, WS, range 0-30 Wave 2 (1st semester grade 4)	1807	17.38	4.60	3	28
	CFT 20, WS, range 0-30 Wave 3 (2nd semester grade 4)	1607	19.35	4.55	2	29

Variable	Description of variable	N	Mean	Std. dev.	Min.	Max.
			Sibling structure			
Number of siblings	Total no. of target child's siblings	2098	1.31	.99	0	10
Birth order	First-born = 0; later-born = 1	2098	.53	–	–	–
Birth spacing to younger siblings	Age gap to next younger sibling; up to 2 years	2098	.66	–	–	–
	Age gap to next younger sibling; more than 2 up to 6 years	2098	.29	–	–	–
	Age gap to next younger sibling; more than 6 years	2098	.05	–	–	–
No younger siblings	0 = having younger siblings; 1 = no younger siblings	2098	.55	–	–	–
Birth spacing to older siblings	Age gap to next older sibling; up to 2 years	2098	.58	–	–	–
	Age gap to next older sibling; more than 2 up to 6 years	2098	.31	–	–	–
	Age gap to next older sibling; more than 6 years	2098	.11	–	–	–
No older siblings	0 = having older siblings; 1 = no older siblings	2098	.47	–	–	–
			Family resources			
HISEI	Highest ISEI score in the household, range 16-90	2098	50.75	16.28	16	90
Highest education	Highest educational level in the household,0 = low; 1 = high	2098	.43	–	–	–
Cultural capital	Factor score of parents' activities with the target child	2098	.00	.1.01	-2.03	3.74
Age at child birth	Main caregiver's age at target child's birth in years	2098	29.48	5.23	15	58
			Control variables			
Only child	0 = siblings present; 1 = only child	2098	.15	–	–	–
Age	Target child's age in years at wave 1	2098	9.50	.58	8	12
Gender	Target child's gender, 0 = male; 1 = female	2098	.48	–	–	–
Migration back-ground	0 = target child's parents born in Germany; 1 = at least one parent born abroad	2098	.22	–	–	–

5 Methodological approach

In order to study sibling effects across three waves including possible changes over time, we apply linear latent growth curve models (LGMs). The average competence level of the three waves is taken as a dependent variable, and an overall pattern of change over time can be investigated alongside effects of explanatory variables on the temporal pattern.

Stepwise, we include additional indicators in altogether 14 models (with control variables considered in all models to hold differences occurring to these attributes constant). To examine the overall effect of all sibling features, we estimate separate models for the three components of sibling structure (number of siblings, birth order, and birth spacing) with and without controlling for family resources. Furthermore, significant interaction terms are presented testing for differential group effects, and slope effects are estimated separately for each sibling indicator to capture respective changes across waves.

Table 2: Linear latent growth curve models (LGMs) on vocabulary test scores (wave 1-3): Number of siblings and birth order

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Wave	2.44**	2.27**	2.31**	2.20**	2.27**	2.31**	2.22**
Sibling structure							
Number of siblings	-.72**	-.68**	-.78**	-.73**	-.62**	-.62**	-.70**
Birth order					-.43*	-.48+	-.34
Family resources							
HISEI		.03**		.03**	.03**		.03**
Highest education		1.41**	1.81**	1.41**	1.39**	1.95**	1.39**
Cultural capital		.23*		.23*	.21*		.21*
Age at child birth		.06**		.06**	.07**		.07**
Interaction terms							
Number of siblings* highest education			.34+				
Birth order*highest education						.55+	
Slope effects							
Number of siblings*time				.05			.07
Birth order*time							-.08
Control variables							
Only child	-.25	-.33	-.20	-.34	-.50	-.33	-.50
Age	-.40*	-.06	-.14	-.06	-.06	-.14	-.06
Gender	-.29	-.31	-.29	-.31	-.30	-.28	-.30
Migration background	-1.54**	-1.26**	-1.56**	-1.26**	-1.28**	-1.59**	-1.28**
Constant	20.02**	12.59**	16.60**	12.66**	12.53**	16.75**	12.58**
Random part							
Slope variance	.99	1.00	.99	.99	.99	.99	.99
Intercept variance	18.26	16.69	17.04	16.69	16.68	17.01	16.67
Intercept/slope covariance	-1.50	-1.51	-1.50	-1.51	-1.52	-1.49	-1.52
Wave: variance	4.77	4.76	4.76	4.76	4.76	4.76	4.76

Source: BiKS 8-14, wave 1-3, + p<0.10, * p<0.05, ** p<0.01, n(observations): 5423, n(children): 2098, linear regression models with random intercept and random slope (robust standard errors), ICC of null model at 2nd level: .83

Table 3: Linear latent growth curve models (LGMs) on vocabulary test scores (Wave 1-3): Birth spacing

	Model 8	Model 9	Model 10	Model 11	Model 12	Model 13	Model 14
Wave	2.48 **	2.44 **	2.26 **	2.22 **	2.45 **	2.27 **	2.09 **
Sibling structure							
Number of siblings		-.72 **	-.70 **	-.74 **	-.66 *	-.63 **	-.70 **
Birth spacing to younger siblings:							
<= 2 years	-.60 +	-.35	-.41	-.37			
> 6 years	-.17	-.08	.16	.03			
No younger siblings	.34	.01	.01	.01			
Birth spacing to older siblings:							
<= 2 years					.22	.36	.21
> 6 years					.84 *	.84 *	.73 +
No older siblings					.39	.30	.30
Family resources							
HISEI			.03 **	.03 **		.03 **	.03 **
Highest education			1.38 **	1.38 **		1.42 **	1.42 **
Cultural capital			.21 *	.21 *	.20 *	.20 *	
Age at child birth			.07 **	.07 **		.07 **	.07 **
Slope effects							
Number of siblings*time				.05			.07
*Birth spacing to younger siblings*time:*							
<= 2 years*time				-.04			
> 6 years*time				.11			
*Birth spacing to older siblings*time:*							
<= 2 years*time							.14
> 6 years*time							.11
Control variables							
Only child	.89 **	-.12	-.17	-.17	-.41	-.50	-.51
Age	-.48 **	-.40 *	-.05	-.05	-.41 *	-.07	-.07
Gender	-.24	-.27	-.29	-.29	-.27	-.29	-.29
Migration background	-1.67 **	-1.56 **	-1.28 **	-1.28 **	-1.59 **	-1.31 **	-1.31 **
Constant	19.87 **	20.16 **	12.47 **	12.51 **	19.69 **	12.08 **	12.26 **
Random part							
Slope variance	1.00	.99	1.00	.99	.99	.99	.98
Intercept variance	18.64	18.24	16.67	16.66	18.20	16.63	16.62
Intercept/slope covariance	-1.53	-1.50	-1.53	-1.53	-1.51	-1.53	-1.52
Wave: variance	4.76	4.77	4.76	4.76	4.77	4.76	4.77

Source: BiKS 8-14, wave 1-3, + p<0.10, * p<0.05, ** p<0.01, n(observations): 5423, n(children): 2098, linear regression models with random intercept and random slope (robust standard errors), ICC of null model at 2nd level: .83

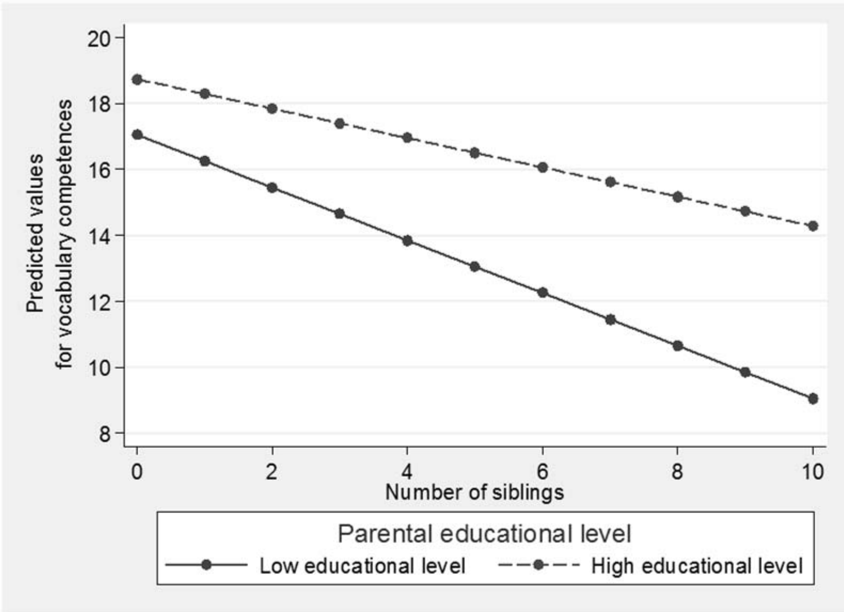
As children in the BiKS sample are clustered in school classes, we review whether the consideration of a third-level – the level of school classes – is necessary. However, only about 4% of variance in vocabulary competences is due to differences between school classes. Therefore, a two-level random intercept, random slope model is applied to analyze individual change in vocabulary competences over time. In order to capture the clustering of children in school classes sufficiently, robust standard errors are estimated.

6 Results

The multivariate regression results are displayed in Table 2 and 3. In a first step, the number of siblings is introduced in addition to the control variables (model 1). As expected from the theoretical and empirical literature, it can be confirmed that, on average, more siblings mean lower vocabulary competences. In a next step, it is the independent effect of sibship size on families' socioeconomic, cultural resources and the parent's age at child birth that is particularly being considered (model 2): the negative effect of the number of siblings decreases only slightly from -.72 to -.68 and remains highly significant. Thus – in line with our hypothesis – sibling size substantially affects competences beyond family resources. However, as suggested from prior research, family resources may be diluted differently, depending on the families' social status. Therefore, we are not only interested in the overall net effect of sibling indicators, but also in possible differential effects by parents' resources. Consequently, all theoretically relevant interaction terms were tested, resulting in one significant effect concerning the number of siblings reported in model 3 and illustrated in figure 1: Particularly when children originate from families with lower educational background, a higher number of siblings mean a widening additional disadvantage for children's vocabulary competences. This confirms the assumption that families with a higher educational level can better compensate for this negative effect, because their children are able to benefit more from the culture capital that rests within the family. This is particularly relevant, as lower educated parents on average have more children (2.36) than higher educated ones (2.25). Concerning changes over time, we modeled the slope effect for number of siblings in model 4, which does not reveal a significant result. Thus, the children's number of siblings has a stable influence during third and fourth grade of elementary school.

Models 5 to 7 investigate the significance of birth order controlling for family size. The theoretically expected negative effect of being a later-born child becomes evident before (not shown) and after controlling for family resources (model 5). Thus, it can be concluded that, on average, birth order has an impact on the dilution of resources, as children do benefit from being a first-born with respect to their vocabulary competences. When testing for interaction terms, a differential educational background effect becomes visible once again (model 6 and figure 2): Whereas in highly educated families, birth order appears to be quite irrelevant to children's vocabulary, being a second- or later-born child implies an additional disadvantage in lower educated families. This means that later-born children in less educated families perform worse than first-borns, even when the number of siblings is held constant. Therefore, the resource dilution argumentation on birth order seems to be relevant only when cultural resources are limited, as less educated families cannot compensate for effects of birth order position. In model 7, the insignificant slope effect of birth order once again indicates a high stability across waves.

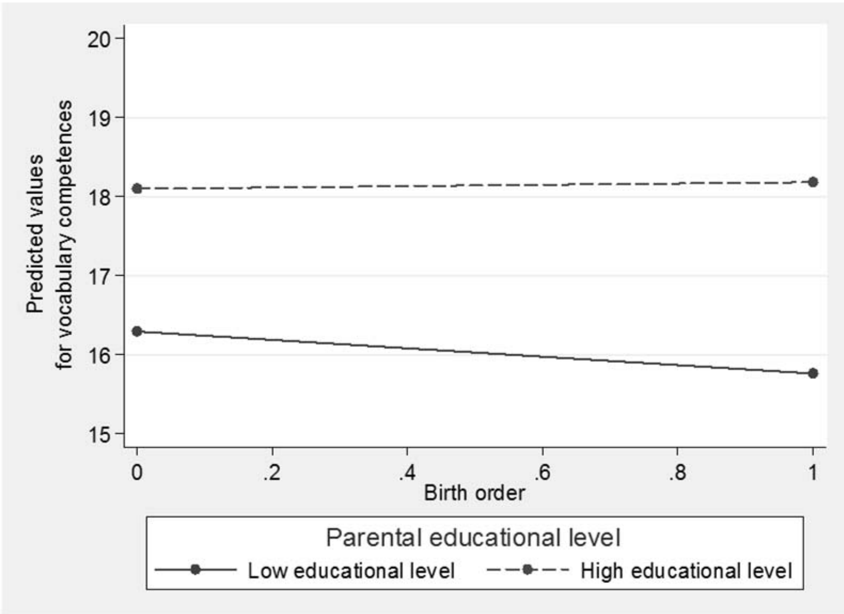
Figure 1: Interaction effect of number of siblings and families' educational level



Source: BiKS 8-14, wave 1-3, model 3, n(observations): 5423, n(children): 2098, controlled for wave, only child, age, gender, migration background

In models 8 to 14 (table 3), we turn to the analysis of birth spacing. We estimate the effects of having younger and older siblings separately. Model 8 shows that the size of birth gap in relation to younger siblings only is relevant when birth gaps are small, while longer gaps do not significantly affect the child's vocabulary competences. This result supports our hypothesis that particularly a shortly spaced newborn means a disadvantage to the older child. However, including the number of siblings (model 9) and family resources (model 10), this negative effect for birth gaps up to two years disappears. Besides missing independent effects of birth gaps to younger siblings, also no differential group effects (not shown) as well as slope effects (model 11) can be identified.

Figure 2: Interaction effect of birth order and families' educational level



Source: BiKS 8-14, wave 1-3, model 6, n(observations): 5423, n(children): 2098, controlled for wave, number of siblings, only child, age, gender, migration background

Regarding birth spacing in relation to older siblings, our analysis reveals a significant positive effect for larger birth gaps (of more than 6 years), also when the number of sibling is considered (model 12). Although slightly weakened, this independent effect remains when controlling for occupational status, education, cultural capital and the parent's age at child birth (model 13). Again, no differential group effects (not shown) and slope effects (model 14) can be identified for birth spacing to older siblings. Overall, the results confirm our assumption on the role of birth spacing, as children with longer spaced older siblings are suggested to benefit twice: First, they benefit from a larger amount of family resources, because the older children require less of their parents' time as they are more self-reliant. And second, they seem to gain an advantage by learning from the older sibling. This is an important result, because this clearly shows that studies replacing birth spacing by birth order or neglecting the role of birth spacing altogether are missing an important part of the picture and might thus be misled in their substantive interpretation of sibling structure effects.

As for none of the sibling indicators, a slope effect could be revealed, and thus a stable influence is observed, the expectation of their rising relevance before the transition to secondary school cannot be confirmed. However, what must be conceded is that the time period under study is rather short (1.5 years). Instead, any possible long-term effects may become discernible if the observation window were to be extended.

7 Conclusion

The aim of this study has been to analyze the role of sibling structure components on educational achievement. This was motivated by a lack of German research in this field, whereas especially U.S. American research could show that – apart from the effects of social background characteristics and other influences of the familial learning environment – sibling structure plays an additional role in the acquisition of education. Although the impact of sibship size can be widely confirmed, findings on birth order, and in particular on birth spacing, are rather mixed.

Regarding our theoretical approach, we have concentrated on the argumentation of the resource dilution hypothesis, which assumes that differences between siblings occur, because they have to share family resources (e.g., parental time, parental investments, or cultural activities). Having a larger number of siblings, being a later-born child, as well as narrow gaps in relation to the other siblings can affect the parental resources available for each child – which may thus negatively affect educational outcome.

As for sibship size, the hypothesis can be clearly confirmed with our analysis. Additionally, we have been able to show that especially children from lower educated families are negatively affected by a larger number of siblings. Thus, families with better resources can better compensate for negative effects of sibling group size.

Also, the hypothesis on birth order effects can be confirmed: Being a later-born child does denote a disadvantage with regard to the acquisition of competences, particularly it is children in lower educated families that are affected by this mechanism. Families with a higher educational level are thought to have better options to support each child equally; whereas in lower educated families, first-borns benefit more from family resources than do later-born children, as they do not have to share them with other siblings for quite some time. Therefore, the assumption that parental time resources (e.g., reading to the child) should be the driving factor of birth order effects falls too short. In line with our findings on sibship size, it rather seems to be the quality of parents' cultural resources and input that compensate for negative birth order effects.

Beyond effects of sibship size and birth order, we assumed effects of birth spacing to be relevant, as with larger birth gaps the available parental resources can be distributed more evenly between the children. It could be shown that having a shortly spaced younger sibling means a disadvantage to the child's competences, as more parental attention is required for the newborn and thus restricts family resources at the cost of the older child. Therefore, it is not surprising that this effect disappears, once family resources and the number of siblings are controlled for. Having largely spaced older siblings appeared to be particularly beneficial, because they can function as role models and teachers to the younger sibling and therefore become an additional family resource from which the younger sibling can benefit.

Additionally, we have been interested in the question whether the effects of sibling structure vary across time. It can be clearly shown that the effects remain very stable during the last 1.5 years of elementary school. With regard to future research, it would be particularly interesting to investigate whether changing effects could rather be identified in a long-term perspective. As our study has concentrated exclusively on vocabulary competences, future analyses in this field should be extended to other educational outcomes at different stages in the life course. In particular for the German context, there is still much room and a great necessity to carry out research on sibling effects in general – but in particular with regard to education.

References

Bagger, J., Birchenall, J. A., Mansour, H. & Urzúa, S. (2013). *Education, birth order, and family size.* ftp.iza.org/dp7454.pdf [Retrieved: 2014-05-07]

Bauer; T. & Gang, I. N. (2001). Sibling rivalry in educational attainment: The German case. *Labour, 15, 2*, p. 237-255.

Baumert, J., Klieme, E., Neubrand, M., Prenzel, M., Schiefele, U., Schneider, W., Stanat, P., Tillmann, K.J & Wieß, M. (Eds.) (2001). *PISA 2000: Basiskompetenzen von Schülerinnen und Schülern im internationalen Vergleich.* Opladen: Leske + Budrich.

Becker, R. (2004). Soziale Ungleichheit von Bildungschancen. In: Becker, R. & Lauterbach, W. (Eds.), *Bildung als Privileg? Erklärungen und Befunde zu den Ursachen der Bildungsungleichheit*. Wiesbaden: VS Verlag für Sozialwissenschaften, pp. 161-195.

Behrman, J. R. & Taubman, P. (1986). Birth order, schooling, and earnings. *Journal of Labor Economics, 4, 3*, pp. 121-145.

Black, S. E., Paul, J. D. & Salvanes, K. G. (2005). The more the merrier? The effect of family size and birth order on children's education. *Quarterly Journal of Economics, 120, 2*, pp. 669-700.

Blake, J. (1981). Family size and the quality of children. *Demography, 18, 4*, pp. 421-442.

Blake, J. (1985). Number of siblings and educational mobility. *American Sociological Review, 50, 1*, pp. 84-94.

Blake, J. (1986). Number of siblings, family background, and the process of status attainment. *Social Biology, 33, 1-2*, pp. 5-21.

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

Blau, P. M. & Duncan, O. D. (1967). *The American occupational structure.* New York: Wiley and Sons.

Buckles, K. & Munnich, E. (2012). Birth spacing and sibling outcomes. *Journal of Human Resources, 47, 3*, pp. 613-642.

Caceres-Delpiano, J. (2005). *The impacts of family size on investment in child quality.* www.eco.uc3m.es/~jcaceres/workingQQ.pdf [Retrieved: 2014-05-27].

Chall, J. S., Jacobs, V. A. & Baldwin, I. E. (1990). *The reading crisis: Why poor children fall behind.* Cambridge: Harvard University Press.

Chall, J. S. & Jacobs, V. A. (2003). The classic study on poor children's fourth-grade slump. *American Educator, 27, 1*, pp. 14-15.

Conley, D. (2000). Sibship sex composition: Effects on educational attainment. *Social Science Research, 29, 3*, pp. 441-457.

Conley, D. & Glauber, R. (2005). *Sibling similarity and differences in socioeconomic status: Life course of family resource effects*. www.nber.org/papers/w11320 [Retrieved: 2014-05-27].

De Graaf, P. M. & Huinink, J. J. (1992). Trends in measured and unmeasured effects of family background on educational attainment and occupational status in the Federal Republic of Germany. *Social Science Research, 21, 1*, pp. 84-112.

Downey, D. B. (1995). When bigger is not better: Family size, parental resources, and children's educational performance. *American Sociological Review, 60, 5*, pp. 746-761.

Downey, D. B. (2001). Number of siblings and intellectual development: The resource dilution explanation. *American Psychologist, 56, 6-7*, pp. 497-504.

Downey, D. B. & Neubauer, S. (1998). *Is resource dilution inevitable? The association between number of siblings and educational outcomes across subgroups.* Presented at the 93rd Annual Meeting of the American Sociological Association, San Francisco.

Dumon, A. (1890). *Dépopulation et civilization. Étude démographique.* Paris: Lecrosnier et Babé.

Ejrnaes, M. & Pörtner, C. C. (2002). Birth order and the intrahousehold allocation of time and education. *Review of Economics and Statistics, 86, 4*, pp. 1008-1019.

Featherman, D. L. & Hauser, R. M. (1978). *Opportunity and change.* New York: Academic Press.

Ganzeboom, H. B. G., de Graaf, P. M. & Treiman, D. J. (1992): A standard international socio-economic index of occupation status. *Social Science Research, 21, 1*, pp. 1-56.

Ginther, D. K. & Pollak, R. A. (2003). *Does family structure affect children´s educational outcomes?* www.nber.org/papers/w9628 [Retrieved: 2014-05-27].

Hannan, C. & Halpin, B. (2014). The influence of family structure on child outcomes: Evidence for Ireland. *The Economic and Social Review, 45, 1*, pp. 1-24.

Hanushek, E. A. (1992). The trade-off between child quantity and quality. *The Journal of Political Economy, 100, 1*, pp. 84-117.

Hart, B. & Risley, T. R. (1995). *Meaningful differences in the everyday experiences of young American children.* Baltimore: Brookes.

Hart, B. & Risley, T. R. (2003). The early catastrophe: The 30 million word gap by age 3. *American Educator, 27, 1*, pp. 4-9.

Härkönen, J. (2014). Birth order effects on educational attainment and educational transitions in West Germany. *European Sociological Review, 30, 2*, pp. 166-179.

Härkönen, J. & Mayer, K. U. (2008). *Parental social class and sibling resemblance and difference in educational attainment in West Germany.* http://www.yale.edu/ciqle/PUBLICATIONS/Harkonen&Mayer.pdf [Retrieved: 2014-05-27].

Hauser, R. M. & Sewell, W. H. (1985). Birth order and educational attainment in full sibships. *American Educational Research Journal, 22, 1*, pp. 1-23.

Helbig, M. (2013). Der positive und negative Einfluss von Geschwistern auf den Gymnasialübergang. *Kölner Zeitschrift für Soziologie und Sozialpsychologie, 65, 4*, pp. 623-644.

Iacovou, M. (2001). *Family composition and children's educational outcomes.* https://www.iser.essex.ac.uk/files/iser_working_papers/2001-12.pdf [Retrieved: 2014-05-27]

Jacob, M. (2010): Do brothers affect their sister's chances to graduate? An analysis of sibling effects on graduation from university or a Fachhochschule in Germany. *Higher Education, 61, 3*, pp. 277-291.

Jaeger, M. M. (2007). *Confluence model or resource dilution hypothesis. How sibship size affects edcuational attainment.* www.sfi.dk/Admin/Public/Download.aspx?file=Files%2FFiler%2FSFI%2FPdf%2FWorking_papers%2FWP_03_2007.pdf [Retrieved: 2014-05-27].

Kalmijn, M. & Kraaykamp, G. (2005): Late or later? A sibling analysis of the effect of maternal age on children's schooling. *Social Science Research, 34, 3*, pp. 634-650.

Kantarevic, J. & Mechoulan, S. (2006): Birth order, educational attainment, and earnings. *Journal of Human Resources, 41, 4*, pp. 755-777.

Kasten, H. (1993a). *Die Geschwisterbeziehung. Band 1.* Göttingen: Hogrefe.

Kasten, H. (1993b). *Die Geschwisterbeziehung. Band 2.* Göttingen: Hogrefe.

Kasten, H. (1998). *Geschwister: Vorbilder, Rivalen, Vertraute.* München: Ernst Reinhardt Verlag.

Kasten, H. (2003). *Weiblich – Männlich. Geschlechterrollen durchschauen.* München & Basel: Reinhardt Verlag.

Keddi, B., Zerle, C., Lange, A. & Cornelißen, W. (2010). *Der Alltag von Mehrkinderfamilien – Ressourcen und Bedarfe.* München: Deutsches Jugendinstitut.

McLanahan, S. & Sandefur, G. (1997). *Growing up with a single parent: What hurts, what helps.* Cambridge: Harvard University Press.

Nagy, W. E. & Herman, P. A. (1987). Breadth and depth of vocabulary knowledge: Implications for acquisition and instruction. In: McKeown, M. G. & Curtis, M. E. (Eds.), *The nature of vocabulary acquisition.* Hillsdale: Erlbaum, pp. 19-35.

Nguyen, N. (2013). *Birth spacing and outcomes in adolescence, young adulthood and adulthood.* economics.rutgers.edu/dmdocuments/NgaNguyen.pdf [Retrieved: 2014-05-27].

Petterson-Lidbom, P. & Skogman Thoursie, P. (2009). *Does child spacing affect children's outcomes? Evidence from a Swedish reform.* www.ifau.se/en/Research/Publications/Working-papers/2009/Does-child-spacing-affect-childrens-outcomes-Evidence-from-a-Swedish-reform/ [Retrieved: 2014-05-27].

Powell, B. & Steelman, L. C. (1989). The liability of having brothers: Paying for college and the sex composition of the family. *Sociology of Education, 62, 2*, pp. 134-147.

Powell, B. & Steelman, L. C. (1990). Beyond sibship size: Sibling density, sex composition, and educational outcomes. *Social Forces, 69, 1*, pp. 181-206.

Powell, B. & Steelman, L. C. (1993). The educational benefits of being spaced out: Sibship density and educational progress. *American Sociological Review, 58, 3*, pp. 367-381.

Powell, B. & Steelman, L. C. (1995). Feeling the pinch: Child-spacing and constraints on parental economic investments in children. *Social Forces, 73, 4*, pp. 1465-1486.

Prenzel, M., Baumert, J., Blum, W., Lehmann, R., Leutner, D., Neubrand, M., Pekrun, R., Rolff, H.-G., Rost, J. & Schiefele, U. (Eds.) (2004). *PISA 2003. Der Bildungsstand der Jugendlichen in Deutschland - Ergebnisse des zweiten internationalen Vergleichs*. Münster: Waxmann.

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

Price, J. (2010). *The effect of parental time investments: Evidence from natural within-family variation*. byuresearch.org/home/downloads/price_parental_time_2010.pdf [Retrieved: 2014-05-27].

Schulze, A. & Preisendörfer, P. (2013). Bildungserfolg von Kindern in Abhängigkeit von der Stellung in der Geschwisterreihe. *Kölner Zeitschrift für Soziologie und Sozialpsychologie, 65, 2*, pp. 339-356.

Sieben, I. (2001). *Sibling similarities and social stratification. The impact of family background across countries and cohorts.* Nijmegen: Katholieke Universiteit Nijmegen (Ph.D. thesis).

Sieben, I. & De Graaf, P. M. (2001). Testing the modernization hypothesis and the socialist ideology hypothesis: A comparative sibling analysis of educational attainment and occupational status. *British Journal of Sociology, 52, 3*, pp. 441-467.

Sieben, I. & De Graaf, P. M. (2003), The total impact of the family on educational attainment. A comparative sibling analysis. *European Societies, 5, 1*, pp. 33-68.

Sieben, I., Huinink, J. & De Graaf, P. M. (2001). Family background and sibling resemblance in educational attainment. Trends in the former FRG, the former GDR, and the Netherlands. *European Sociological Review, 17, 4*, pp. 401-430.

Steelman, L. C. & Powell, B. (1991). Sponsoring the next generation: Parental willingness to pay for college. *The American Journal of Sociology, 96, 6*, pp. 1505-1529.

Steelman, L.C., Powell, B. Werum, R. & Carter, S. (2002). Reconsidering the effects of sibling configuration: Recent advances and challenges. *Annual Review of Sociology, 28*, pp. 243-269.

von Maurice, J., Artelt, C., Blossfeld, H.-P., Faust, G., Roßbach, H.-G. & Weinert, S. (2007). *Bildungsprozesse, Kompetenzentwicklung und Formation von Selektionsentscheidungen im Vor- und Grundschulalter: Überblick über die Erhebungen in den Längsschnitten BiKS-3-8 und BiKS-8-12 in den ersten beiden Projektjahren.* psydok.sulb.uni-saarland.de/volltexte/2007/1008/ [Status: 2014-05-27].

Weiß, R. H. (1998). *Grundintelligenztest Skala 2 (CFT 20) mit Wortschatztest (WS) und Zahlenfolgentest (ZF.). Handanweisung*. Göttingen: Westermann Test.

Wolter, S. C. (2003). *Sibling rivalry: A six country comparison.* ideas.repec.org/p/iza/izadps/dp734.html [Retrieved: 2014-05-27].

Zajonc, R. B. & Markus, G. B. (1975). Birth order and intellectual development. *Psychological Review, 82, 1*, pp. 74-88.

Zerle, C., Cornelißen, W. & Bien, W. (2012). Das Timing der Familiengründung und dessen Folgen für die Familien. *Zeitschrift für Familienforschung/Journal of Family Research, 24, 1*, pp. 46-66.

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