

Birth order and adult family relationships: Firstborns have better sibling relationships than laterborns

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ABSTRACT

Although middleborn college students commonly report worse family relationships than other birth orders, it is unknown whether this effect persists into adulthood. Therefore, we investigated the effect of birth order on self-reported family and friend relationships among a large sample of Dutch adults ($n = 794$). Middleborns did not differ from other birth orders in relationships with their father, mother, sibling or close friend. Middleborns do not prefer a friend over their father, mother or sibling more than other birth orders. Evidence for a “neglected middleborn effect” appeared only in a within-family design for siblings. Firstborns were more likely to report very good sibling relationships and preferred a sibling over a friend. The results are discussed in terms of kin competition and inclusive fitness.

KEY WORDS: birth order • family relationships • kin selection theory • relationship quality • reproductive value • siblings

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Middleborns have been consistently found to differ from other birth positions in their kin relations (Kennedy, 1989; Kidwell, 1981, 1982; Rohde et al., 2003; Salmon, 2003; Salmon & Daly, 1998). Middleborns tend to perceive their parents as more punitive and less generous, and feel less close to their parents and family, than do firstborns or lastborns (Salmon, 1999, 2003; but see Hardman, Villiers, & Roby, 2007). Middleborns also tend to prefer a (close) friend over family members and have less contact with family members than other birth orders. Perceived parental favouritism appears to be curvilinearly related to birth order, with middleborns reporting lowest favouritism (Kidwell, 1981, 1982; Rohde et al., 2003). Most of these studies, however, have used an undergraduate student, rather than older adult, population. Little is known about whether middleborns continue to report worse family relations in later life. For example, one recent study failed to find any evidence for a “neglected middleborn effect”, not only in an adult sample, but also in a sample of children (Hardman et al., 2007).

It is plausible that the sibling competition dynamics, induced by parent-offspring conflict (Trivers, 1974), would not persist in adulthood. Once siblings cease to be part of a household, an economic unit wherein they compete for finite parental resources, sibling competition and the associated “neglected middleborn effect” should become less important. While undergraduate students might indeed exhibit this neglected middleborn effect, this effect may disappear when they are no longer financially dependent on their parents. Thus, the neglected middleborn effect may be specific to young people. One study by Salmon (1999) did, however, show a neglected middleborn effect persisting into adulthood. This study showed that grandparents had less contact with their grandchildren if they were related through middleborn parents. This finding has been replicated by Suito and Pillemer (2007), who showed that mothers in old age systematically preferred their firstborn or lastborn child over their middleborn child. However, Euler and Michalski (2007) found no evidence that grandparental solicitude was lower when grandchildren were related through a middleborn parent.

In a large-scale study of adults by Pollet and Nettle (2007), middleborns did not consistently differ from other birth orders in face-to-face contact with their sibling. The study did however find that firstborns were significantly more likely than laterborns to have frequent face-to-face contact with their sibling. This is in line with Sulloway’s (1996, 2001) prediction that firstborns are more likely to act as surrogate parents than laterborns. This claim can be related to kin selection theory (Hamilton, 1964). All else being equal, firstborns can increase their inclusive fitness to a greater extent by investing in a laterborn than vice versa, due to age differentials in reproductive value (Hughes, 1988; Pollet & Nettle, 2007). This leads to the prediction that adult firstborns will invest more in laterborns than vice versa.

In the present study, we examine the effect of birth order on the rated quality of relationships with family members and a close friend in adulthood. We assume that people’s judgments about the quality of their relationships are systematically related to their present and future investments

in that relationship partner. This assumption appears justified. Pollet (2005) showed that, amongst the same cohort of Dutch adults as is studied here, rated relationship quality was positively correlated with more objective indicators of social and financial support provided.

As intra-family relationships differ by gender, educational attainment, and age (Pollet, 2005, 2007; Salmon, 1999), it is important to control for these factors. We test the hypothesis that middleborns report worse family relationships than firstborns or lastborns, after controlling for other variables. Previous tests of this hypothesis (e.g. Salmon, 2003), in addition to relying too heavily upon undergraduate students (rather than a representative adult population), have inadequately investigated the role of sibship size. Given that families come in different sizes, the likelihood of coding individuals as a lastborn or middleborn is thus not consistent across families. Statistically controlling for sibship size does not rule out this confound. Therefore, we consider only individuals with two full siblings.

We also test the hypothesis that firstborns have better relationships with their sibling than laterborns, since they are more likely to invest in their sibling (see Pollet & Nettle, 2007). The disposition to invest would create a motivational bias, where firstborns subjectively evaluate their relationship with a sibling more positively than laterborns do. We predict that even if asymmetries in investments arise (Pollet & Nettle, 2007), firstborns will still be more inclined than other birth orders to positively evaluate their relationship. Ultimately, this is because firstborns have relatively more to gain than other birth orders, in terms of inclusive fitness.

Methods

Sample

The Netherlands Kinship Panel Study (NKPS) dataset was obtained through the Netherlands Interdisciplinary Demographic Institute (NIDI). The NKPS is a large-scale study designed to investigate family and kin relations in the Netherlands that aimed to reach 8500 non-institutionalized individuals between 18 and 79 years old (Dykstra et al., 2004). These individuals were randomly drawn from a large Dutch address register. The study yielded a final sample of 8161 adults (mean age = 46.43; $SD = 15.13$; Dykstra et al., 2004) that was unbalanced in terms of gender, with more female ($n = 4741$) than male respondents ($n = 3420$).

Individuals were interviewed face-to-face by trained researchers between October 2002 and October 2004 about various aspects of their family life, including relationships with their siblings (Dykstra et al., 2004). The average interview lasted 74 minutes during which data were collected for a wide variety of family-related variables, e.g. relationships with and characteristics of family members (mainly for fathers, mothers, siblings, husband/spouse, children, grandparents, grandchildren, but also for close friends). Respondents also provided detailed information on a wide range of socio-demographic variables (educational attainment, marital status, employment

history). In addition, the respondents completed a questionnaire (Dykstra et al., 2004). Variables analyzed for this study come only from interviews. The sampling procedure (including the representativeness of the sample), the survey and other aspects of the study are described in much greater detail by Dykstra et al. (2004).

From this dataset, we selected all individuals who had two full siblings and a living mother, father, sibling, and close friend at the time of the interview ($n = 794$). Limiting the analysis to respondents with two siblings avoids sampling bias in respect of lastborns and middleborns and keeps sibship size constant. Respondents with step- or half-siblings or twins were excluded from the analysis (see Freese, Powell, & Steelman, 1999; Michalski & Shackelford, 2002). Birth order of the respondent was then coded as first-born, middleborn or lastborn based on the year of birth. Individuals for whom birth order was indeterminable were excluded from analysis.

Measurement

In the NKPS interview, respondents were asked about respondents' quality of their relationship with a randomly selected sibling ("sibling A"), their mother, father, partner and a close friend. The quality of the relationship was assessed with the question: "*Taking everything together, how would you describe your relation with {name, description}?*" (Dykstra et al., 2004). The quality of the relationship variable was recoded from four categories (not great, reasonable, good, very good) to three, by merging not great and reasonable responses, to avoid categories with few cases. This measure is a reasonable proxy measure for financial investments and other forms of support (see House, Umberson, & Landis, 1988; Marsden & Campbell, 1984; Pollet, 2005). Relationship quality, as well as subjective closeness to a person, are commonly included measures in social network analysis and have been argued to have a predictive value for helping behaviour in times of need (for example, Bromberg, 1983; Cicirelli, 1983; Rossi & Rossi, 1990; see House et al., 1988, for a review of social network measures). In addition, relationship quality is also closely related to measures from previous studies on "the middleborn effect" (e.g. Salmon, 2003).

The gender of the sibling, respondent and close friend were also coded and used as control variables in the analyses (see Dykstra et al., 2004). The variables selected for analyses are presented in Table 1. Educational attainment was recoded in order to avoid categories with very low frequencies. The first two (*incomplete* ($n = 1$) and *primary* ($n = 22$)) and last two categories (*university* ($n = 118$) and *postgraduate* ($n = 9$)) of the educational attainment variable were merged. Additional information on the variables can be found in the NKPS codebook (Dykstra et al., 2004). Missing values on variables were treated listwise for each multinomial logistic regression (MLR). This led to a working sample of 794 respondents.

As a second analysis we calculated difference scores in relationship quality between each family member and friend (i.e. father versus friend; mother versus friend; sibling versus friend). Each comparison variable had five levels. For example, when comparing a father versus a friend, a score of

TABLE 1
Descriptive statistics for variables in the model

Variables	Categories	Frequencies/means
Birth order	0 = Eldest	<i>n</i> = 316
	1 = Middleborn	<i>n</i> = 249
	2 = Youngest	<i>n</i> = 229
Educational attainment of respondent	1 = Incomplete primary or primary	<i>n</i> = 22
	2 = Lower vocational	<i>n</i> = 55
	3 = Lower general secondary	<i>n</i> = 63
	4 = Medium general secondary	<i>n</i> = 65
	5 = Upper general secondary	<i>n</i> = 49
	6 = Intermediate vocational	<i>n</i> = 196
	7 = Higher vocational	<i>n</i> = 216
	8 = University or postgraduate	<i>n</i> = 127
Gender of the respondent	0 = Male	<i>n</i> = 303
	1 = Female	<i>n</i> = 491
Gender of sibling a	0 = Male	<i>n</i> = 402
	1 = Female	<i>n</i> = 392
Gender of close friend	0 = Male	<i>n</i> = 342
	1 = Female	<i>n</i> = 452
Age	(interval)	Mean = 33.48 years (<i>SD</i> = 8.6 years)
Relationship quality with father/mother/sibling/close friend (dependent variables)	1 = Not great/reasonable	
	2 = Good	
	3 = Very good	

0 indicates no difference in relationship quality (e.g. both relationships judged as “good”). On the other hand, a score of 2 indicates a far better relationship with one’s father than with one’s friend, while a score of –2 indicates the reverse. A score of 1 reveals a slightly better relationship with one’s father than with one’s friend, while a score of –1 indicates the reverse. These scores can also be seen as preference scores. A score of 2 in this example would indicate a strong preference for one’s father over one’s friend. A score of 1 would indicate a slight preference for one’s father over one’s friend.

A third and final set of analyses will examine significant and consistent findings from the first two sets of analyses using a within-family design. Either “sibling A” or “sibling B” completed a mail questionnaire containing the same relationship quality measure about their relationship with the respondent (*n* = 368). Subtracting the sibling’s score from the respondent’s score creates a measure of relatively relational quality. Positive scores indicate that the respondent viewed the relationship more positively than the sibling did, while a negative score indicates the reverse. A score of 2 means that the respondent rated the relationship much more positively than did the sibling and a score of –2 indicates the reverse. One parent also completed a

mail questionnaire and the same procedure was used to construct a measure for the respondent's mother ($n = 210$) or father ($n = 192$). No data on the respondent's friend were available. We will use the same controls as for analyses 1 and 2.

Statistical methods

We use multinomial logistic regressions (MLRs) to investigate the independent effect of birth order on the dependent variables, quality of the relationship and preference. MLRs are ideal for evaluating multiple independent effects on a nominal dependent variable (Hosmer & Lemeshow, 1989; Menard, 1995; Pampel, 2000). It is relatively free of assumptions and statistically robust. The MLR is very similar to the ordinary least squares regression (OLS) in many aspects. For instance, λ , the standardized parameter estimate in MLR, corresponds to the standardized estimates (β) from OLS. In addition, Wald test statistics which correspond to each λ are similar to t -test statistics corresponding to β in OLS. Nagelkerke R^2 (Nagelkerke, 1991) is a frequently used measure of variance explained in MLR, and is similar to R^2 from OLS. Unlike OLS, however, where parameters are estimated by minimizing the sum of squares, parameters in MLR are estimated by maximum likelihood.

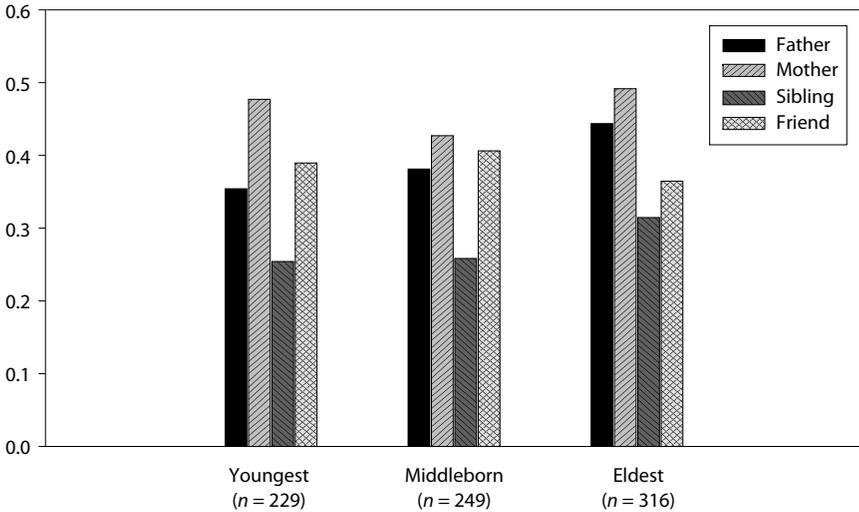
We used the forward stepwise parameter selection procedure for variables in each analysis. For both analyses, outcomes (model fit and Nagelkerke R^2) were essentially the same compared with the use of backward stepwise (not shown). We will report the likelihood ratio tests for variables in the model and parameter estimates with their respective significance levels (see Peng, Lee, & Ingersoll, 2002). Likelihood ratio tests (p_{lir}) are used to examine the significance of a variable for the MLR model, while the Wald statistic is used to determine the significance of specific parameter estimates (p_{wald}). Thus, likelihood ratio tests and Nagelkerke R^2 are the same for different parameter estimates. It is also important to bear in mind that for categorical variables the likelihood ratio test can be significant, with only a few (or even one) of the actual parameter estimates being significant. We use a 5% significance level for all analyses, but will also report statistical trends ($.05 < p < .1$). In this presentation we focus on the independent effects of birth order, rather than discussing the control variables in detail. Given that we have two predictions, for all birth order effects, we will not only compare middleborns with other birth orders, but also firstborns with laterborns.

Results

Relationships with father, mother, sibling and friend

There is no difference immediately apparent between middleborns and other birth orders in their relationships with family members and with their friend (Figure 1). However, there does appear to be a (slight) difference between firstborns and laterborns in their sibling relationships, with a relatively larger proportion of firstborns reporting a very good relationship.

FIGURE 1
Proportion of respondents for each birth order that reported a very good relationship



We constructed stepwise MLRs with the age, educational attainment, gender and birth order of the respondent and the gender of the sibling/friend as predictors for relationship quality with family members and a friend (Table 2). Age influenced the respondent’s relationship with his or her mother (Likelihood ratio test; $\chi^2 = 17.54$; $p < .001$), with older individuals reporting a worse relationship. Higher educated respondents tended to report better relationships with their father and their sibling (respectively: Likelihood ratio test $\chi^2 = 26.07$; $p = .025$ and $\chi^2 = 24.02$; $p = .046$). The odds ratios (ORs) from Table 2 can be interpreted as follows: the OR 0.38 implies that the odds for a very good relationship with one’s father increase by a factor of 0.38 for respondents with a lower vocational education, instead of a university degree. Given that the ORs below one are not very intuitive to interpret, we can simply invert the OR and switch reference categories ($1/0.377 = 2.652$). So a university education, instead of a lower vocational education, increases the odds of a very good relationship with one’s father by a factor of 2.65 ($1/0.377$). Gender influenced the respondent’s relationship with their friend and sibling (Likelihood ratio test $\chi^2 = 8.55$; $p = .018$ and $\chi^2 = 9.18$; $p = .008$, respectively). Respondents reported significantly better relationships if their friend or sibling was female.

Birth order proved a significant predictor only for relationship quality with a sibling (Likelihood ratio test $\chi^2 = 13.74$; $p = .008$). The odds for describing a “very good” relationship with the sibling, instead of describing the relationship as “reasonable or not great” were 1.79 times larger for firstborns than middleborns ($p_{\text{wald}} = .018$) and 2.392 times larger for firstborns than lastborns ($p_{\text{wald}} < .001$).

TABLE 2
ORs (exp(λ)) for multinomial logistic regression with reference category “not great/reasonable”

Dependent	Very good	Father	Mother	Sibling	Friend
Nagelkerke R^2		$R^2 = 0.04$	$R^2 = 0.05$	$R^2 = 0.1$	$R^2 = 0.01$
Gender respondent	Female	ns	ns	ns	ns
Age	(increase by one year)	ns	0.97*	0.93*	ns
Education	Incomplete/primary	ns	ns	0.26*	ns
	Lower vocational	0.38*	ns	ns	ns
	Lower general secondary	ns	ns	0.37*	ns
	Medium general secondary	ns	ns	0.29*	ns
	Upper general secondary	ns	ns	ns	ns
	Intermediate vocational	ns	ns	ns	ns
	Higher vocational	ns	ns	0.54*	ns
	University or postgraduate	0	0	0	0
Gender alter	Female	n/a	n/a	1.96**	2.57**
Birth order	Firstborn	ns	ns	1.79*	ns
	Lastborn	ns	ns	ns	ns
	Middleborn	0	0	0	0

Reference categories for independent categorical variables have parameter estimates set to 0. * $p < .05$; ** $p < .01$.

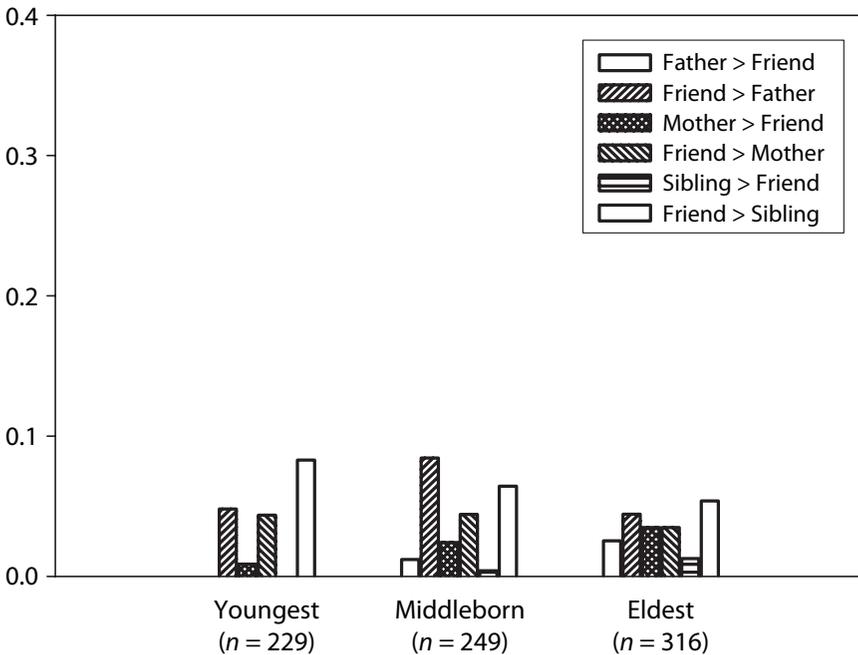
Firstborns were not significantly more likely than middleborns to report a “good” relationship with their sibling instead of describing their sibling relationship as “reasonable or not great”, although the effect is in the predicted direction. Firstborns were, however, more likely than lastborns to describe the relationship with their sibling as “good”, instead of reporting it as “reasonable or not great” (OR 1.78; $p_{wald} = .008$; table not shown).

Relative comparisons of family relationships to friendships

Secondly, we investigated relative preferences (based on difference scores between ratings of relationship quality). Neither “strong preferences” (difference score = 2; Figure 2), nor “slight preferences” (difference score = 1; Figure 3) for a family member over a close friend appeared to show any strong birth order patterns.

Again, we constructed MLRs with age, educational attainment and gender in order to examine frequencies of relationship preferences. Only a few respondents had a strong preference for family member over their friend. Firstborns were, however, disproportionately more likely to have a strong preference (score of 2) for a family member over a friend (8 of the 11 with a strong preference for a father; 11 out of 19 with a strong preference for mother; and 4 out of 5 with strong preference for sibling). Given the small number of strong preferences for family, we merged a slight preference (score of 1) with a strong preference (score of 2) for each family member over a friend.

FIGURE 2
Proportion of respondents that has a very strong relative preference for the first listed over the last listed (difference score of 2) by birth order



Comparisons between strong preferences (2 versus -2)

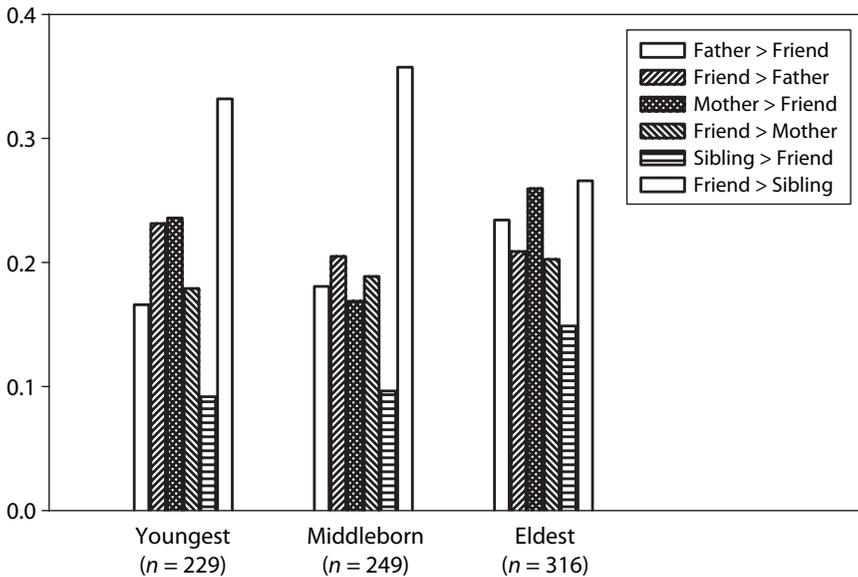
There were no significant birth order effects on any of the comparisons between strong preferences (all $p_{wald} > .1$; Table not shown). Elder respondents tended to show a preference for their parent over their sibling (OR for mother over sibling = .08; $p_{wald} < .05$ and OR for father over sibling = 1.1; $p_{wald} < .01$; Table not shown).

Comparisons between slight and strong preference (1 versus -2)

None of the variables influenced a slight preference for one’s mother over one’s friend (instead of a strong preference for one’s friend over one’s mother) (Table 3). The age of the respondent and the gender of the respondent’s sibling influences the respondent’s preference for one’s sibling over one’s friend (Likelihood ratio test $\chi^2 = 15.24$; $p = .002$ and $\chi^2 = 13.13$; $p = .004$, respectively). Educational attainment of the respondent proved a significant predictor for the respondent’s preference for one’s father over one’s friend (Likelihood ratio test $\chi^2 = 35.2$; $p = .037$).

Birth order was a significant predictor of one’s slight preference for a father over a friend (Likelihood ratio test $\chi^2 = 13.29$; $p = .039$; Table 3). Firstborns were significantly more likely than middleborns to show a slight preference for their father over a strong preference for their friend (OR

FIGURE 3
Proportion of respondents that has a slight relative preference for the first listed over the last listed by birth order



2.78; $p_{wald} = .01$; Table 3). Neither firstborns nor middleborns differed significantly from lastborns ($p_{wald} > 0.15$). Thus, it appears that there is no conclusive evidence that firstborns are more likely than lastborns to prefer their father over their friend.

Birth order also significantly influenced the likelihood of a slight preference for a sibling over a friend (Likelihood ratio test $\chi^2 = 15.31$; $p < .05$). The comparison between middleborns and firstborns in the likelihood of a slight preference for one's sibling versus a strong preference for one's friend is not significant, although there is a trend. Firstborns tended to have a slight preference for their sibling over their friend compared to middleborns (OR 2.03; $p_{wald} = .099$). The comparison between middleborns and lastborns is not significant, and is in the direction opposite of that predicted (lastborns having a slightly stronger preference for a friend over a sibling than middleborns; $p_{wald} = .353$). By substituting reference categories, firstborns are significantly more likely than lastborns to show a slight preference for their sibling over a strong preference for their friend (OR 3.1; $p_{wald} = .008$; Table 4). It thus appears that firstborns are differentially more likely to prefer a sibling over a friend than laterborns, whereas middleborns do not consistently differ from other birth orders. The differences between firstborns and laterborns are also quite sizeable (ORs of 2.03 and 3.1).

TABLE 3
ORs (exp(λ)) for multinomial logistic regression with reference category
“a better relationship with the last listed (-2)”

Dependent	Slightly better relationship (1) with first listed	Father vs. friend	Mother vs. friend	Sibling vs. friend
Nagelkerke R^2		$R^2 = 0.04$	$R^2 = 0.01$	$R^2 = 0.04$
Gender respondent	Female	ns	ns	ns
Age	(increase by one year)	ns	ns	0.95**
Education	Incomplete/primary	ns	ns	ns
	Lower vocational	0.17*	ns	ns
	Lower general secondary	ns	ns	ns
	Medium general secondary	ns	ns	ns
	Upper general secondary	ns	ns	ns
	Intermediate vocational	ns	ns	ns
	Higher vocational	ns	ns	ns
	University or postgraduate	0	0	0
Gender sibling	Female	ns	n/a	2.43**
Gender friend	Female	ns	ns	ns
Birth order	Firstborn	2.78*	ns	ns
	Lastborn	ns	ns	ns
	Middleborn	0	0	0

For father vs. friend; mother vs. friend and sibling vs. friend “Slightly better relationship (1) with first listed” incorporates a minority who have a “better relationship with the first listed (2)” * = $p < .05$; ** = $p < .01$. Reference categories for independent categorical variables have parameter estimates set to 0.

Comparisons between slight preference versus slight preference (1 versus -1)

Birth order influenced the likelihood of a slight preference for one’s father versus a slight preference for one’s friend (Table 4). Firstborns did however differ from lastborns, with firstborns being more likely to show a slight preference for their father over their friend (OR 1.93; $p_{wald} = .016$). Middleborns did not differ from firstborns or lastborns (both $p_{wald} > .15$). However, given that firstborns did not differ from middleborns (OR 1.44; $p_{wald} = .171$), we cannot definitively conclude that firstborns show a slight preference for their father over their friend.

Birth order also significantly influenced the likelihood of a slight preference for one’s sibling versus a slight preference for one’s friend (Likelihood ratio test $\chi^2 = 15.31$; $p < .05$). Firstborns were significantly more likely than middleborns to have a slight preference for their sibling rather than a slight preference for their friend (OR 2.29; $p_{wald} = .005$). By recoding birth order, we can again make comparisons and firstborns are also more likely than lastborns to show a slight preference for their sibling, instead of a slight preference for their friend (OR 2.51; $p_{wald} = .003$). There are thus quite

TABLE 4
ORs (exp(λ)) for multinomial logistic regression with reference category “a slightly better relationship with the last listed (-1)”

Dependent	Slightly better relationship (1) with first listed	Father vs. friend	Mother vs. friend	Sibling vs. friend
Nagelkerke R^2		$R^2 = 0.06$	$R^2 = 0.01$	$R^2 = 0.06$
Gender respondent	Female	ns	ns	ns
Age	(increase by one year)	ns	0.97**	0.95***
Education	Incomplete/primary	ns	ns	ns
	Lower vocational	ns	ns	ns
	Lower general secondary	ns	ns	ns
	Medium general secondary	ns	ns	ns
	Upper general secondary	ns	ns	ns
	Intermediate vocational	ns	ns	ns
	Higher vocational	ns	ns	ns
	University or postgraduate	0	0	0
Gender sibling	Female	0.32***	n/a	2.84***
Gender friend	Female	n/a	ns	ns
Birth order	Firstborn	ns	ns	2.29**
	Lastborn	ns	ns	ns
	Middleborn	0	0	0

For father vs. friend; mother vs. friend and sibling vs. friend “Slightly better relationship (1) with first listed” incorporates a minority who have a “better relationship with the first listed (2)”
 ** = $p < .01$; *** = $p < .001$. Reference categories for independent categorical variables have parameter estimates set to 0.

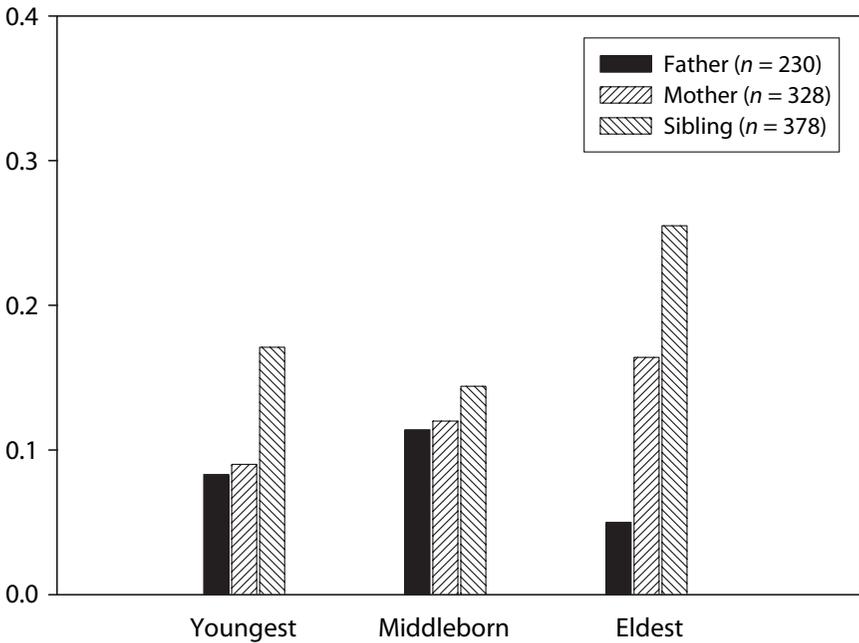
sizeable differences between firstborns and middleborns or lastborns in preferences for one’s sibling over one’s friend. The odds for preference of a sibling over a friend are 2.29 times larger for a firstborn than for a middleborn and the odds for preference of a sibling over a friend are 2.51 times larger for a firstborn.

Relative relationship quality with siblings: Sibling reports

It appears that firstborns were differentially more likely than other birth orders to report a better relationship with their sibling (see Figure 4). Given that the only consistent results for birth order so far are on sibling relationships, we will only test birth order affects using this within-family design. Only very few respondents differed strongly with their sibling, therefore this category was merged with slight difference.

Birth order was the only significant predictor of the relative difference in ratings (Likelihood ratio test $\chi^2 = 14.68$; $p = .005$). The model with just birth order has a Nagelkerke R^2 of 0.045. Firstborns were more likely than other birth orders to report that they have a better relationship with their sibling (compared to the sibling’s report). The odds that the respondent

FIGURE 4
Proportion of respondents that reports a better relationship with their sibling than their sibling reports with them by birth order



reported a better relationship than the sibling did were 4.5 times larger if the respondent was a firstborn instead of a middleborn (Table 5). Firstborns were, however, no more likely than lastborns to report a better relationship than their sibling did (OR 1.68; $p_{wald} = .168$). Interestingly, middleborns were also more likely than firstborns or lastborns to report a worse relationship than their sibling did (respectively: OR 4.5 and OR 2.7; Table 5).

Given this finding for middleborns, we also tested for birth order effects on the differential ratings of parents. As with siblings, only very few respondents (less than 3%), reported a far worse or a far better relationship than their parents did. Birth order did not predict differences in ratings between the respondent and his or her mother in the MLR (all $p > .1$). Birth order and education did predict differential ratings between the respondent and his/her father (respectively: Likelihood ratio test $\chi^2 = 11.43$; $p = .022$; Likelihood ratio test $\chi^2 = 10.03$; $p = .007$). The model had a Nagelkerke R^2 of .126.

Higher educated respondents tended to evaluate their relationship more positively than their father did, instead of vice versa (change of one category: OR 1.72; $p_{wald} = .01$). Middleborns tended to be more likely than firstborns to report a better relationship with their father, rather than vice versa (OR 3.92; $p_{wald} = .07$). By contrast, middleborns were less likely than lastborns to agree with their father on the quality of their relationship; instead their

TABLE 5
ORs (exp(λ)) for multinomial logistic regression with reference category
“sibling reported a better relationship than respondent did (-1)”

Dependent		Respondent reports better relationship (1)
Nagelkerke R^2		$R^2 = 0.05$
Birth order	Firstborn	4.53***
	Lastborn	2.76**
	Middleborn	0
Dependent		Respondent reports same relationship quality as sibling does (0)
Nagelkerke R^2		$R^2 = 0.05$
Birth order	Firstborn	1.73 [†]
	Lastborn	ns
	Middleborn	0

Reference categories for independent categorical variables have parameter estimates set to 0. ** = $p < .01$; *** = $p < .001$; [†] = $.05 < p < .1$.

father reported a better relationship than they did (OR 2.58; $p_{wald} = .025$). No other comparisons were significant.

Discussion

In this study we examined whether or not middleborns differed from other birth orders in their family relationships by examining an adult sample. We only found support for the prediction that middleborns from an adult population have significantly worse family relationships than either firstborns or lastborns in the within-family design. In the between-family design, the only significant and sizeable contrast in our study is between firstborns and middleborns. Firstborns were significantly more likely than laterborns to have a very good relationship with their sibling. Firstborns were also significantly more likely than laterborns to prefer their sibling over their friend. In a within-family design, we found that firstborns were differentially more likely than middleborns to rate their relationship as better in comparison to their siblings. Firstborns did not however consistently differ from lastborns in their relative ratings of relationship quality. However, the estimate for the difference between firstborns and lastborns was in the predicted direction and within the range of the effect found for the between-family design (OR 1.64) and it is possible that there was simply not enough statistical power in the within-family design to replicate the effect from the between-family design.

Since the only evidence for a neglected middleborn effect was documented in the within-family design, and then limited to relationships with siblings,

the neglected middleborn effect appears less robust than the firstborn effect in this adult sample. We found no support that middleborns were differentially more likely than other birth orders to have a worse relationship with their parents.

An additional finding was that sex played a pivotal role in family relationship ratings, but only in the between-family design. This result relates to a common finding: women tend to have closer kin ties (for example, Pollet, 2007; Rosenthal, 1985; Umberson, 1992). Respondents tended to rate their relationships with female siblings as relatively more positive than their relationship with a close friend or parent.

The results relevant to firstborns' sibling relationships are consistent with the hypothesis derived from kin selection that firstborns are differentially more likely than laterborns to invest in their sibling (Pollet & Nettle, 2007). An investment by a firstborn in a laterborn enhances the firstborn's fitness to a greater extent than an investment by a laterborn in a firstborn, because reproductive value declines with age, and because the firstborn sibling is by definition the older of the two. Interestingly, firstborns did not consistently differ from laterborns in relationships with their parents. Thus, firstborns are not simply generally more positive toward kin or more likely to identify with parental authority (Sulloway, 1996, 2001). Instead, the difference relates specifically to siblings, as the reproductive-value sibling-investment hypothesis would predict (Pollet & Nettle, 2007). Substantially more work is needed, however, to demonstrate that these asymmetries are indeed consistent with kin selection theory.

Our data diverge partially from results from studies using undergraduate populations, which typically find middleborns to have less close family relationships than other birth orders (Kennedy, 1989; Kidwell, 1981, 1982; Rohde et al., 2003; Salmon, 2003; Salmon & Daly, 1998). This may be because the context of kin-directed behaviour is very different for a student population than for adults. In adolescence and during their university lives, siblings compete within a small locality (the household) for finite parental resources (e.g. funding for education; see Zvoch, 1999). Middleborns may fare least well in such competition as they are neither the oldest nor the most recently arrived competitors, perhaps leading to their relatively estranged family relationships. By adulthood, siblings have dispersed and maintain separate households. Thus, local competition is attenuated and they may choose to invest to enhance their inclusive fitness. It has long been understood that local competition disrupts patterns of cooperation between kin that might otherwise be expected from a straightforward application of Hamilton's rule (see Borgerhoff Mulder, 2007). The difference between adults' and students' sibling relationships may be an illustration of this principle.

Interestingly, however, Hardman et al. (2007) found no significant differences in family relationships by birth order in either children or adults. Perhaps the neglected middleborn effect is limited to very specific life phases, domains and contexts (e.g. monetary investment in young adulthood). This may explain why a neglected middleborn effect is reliable among young adolescents, but less reliable at other times. Future research

is necessary, however, to differentiate various domains of investment, as well as the timing of competition and cooperation. In addition, future birth order research should aim not only to demonstrate that both competition and cooperation between siblings generates actual fitness consequences, but also to elucidate the proximate mechanisms governing these dynamics between siblings.

This study included both within- and between-family comparisons. Some researchers have argued that a within-family design is better suited for evaluating subjective perceptions within a family niche (Healy & Ellis, 2007; Paulhus, Trapnell, & Chen, 1999). Yet, if birth order effects are truly important for a given behaviour in society at large, they should also be detectable by between-family designs (Steelman, 1985; Steelman & Powell, 1985). Moreover, a between-family design can rule out many potential confounds, such as socio-economic status (e.g. Steelman & Powell, 1985). In view of the different results of our within- and between-family analyses, further research is necessary to elucidate how choice for a design influences birth order findings.

An important limitation to our study is that we used a single item to measure our dependent variable: relationship quality. It was not possible to create a relationship quality scale using this data set. This measure is used commonly in social network research and has been argued to form a reliable proxy for providing various forms of support (see House et al., 1988; Marsden & Campbell, 1984; Pollet, 2005). Given that the NKPS is a longitudinal survey, we aim to test whether relationship quality patterns are stable over time and whether initial relationship quality ratings predict various forms of future support. In addition, we aim to show that this support is non-trivial and has some measurable effect on the respondent's inclusive fitness. This would provide stronger evidence for the reproductive-value sibling-investment hypothesis.

Of course, other factors, apart from birth order, might influence adult siblings' social dynamics interacting with birth order effects. For example, childlessness has been suggested to play an important role for investment in kin as childless individuals generally invest more in their kin (Essock-Vitale & McGuire, 1985; Pollet & Dunbar, 2008; Pollet, Kuppens, & Dunbar, 2006). Factors such as sibling spacing, socio-economic conditions during child development, and maternal age (Freese et al., 1999; Powell & Steelman, 1990; Steelman et al., 2002; Sulloway, 1996) could interact with birth order effects. Further research is necessary to establish if and how childlessness and/or other mediating factors interact with birth order to affect social dynamics and investment between adult siblings. In addition, further research is necessary to establish the relative importance of birth order in comparison to other proximate factors (such as sibling spacing, socio-economic status, parental conflict, distance between siblings) for investment in siblings, and the associated fitness pay offs. Here we have, however, presented a more limited finding, namely that, all else being equal, asymmetries between adult siblings in investment appear in line with differences in reproductive value, leading firstborns to report better sibling relationships than laterborns.

REFERENCES

- Borgerhoff Mulder, M. (2007). Hamilton's rule and kin competition: The Kipsigis case. *Evolution and Human Behavior* 28, 299–312.
- Bromberg, E. A. (1983). Mother–daughter relationships in later life: The effect of quality of relationship upon mutual aid. *Journal of Social Gerontological Work*, 6, 75–92.
- Cicirelli, V. G. (1983). Adult children's attachment and helping behavior to elderly parents: A path model. *Journal of Marriage and the Family*, 45, 815–825.
- Dykstra, P. A., Kalmijn, M., Knijn, T. C. M., Komter, A. E., Liefbroer, A. C., & Mulder, C. H. (2004). *Codebook of the Netherlands Kinship Panel Study, a multi-actor, multi-method panel study on solidarity in family relationships, Wave 1. NKPS Working Paper No. 1*. The Hague: Netherlands Interdisciplinary Demographic Institute. (Version of July 2005).
- Essock-Vitale, S. M., & McGuire, M. T. (1985). Women's lives viewed from an evolutionary perspective. II. Patterns of helping. *Ethology and Sociobiology*, 6, 155–173.
- Euler, H. A., & Michalski, R. L. (2007). Grandparental and extended kin relationships. In C. Salmon, & T. K. Shackelford (Eds.), *Family Relationships: An evolutionary perspective* (pp. 230–256). Oxford: Oxford University Press.
- Freese, J., Powell, B., & Steelman, L. C. (1999). Rebel without a cause or effect: Birth order and social attitudes. *American Sociological Review*, 64, 207–231.
- Hamilton, W. D. (1964). The genetical evolution of social behaviour, parts I and II. *Journal of Theoretical Biology*, 7, 1–52.
- Hardman, D., Villiers C., & Roby, S. (2007). Another look at birth order and familial sentiment: Are middleborns really different? *Journal of Evolutionary Psychology*, 5, 197–211.
- Healey, M. D., & Ellis, B. J. (2007). Birth order, conscientiousness, and openness to experience: Tests of the family-niche model of personality using a within-family methodology. *Evolution and Human Behavior*, 28, 55–59.
- Hosmer, D., & Lemeshow, S. (1989). *Applied Logistic Regression*. New York: Wiley & Sons.
- House, J. S., Umberson, D., & Landis, K. R. (1988). Structures and processes of social support. *Annual Review of Sociology*, 14, 293–318.
- Hughes, A. L. (1988). *Evolution and Human Kinship*. Oxford: Oxford University Press.
- Kennedy, G. E. (1989). Middleborns' perceptions of family relationships. *Psychological Reports*, 64, 755–760.
- Kidwell, J. S. (1981). Number of siblings, sibling spacing, sex and birth order: Their effects on perceived parent–adolescent relationships. *Journal of Marriage and the Family*, 43, 315–332.
- Kidwell, J. S. (1982). The neglected birth order: Middleborns. *Journal of Marriage and the Family*, 44, 225–235.
- Marsden, P. V., & Campbell, K. E. (1984). Measuring tie strength. *Social Forces*, 63, 482–501.
- Menard, S. (1995). *Applied Logistic Analysis, Quantitative Applications in the Social Sciences Series #106*. Thousand Oaks: Sage Publications.
- Michalski, R. L., & Shackelford, T. K. (2002). An attempted replication of the relationships between birth order and personality. *Journal for Research on Personality*, 36, 182–188.
- Nagelkerke, N. J. D. (1991). A note on a general definition of the coefficient of determination. *Biometrika*, 78, 691–692.
- Pampel, F. C. (2000). *Logistic regression: A primer, Quantitative Applications in the Social Sciences Series #132*. Thousand Oaks: Sage Publications.
- Paulhus, D. L., Trapnell, P. D., & Chen, D. (1999). Birth order effects on personality and achievement within families. *Psychological Science*, 10, 482–488.
- Peng, C.-Y. J., Lee, K. L., & Ingersoll, G. M. (2002). An introduction to logistic regression analysis and reporting. *Journal of Educational Research*, 96, 1–14.
- Pollet, T. V. (2005). *Childlessness and genetic relatedness: their influence on sibling ties in a Post-Industrial society*. Unpublished MSc thesis. Liverpool: University of Liverpool.
- Pollet, T. V. (2007). Genetic relatedness and sibling relationship characteristics in a modern society. *Evolution and Human Behavior*, 28, 176–185.

- Pollet, T. V., & Dunbar, R. I. M. (2008). Childlessness predicts helping of nieces and nephews in United States, 1910. *Journal of Biosocial Science*, *40*, 761–770.
- Pollet, T. V., Kuppens, T., & Dunbar, R. I. M. (2006). When nieces and nephews become important: Differences between childless women and mothers in relationships with nieces and nephews. *Journal of Cultural and Evolutionary Psychology*, *4*, 83–93.
- Pollet, T. V., & Nettle, D. (2007). Birth order and face-to-face contact with a sibling: Firstborns have more contact than laterborns. *Personality and Individual Differences*, *43*, 1796–1806.
- Powell, B., & Steelman, L. C. (1990). Beyond sibship size: Sibling density, sex composition, and educational outcomes. *Social Forces*, *69*, 181–206.
- Rohde, P. A., Atzwanger, K., Butovskaya, M., Lampert, A., Mysterud, I., Sanchez-Andres, A., & Sulloway, F. J. (2003). Perceived parental favoritism, closeness to kin, and the rebel of the family: The effects of birth order and sex. *Evolution and Human Behavior*, *24*, 261–276.
- Rosenthal, C. J. (1985). Kinkeeping and the familial division of labor. *Journal of Marriage and the Family*, *47*, 965–974.
- Rossi, A. S., & Rossi, P. H. (1990). *Of human bonding: Parent–child relations across the life course*. New York: Aldine.
- Salmon, C. A. (1999). On the impact of sex and birth order on contact with kin. *Human Nature*, *10*, 183–197.
- Salmon, C. A. (2003). Birth order and relationships: friends, family, sexual partners. *Human Nature*, *14*, 73–81.
- Salmon, C. A., & Daly, M. (1998). Birth order and familial sentiment: middleborns are different. *Evolution and Human Behavior*, *19*, 299–312.
- Steelman, L. C. (1985). A tale of two variables: A review of the intellectual consequences of sibship size and birth order. *Review of Educational Research*, *55*, 353–386.
- Steelman, L. C., & Powell, B. (1985). The social and academic consequences of birth order: Real, artifactual, or both? *Journal of Marriage and the Family*, *47*, 117–124.
- 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*, 243–269.
- Suito, J. J., & Pillemer, K. (2007). Mothers' favoritism in later life: The role of children's birth order. *Research on Aging*, *29*, 32–55.
- Sulloway, F. (1996). *Born to rebel: Birth order, family dynamics, and creative lives*. New York: Pantheon.
- Sulloway, F. (2001). Birth order, sibling competition, and human behaviour. In P. S. Davies, & H. R. Holcomb (Eds.), *Conceptual challenges in evolutionary psychology: Innovative research strategies* (pp. 39–83). Dordrecht: Kluwer Academic Publishers.
- Trivers, R. L. (1974). Parent–offspring conflict. *American Zoologist*, *14*, 249–264.
- Umberson, D. (1992). Relationships between adult children and their parents: Psychological consequences for both generations. *Journal of Marriage and the Family*, *54*, 664–674.
- Zvoch, K. (1999). Family type and investment in education: A comparison of genetic and step-parent families. *Evolution and Human Behavior*, *20*, 453–464.