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Birth order and face-to-face contact with a sibling: Firstborns have more contact than laterborns

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Abstract

The evolutionary theory of kin selection predicts that individuals may invest time and resources in their siblings, but that older siblings will invest in younger ones more than vice versa. This leads us to predict that firstborns are more likely to keep in touch with their sibling(s) than middleborns or laterborns. Using a large-scale dataset from the Netherlands ($n_1 = 1558$), firstborns were indeed found to have significantly more frequent face-to-face contact, on a weekly basis, with a sibling than middle- or lastborns. This effect was found using multinomial logistic regression in which we controlled for other factors (educational attainment, difference between siblings in educational attainment, age and gender). The finding that firstborns are significantly more likely to keep in touch with their sibling on a weekly basis than laterborns remained unaltered after controlling for geographical distance between siblings ($n_2 = 1394$). Middleborns did not differ significantly from lastborns in contact with their sibling(s). Findings are discussed with reference to research on birth order and family relationships.

Keywords: Birth order; Siblings; Family ties; Contact frequency; Kin selection

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1. Introduction

Following Sulloway's (1996, 2001) formulation of the 'rebel hypothesis', interest in birth order effects on adult behaviour has been renewed. The evidence for Sulloway's claims on the effect of birth order on personality and achievement is mixed (Freese, Powell, & Steelman, 1999; Jefferson, Herbst, & McCrae, 1998; see Steelman, Powell, Werum, & Carter, 2002 for a review). The renewed focus on birth order generated by Sulloway's findings has mainly centred on personality, social attitudes and educational attainment (e.g. Beer & Horn, 2000; Freese et al., 1999; Healey & Ellis, 2007; Michalski & Shackelford, 2002; Paulhus, Trapnell, & Chen, 1999; Rohde et al., 2003; Saroglou & Fiasse, 2003), and relatively little attention has been paid to its influence on family-related behaviour (though see Salmon & Daly, 1998).

Amongst Sulloway's (1996) predictions is the idea that firstborns within the family are differentially likely to act as surrogate parents, and take on the role of family custodian. This particular claim has remained largely untested. This claim is derived from the theory of kin selection. Individuals can promote their biological fitness not just by reproducing themselves, but also by investing time or resources in kin (Hamilton, 1964). In many non-human species, siblings allocate effort to caring for each other, even at cost to their own reproduction, a phenomenon accounted for by the fact that they share half of their genetic material by descent. Such surrogate parenting is also widely observed in human societies (e.g. Bereczkei & Dunbar, 2002; Borgerhoff Mulder & Milton, 1985; Bove, Vallegia, & Ellison, 2002; Turke, 1988; Weisner et al., 1977; but see Hames & Draper, 2004) and often increases inclusive fitness. The arrangement is not symmetrical, since older individuals can often increase the fitness of their younger siblings to a greater extent or at lower cost than vice versa. Younger individuals also have higher reproductive value (that is, future reproductive potential) than older ones, all else being equal. Hughes (1988) argues that the optimal level of kin investment is a function not just of the costs, benefits, and degree of relatedness, but also of the reproductive value of the individuals involved. This means that, in general, the optimal rate of investment in siblings is higher for an older sibling investing in a younger one than for a younger one investing in an older one.

There is some empirical evidence that the flow of investment tends to be from older to younger siblings in modern societies (Essock-Vitale & McGuire, 1985). However, the number of studies of sibling–sibling investment is small compared to the attention that has been focussed on birth order effects on parental favouritism and closeness to parents (Kennedy, 1989; Kidwell, 1981; Rohde et al., 2003; Salmon & Daly, 1998).

Here, we examine the effect of birth order on a sibling-directed behaviour, namely face-to-face interaction with a sibling in adulthood. Differentials in frequency of contact are important as they are related to helping behaviour and willingness to incur costs in order to help a sibling (Pollet, 2005). Since face-to-face contact with family has been found to be mediated by gender, educational attainment, age, and geographical distance (Hill & Dunbar, 2003; Pollet, 2007; Salmon, 1999), it is important to control for these factors. Our general prediction is that after controlling for such variables, firstborns will have more contact than middleborns, who will in turn have more contact than lastborns.

2. Methodology

2.1. Sample and assessment procedures

The Netherlands Kinship Panel Study (NKPS) dataset was obtained through the Netherlands Interdisciplinary Demographic Institute (NIDI). The NKPS is a large-scale study ($n = 8161$), designed to investigate family and kin relations in the Netherlands (Dykstra et al., 2004). The main study aimed to reach 8500 non-institutionalized individuals between 18 and 79 years old (Dykstra et al., 2004: 23-ff.). These individuals were randomly drawn from a large Dutch address register. The study yielded a final sample with data for 8161 persons (mean age = 46.43; std = 15.13; Dykstra et al., 2004). The sample was unbalanced in terms of gender, with more female than male respondents ($n_{men} = 3420$; $n_{women} = 4741$).

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 min during which data was 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, etc.). The sampling procedure, representativeness, the survey method and other aspects of the study are described in much more detail by Dykstra et al. (2004).

From this dataset, we selected all individuals who had two full siblings ($n_1 = 1558$). Limiting the analysis to respondents with two siblings avoids sampling bias in respect of middleborns and controls for sibship size. Moreover, it is important to distinguish middleborns from lastborns, rather than comparing firstborns with laterborns, as middleborns have been shown to differ from first- and lastborns in familial sentiment (Salmon & Daly, 1998).

Respondents who had step- or half-siblings were excluded from analysis (see Freese et al., 1999; Michalski & Shackelford, 2002). Birth order of the respondent was then coded as firstborn, middleborn, or lastborn. Individuals for which the birth order could not be determined based on this coding were excluded from analysis. In the NKPS-interview, questions were asked about respondents' frequency of face-to-face contact with '*sibling a*', a randomly selected sibling of the respondent. Face-to-face contact frequency was surveyed as '*how often have you seen* (*name, description*) *in the past* 12 *months*' (Dykstra et al., 2004) This variable was recoded from seven to five categories, by merging the first two (*not at all* ($n = 99$) and *once* ($n = 77$)) and the last two categories (*several times a week* ($n = 60$) and *daily* ($n = 29$)), in order to avoid categories with too few cases (Table 1). Characteristics of sibling a (gender, educational attainment) were coded by use of the sibling identification code (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. As with contact frequency, the first two (*incomplete* ($n = 6$) and *primary* ($n = 76$)) and last two categories (*university* ($n = 193$) and *postgraduate* ($n = 20$)) of the educational attainment variable were merged. Difference in educational attainment was calculated as the absolute difference between siblings in educational attainment categories. Additional informa-

Table 1
Descriptive statistics (frequencies/means) for variables in the model

Variables	Categories	Frequencies/means
Birth order	0 = eldest	$n = 565$
	1 = middleborn	$n = 490$
	2 = youngest	$n = 503$
Educational attainment of respondent	1 = incomplete primary or primary	$n = 82$
	2 = lower vocational	$n = 160$
	3 = lower general secondary	$n = 173$
	4 = medium general secondary	$n = 86$
	5 = upper general secondary	$n = 80$
	6 = intermediate vocational	$n = 361$
	7 = higher vocational	$n = 403$
	8 = university or postgraduate	$n = 213$
Difference in educational attainment between siblings	7 categories	Median = 1
Gender of the respondent	0 = male	$n = 662$
	1 = female	$n = 953$
Gender of sibling a	0 = male	$n = 786$
	1 = female	$n = 772$
Age	(Interval)	Mean = 43.23 years (SD = 14.16 years)
Geographical distance	(Interval; only used in analysis 2)	Mean = 41.99 km (SD = 49.6 km)
Contact frequency over past 12 months	1 = not at all or once	(Dependent variable)
	2 = a few times	
	3 = at least once a month	
	4 = at least once a week	
	5 = several times a week or daily	

tion on variables can be found in the NKPS codebook (Dykstra et al., 2004). Missing values on variables were treated listwise for the multinomial logistic regression.

2.2. Statistical methods

We will use multinomial logistic regression (MLR) to investigate the independent effect of birth order on the dependent variable, contact frequency (Hosmer & Lemeshow, 1989; Menard, 1995; Pampel, 2000). Multinomial logistic regression as a statistical technique is relatively free of assumptions and statistically robust. MLR is very similar to 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. Also, Wald test statistics which correspond to each λ are similar to t-test statistics corresponding to β's in OLS. Unlike OLS, however, where parameters are estimated by minimizing the sum of squares, parameters in MLR are estimated by maximum likelihood. Besides this MLR is quite similar to ordinary least squares regression and is adequate for analyzing independent effects on a dependent nominal variable.

We will construct two models for contact frequencies. In the first analysis ($n_1 = 1558$), we will investigate the independent effect of birth order while controlling for the effects of educational attainment, difference between the siblings in educational attainment, age, gender and gender of the random sibling. This first model does not control for the effect of geographical distance as more than ten percent of the respondents lack these data. A second analysis including a Euclidean distance measure allows one to estimate the effect for birth order while controlling for the other variables plus geographical distance between siblings ($n_2 = 1394$; see Dykstra et al., 2004).

As the parameter selection procedure for the variables in each analysis, we used forward stepwise. For both analyses, outcomes were the same in terms of model fit and Nagelkerke R^2 (1991) when backward stepwise was used instead (data not shown). Nagelkerke R^2 is a frequently used measure of variance explained in MLR, and is similar to R^2 from OLS. 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_{llr}) are used to examine the significance of a variable for the MLR model, while the Wald statistic is used to determine the significance of parameter estimates (p_{wald}). We will use a five percent significance level for all analyses.

3. Results

3.1. Analysis 1

Fig. 1 shows the distribution of contact frequency for firstborns, middleborns and lastborns. A higher proportion of firstborns than laterborns have contact on at least a weekly basis but other

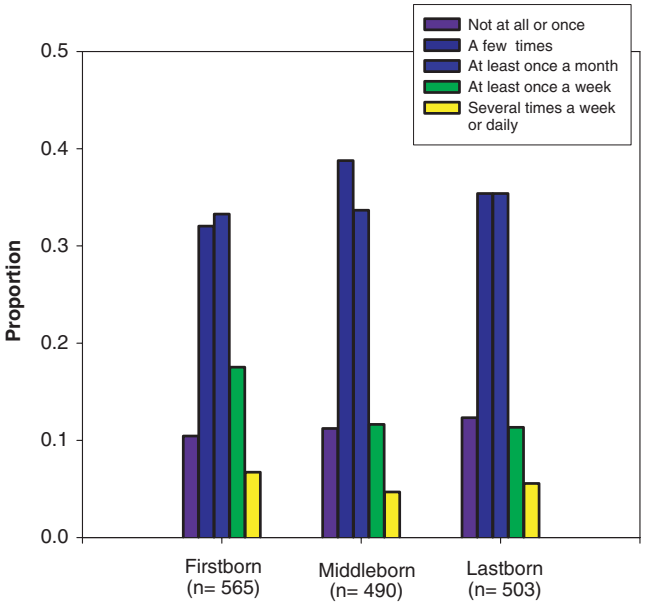

Fig. 1. Birth order and contact with a random sibling over the past 12 months ($\chi^2 = 16.16$; $p < 0.05$). Within each category, proportions add up to 1.

than that the distributions for firstborns, middleborns and lastborns appear quite similar. This leads us to expect that significant differences between firstborns and laterborns will mainly exist for comparisons between 'at least once a week' and other categories but not necessarily for comparisons between other categories.

We constructed a stepwise MLR with age, educational attainment, gender and birth order of the respondent, difference in educational attainment between siblings and gender of the sibling as predictors for frequency of contact with a sibling. Birth order, educational attainment and age of the respondent, and gender of the sibling proved significant predictors of frequency of contact with a sibling in this stepwise procedure. The difference in attained level of education between siblings, and the gender of the respondent, were not significant and were dropped from the model. The final model has a Nagelkerke R^2 of 0.14 (Model Fit $\chi^2 = 226.21$; df = 44; $p < 0.0001$; Table 2). It thus performs well according to usual standards in the social sciences. As predicted, birth order independently influenced frequency of face-to-face contact with a sibling over the past 12 months once other key variables had been controlled for.

Parameters from Table 2 are most easily interpreted in terms of odds ratios (exp(λ)). For instance, firstborns are 1.88 times more likely than lastborns to have had contact several times a week or daily, instead of once or not at all over the past 12 months. This effect is found while controlling for the other variables (educational attainment, age, gender of sibling) in the model. Odds ratios for interval variables, age for example, are interpreted as follows: an increase in age of one year makes it 0.92 times more likely that a respondent has had contact several times a week or daily, instead of once or not at all.

Table 2
Parameter estimates (λ) and odds ratios (exp(λ)) for daily/several times a week from multinomial logistic regression (analysis 1) with as reference category of contact frequency set as "not at all or once"

Contact frequency	Daily/several times a week	λ	Std. error	Wald	p_{Wald}	Exp(λ)	p_{LLR}
Intercept		0.35	0.76	0.21	n.s.		
Education	Incomplete/primary	*1.58*	0.68	5.33	0.021	*4.85*	<0.001
	Lower vocational	0.78	0.63	1.55	n.s.	2.19	
	Lower general secondary	*1.36*	0.57	5.64	0.018	*3.91*	
	Medium general secondary	−0.13	0.76	0.03	n.s.	0.87	
	Upper general secondary	0.18	0.84	0.05	n.s.	1.20	
	Intermediate vocational	0.88	0.53	2.69	n.s.	2.40	
	Higher vocational	1.06	0.55	3.73	n.s.	2.88	
	University or postgraduate	0	–	–	–	–	
Birth order	Firstborn	*0.63*	0.32	3.88	0.049	*1.88*	0.002
	Middleborn	0.04	0.35	0.01	n.s.	1.04	
	Lastborn	0	–	–	–	–	
Age	(Increase by one year)	−0.08	0.01	55.15	<0.001	*0.92*	<0.001
Gender sibling a	Female	*0.94*	0.28	11.69	0.001	*2.56*	<0.001

The Wald statistic allows to determine the significance of individual parameters, the likelihood ratio test allows to determine the overall significance of a variable (p_{LLR}). Reference categories for independent categorical variables have parameter estimates set to 0.

By substituting categories we can obtain odds ratios that allow comparison between different categories of birth order and contact frequency. As was apparent from Fig. 1, significant differences between firstborns and laterborns are mainly limited to comparisons between 'at least once a week' and a different category (Table 3). Odds ratios for comparisons of 'at least once a week' with another category showed considerable differences between firstborns and laterborns in their frequency of contact, with odds ratios ranging from around 1.7 to 2.4. Depending on the contrast category, firstborns are thus between 1.7 and 2.4 times more likely than laterborns to have had contact on at least a weekly basis with their sibling. With the exception of two comparisons of 'daily or several times a week' with another category, differences between firstborns and laterborns for other comparisons were not significant. For comparisons between 'daily or several times a week' with another category, there are no consistent differences between firstborns and laterborns.

3.2. Analysis 2

We constructed a second stepwise MLR-model for contact frequency, with the same independent variables used for analysis 1 (gender, age, educational attainment and birth order of the respondent, gender of the sibling and difference between the siblings in educational attainment). In addition, we also included a measure for geographical distance between the siblings as an independent variable in this second analysis. In the stepwise procedure, geographical distance, age and birth order of the respondent, and gender of the sibling proved significant predictors of frequency of contact with a sibling. The MLR-model with these variables had a Nagelkerke R^2 of 0.3 (Model Fit $\chi^2 = 463.63$; df = 20; $p < 0.0001$; Table 4). This model thus performs very well according to common standards in the social sciences. In line with analysis 1, difference in educational attain-

Table 3
Odds ratios (exp(λ)) for comparisons between different birth orders and contact frequencies

Reference category	Birth order	A few times Exp(λ)	At least once a month Exp(λ)	At least once a week Exp(λ)	Several times a week or daily Exp(λ)
Once or not at all	1st vs 2nd	n.s.	n.s.	1.9*	n.s.
	1st vs 3rd	n.s.	n.s.	2.36***	1.88*
	2nd vs 3rd	n.s.	n.s.	n.s.	n.s.
A few times	1st vs 2nd	–	n.s.	2.11***	2*
	1st vs 3rd	–	n.s.	2.06***	n.s.
	2nd vs 3rd	–	n.s.	n.s.	n.s.
At least once a month	1st vs 2nd	–	–	1.71**	n.s.
	1st vs 3rd	–	–	1.83**	n.s.
	2nd vs 3rd	–	–	n.s.	n.s.
At least once a week	1st vs 2nd	–	–	–	n.s.
	1st vs 3rd	–	–	–	n.s.
	2nd vs 3rd	–	–	–	n.s.

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$ (Wald statistic). For example: firstborns are 1.9 times more likely than middleborns to have contact at least once a week instead of once or not at all over the past 12 months. These effects are found while controlling for the other variables in analysis 1.

Table 4
Parameter estimates (λ) and odds ratios (exp(λ)) for contact 'daily/several times a week' compared to 'not at all or once' (analysis 2)

Contact frequency	Daily/several times a week	λ	Std. error	Wald	p_{Wald}	Exp(λ)	p_{LLR}
Intercept		*2.32*	0.73	10.00	0.002		
Geographical distance	(Increase by one km)	*−0.05*	0.01	44.75	<0.001	*0.95*	<0.001
Birth order	Firstborn	*0.92*	0.37	6.17	0.013	*2.51*	0.002
	Middleborn	0.29	0.40	0.53	n.s.	1.34	
	Lastborn	0	–	–	–	–	
Age	(Increase by one year)	*−0.09*	0.01	51.90	<0.001	*0.92*	<0.001
Gender sibling a	Female	*1.61*	0.32	24.50	<0.001	*4.99*	<0.001

The Wald statistic allows determination of the significance of individual parameters, whilst the likelihood ratio test allows determination of the overall significance of a variable (p_{LLR}). Reference categories for independent variables have parameter estimates set to 0.

ment and gender of the respondent did not prove significant predictors of contact frequency in the stepwise procedure. Contrary to analysis 1, however, educational attainment was not a significant predictor of contact frequency. As in the first analysis we can conclude that birth order independently influences frequency of face-to-face contact with a random sibling. Firstborns are approximately two and half times more likely than lastborns to have had contact several times a week or daily, instead of once or not at all over the past 12 months (Table 4).

Table 5
Odds ratios (exp(λ)) for comparisons between different birth orders and contact frequencies

Reference category	Birth order	A few times Exp(λ)	At least once a month Exp(λ)	At least once a week Exp(λ)	Several times a week or daily Exp(λ)
Once or not at all	1st vs 2nd	n.s.	n.s.	*1.96**	n.s.
	1st vs 3rd	n.s.	n.s.	*3.04****	*2.51**
	2nd vs 3rd	n.s.	n.s.	n.s.	n.s.
A few times	1st vs 2nd	–	n.s.	*2.14***	*2.06**
	1st vs 3rd	–	n.s.	*2.31****	*1.91**
	2nd vs 3rd	–	n.s.	n.s.	n.s.
At least once a month	1st vs 2nd	–	–	*1.66**	n.s.
	1st vs 3rd	–	–	*1.86***	n.s.
	2nd vs 3rd	–	–	n.s.	n.s.
At least once a week	1st vs 2nd	–	–	–	n.s.
	1st vs 3rd	–	–	–	n.s.
	2nd vs 3rd	–	–	–	n.s.

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$ (Wald statistic). For example: firstborns are 1.96 times more likely than middleborns to have contact at least once a week instead of once or not at all over the past 12 months ($p < 0.05$). These effects are found while controlling for the other variables in analysis 2.

As in the first analysis, we can obtain odds ratios by substituting categories, which are reported in Table 5. The significant differences between firstborns and laterborns are mainly limited to comparisons between 'at least once a week' and other categories, as in analysis 1 (Table 3). Significant odds ratios for these comparisons showed similar sized effects (1.7–3) as those from analysis 1 (1.7–2.4). There were also some significant differences between firstborns and laterborns in comparisons between 'daily or several times week' with other categories (Table 5). Yet, as in analysis 1, these significant differences between firstborns and laterborns when comparing 'daily or several times a week' with other categories were not a consistent finding.

4. Discussion

We find that firstborns have significantly more face-to-face contact with their sibling than laterborns. In general, firstborns are significantly more likely than laterborns to have had contact on a weekly basis over the past 12 months. Other comparisons between categories of contact frequencies showed no significant differences between firstborns and laterborns, with the exceptions of occasional comparisons between 'daily or several times a week' with another category. The differences between firstborns and laterborns are thus largely restricted to comparisons between 'at least once a week' and other categories. The finding that firstborns are more likely than laterborns to have contact with a sibling on a weekly basis appears robust, however. It cannot be attributed to other variables summarized in Table 1. The differences between firstborns and laterborns in contact with their sibling are considerable, with odds ratios ranging from 1.66 to 3.

As for the mechanism underlying these results, firstborns only have younger siblings, whereas middleborns have a mixture of younger and older siblings, and lastborns only older siblings. A bias whereby individuals make a greater effort to spend time with younger than older siblings, would account for the difference between firstborn and laterborn behaviour observed here. Thus, the results, as well as being consistent with Sulloway's (1996) claim, accord with the more general predictions of kin selection theory (Hamilton, 1964). However, middleborns did not differ from lastborns in their behaviour, either by making more investment, as the theory of kin selection and reproductive value would predict Hughes, 1988, or by making less investment, as the finding that middleborns are the least close to family in general (Salmon & Daly, 1998; Salmon, 2003) might suggest.

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