



Sibling Conflict and Closeness: The Effects of Sex, Number of Siblings, Relatedness, Parental Resemblance and Investment

Jessica A. Hehman¹ · Rebecca L. Burch² · Catherine A. Salmon¹

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Abstract

Siblings may be our staunchest supporters as well as our most significant rivals. What factors shape these sibling relationships into ones of conflict versus closeness? Are conflict and closeness shaped by the same factors, occupying opposite ends of the same spectrum? Or are conflict and closeness independent of each other, being shaped by different factors? The current study examined conflict and closeness between siblings as a function of respondent sex; sex of sibling; genetic relatedness; age difference; time spent together; and perceived parental resemblance, investment, and favoritism. Results indicate the factors that shape conflict differ from those that shape closeness, suggesting they are not simply opposite ends of the same spectrum. While genetic relatedness, perceived parental favoritism, and sex of sibling relative to the respondent explained most of the variance in sibling conflict, most of the variance in sibling closeness was explained by time spent with the sibling and perceived sibling resemblance—not genetic relatedness. Furthermore, the factors examined in the study explained much more variance in closeness than in conflict. Future research utilizing within-family designs as well as cross-cultural data will be useful in adding to our understanding of how sibling conflict and closeness are shaped.

Keywords Kin selection · Sibling conflict · Sibling closeness · Relatedness

Introduction

Over the human lifespan, we experience many different kinds of relationships, perhaps none so enduring yet sometimes challenging as those of sibship. Our siblings can be our strongest supporters or our most acrimonious rivals. Fictional accounts of highly aggressive conflict, even sibicide such as Cain and Abel, are common and often in the pursuit of power and resources for their own children. Yet, siblings can be incredibly solidary, from older ones protecting younger siblings on the playground or within their own family, to carrying a baby for a sister unable to carry her own to term. Siblings can be playmates when close in age, surrogate parents when one is older, and sources of substantial social support. Of all our family relationships, siblings are typically with us on our journey the longest, from childhood to old

age. A number of researchers who study sibling conflict have considered it a normal part of human development, one that declines over the lifespan (Campione-Barr & Smetana, 2010; Jensen et al., 2018; McHale et al., 2012). When children are young, siblings spend significant amounts of time together which creates conditions for high degrees of conflict but also of cooperation and closeness (Buist et al., 2002; Tibbetts & Scharfe, 2015). But what shapes whether sibling relationships are ones of conflict versus closeness and cooperation? From an evolutionary perspective, what are the factors that should influence conflict and cooperation? Do the same factors that shape conflict, shape closeness? Or do different mechanisms play a role? Is conflict the opposite side of a spectrum from closeness, or are they independent of each other?

Theories of Sibling Conflict and Cooperation

As sibling relationships endure across the lifespan, they possess the potential for great solidarity as well as strife (Cicirelli, 2013; Michalski & Euler, 2008). Explaining altruistic or cooperative behavior from an evolutionary perspective was often seen as a puzzle before Hamilton (1964) proposed *kin selection theory*. In doing so, he introduced the concept of inclusive fitness,

✉ Jessica A. Hehman
jessica_hehman@redlands.edu

¹ Department of Psychology, University of Redlands, Redlands, 1200 E. Colton Ave., Redlands, CA, 92373, USA

² Human Development, SUNY Oswego, Oswego, USA

fitness not only due to one's own survival and reproduction but also that of genetically related individuals. This perspective modeled the likelihood that an individual will behave altruistically toward another depending on the degree of relatedness and the potential fitness benefit to the other person relative to the potential fitness cost to the altruistic individual. Altruistic behavior exhibited toward kin serves to indirectly increase one's own inclusive fitness. This suggests that genetic relatedness and related heuristic cues (co-residence, maternal perinatal association, resemblance, emotional closeness) will influence the likelihood of conflict and cooperation between individuals with less conflict and likely greater closeness and cooperation between genetically related individuals, all else being equal (Bressan & Kramer, 2015). Studies examining feelings of closeness and social support in adult relationships as a function of the degree of relatedness have generally produced results consistent with this theory, such that higher levels of closeness and support have been reported between kin versus non-kin and close versus more distant kin such as cousins (Neyer & Lang, 2003). As siblings are highly genetically related, we would expect greater solidarity and closeness between them.

However, shared genetic interests are not identical interests and much research attention has been directed to the nature of sibling conflict. From an evolutionary perspective, this has often focused on competition between siblings for limited parental resources (Michalski & Euler, 2008; Trivers, 1972) which ancestrally would have likely included food as well as shelter and time spent teaching essential skills (hunting, weaving). As a result, one might predict greater sibling conflict in families with more limited parental resources and/or greater numbers of offspring. While some studies have shown that larger sibships are associated with more sibling conflict (Straus et al., 2006), much of the research in the modern west has taken place in populations where resources are at least adequate if not abundant. In such populations, research suggests the most common sources of sibling conflict include issues of relative power, self-interest (sharing), violations of rules/obligations, and activities outside the family (Campion-Barr & Smetana, 2010; McGuire et al., 2000).

What Factors Influence Whether Siblings Experience Conflict and/or Cooperation

Sex of Sibling

Researchers have indicated that sex plays a role in sibling behavior with a number of studies indicating that boys experience more conflict than girls and also engage in more physical conflict (Salmon & Hehman, 2015; Straus et al., 2006), though Salmon and Hehman (2021) indicated females reported more conflict overall, which may reflect sex differences in the type of conflict, direct physical conflict versus indirect, and/or verbal conflict. Some studies have

also reported greater emotional closeness between sisters than between brothers or brothers and sisters (Pollet, 2007; Stocker et al., 2020; Tanskanen & Danielsbacka, 2019). Theoretically, same-sex individuals might be expected to have more direct conflict in that if close in age, they may have more similar needs and might be in competition for mates and friends, for example. Interestingly, a study of joint video game playing and sibling relationships suggested that playing together increased sibling affection for boys and girls but was also associated with greater conflict in boys, though it was associated with decreased conflict when the boys were playing violent games, perhaps due to a “band of brothers” type effect (Coyne et al., 2016).

Relatedness and Resemblance

Based on inclusive fitness theory, we would expect increased relatedness to be associated with less conflict and more closeness and, in terms of conflict and cooperation, this has been well studied in non-humans (Dyble & Clutton-Brock, 2020; Humphries et al., 2021; Sherman, 2019). Extending the animal work to humans, we would expect brothers and sisters to invest more in full siblings than in half or step siblings as the inclusive fitness benefits (and associated feelings of closeness) likely decrease with decreasing degrees of relatedness. Emlen (1997) also suggested that conflict would increase as relatedness decreased. A number of studies have supported these predictions (Jankowiak & Diderich, 2000; Pollet, 2007) including twin studies reporting more cooperation and emotional closeness between monozygotic compared to dizygotic twins (Reed et al., 2021; Segal, 2005; Tornero et al., 2018). However, some results have also differed from predictions based on Emlen (1997) or Hamilton (1964). Salmon and Hehman (2015, 2021) reported that genetic relatedness influenced levels of conflict but that the most intense conflict was between non-biological siblings, followed by full siblings with the least conflict between half siblings. Similar higher levels of full sibling conflict compared to half sibling have been reported by a number of researchers (Khan et al., 2020; Steinbach & Hank, 2018; Tanskanen et al., 2017). Interestingly, there have been reports of seemingly different patterns of relatedness effects for conflict versus cooperation with more conflict reported for full siblings compared to half siblings but also more closeness or cooperation reported for full siblings (Salmon & Hehman, 2021). Steinbach and Hank (2018) reported full siblings to have greater emotional closeness than half and step siblings but also more conflict as did Tanskanen and colleagues (2016). Sznycer and colleagues (2016) also reported that full and half siblings elicited more altruism than step siblings. This raises the question of whether the factors influencing conflict versus cooperation among siblings are somewhat different depending on the behavior or emotional state.

Recent attention has also focused on the importance of familial resemblance as a cue of relatedness and shaper of family relationships. Facial resemblance has been hypothesized as an important kinship cue in humans, facilitating kin recognition. Mechanisms to facilitate kin recognition, not only physical resemblance but olfactory cues and co-residence in maternal nests, exist in many different species and have probably evolved to promote nepotism as well as avoid inbreeding (Daniel & Rodd, 2021; Henkel & Setchell, 2018; Leedale et al., 2020). A great deal of the human research has concentrated on how resemblance might increase parental, particularly paternal, investment in offspring (Alvergne et al., 2009; Daly & Wilson, 1982; Regalski & Gaulin, 1993; Volk & Quinsey, 2002; Yu et al., 2019). While some have hypothesized that paternal uncertainty influences sibling uncertainty and therefore resemblance should play a role in sibling relationships (Burch et al., 2006), relatively little effort has been expended on examining the possible role of resemblance on sibling conflict or cooperation in humans. A notable exception is Lewis' (2011) study of the association between sibling facial resemblance, emotional closeness, altruism, and conflict. His results suggested that facial resemblance is a cue in sibling recognition and that individuals reported greater closeness and altruism toward siblings who more closely resembled them. When it came to conflict, there was an interaction between resemblance and co-residence duration. For siblings with less resemblance, longer durations of co-residence predicted greater conflict, but for siblings with greater resemblance, longer durations of co-residence were associated with lower levels of conflict.

Co-residence/Time Spent with Sibling

Another proximate cue of kinship, in addition to resemblance, receiving recent attention is the importance of co-residence (as well as observations of maternal investment in a newborn, referred to as maternal perinatal association) as a cue of relatedness (Gyuris et al., 2020; Salmon & Hehman, 2021; Sznycer et al., 2016; Tanskanen & Danielsbacka, 2019) that contributes to prosocial or conflictual sibling relationships as well as incest avoidance (Lieberman, 2009; Lieberman & Lobel, 2012). Some studies have reported longer co-residence to be associated with more intense conflict (Salmon & Hehman, 2015) while studies looking at relationship quality and altruism have reported greater co-residence (as well as maternal perinatal association) to predict greater emotional closeness and sibling directed altruism (Sznycer et al., 2016; Tanskanen & Danielsbacka, 2019). Bressan and colleagues' scenario study (2009) suggested that acts of costly altruism were most strongly predicted by co-residence duration. This study also reported that emotional closeness was a predictor of altruism for step siblings but not when siblings shared one of both biological parents. Similarly, a Finnish study

of middle-aged adults reported that childhood co-residence duration was associated with better relationship quality, indexed by contact frequency, emotional closeness, and provisioning of help as adults (Tanskanen et al., 2021). Full siblings also reported better relationship quality than half siblings. The differing results among some studies with regard to sibling conflict versus sibling cooperation or closeness and the impact of co-residence again indicate that different mechanisms may moderate conflict as opposed to cooperation between siblings.

Parental Investment and Favoritism

Parental investment theory (Trivers, 1972) suggests that the amount and allocation of parental investment depends on the resources available to parents, the quality of the offspring, and the potential for future offspring. All else being equal, one would expect parents to value offspring equally and to encourage them to value their siblings perhaps a bit more than they are naturally inclined to do. However, each offspring, being more closely genetically related to themselves than to their siblings, generally values themselves over their siblings. This raises the possibility of sibling conflict, each child trying to maximize their "fair share" in comparison to their siblings. It also suggests that siblings may be very attuned to indicators of parental favoritism (Salmon et al., 2012). *Favoritism* can be defined as the real or perceived preferential treatment of one or more of a parent's children at the expense of that parent's other children (Salmon et al., 2012). When one sibling is perceived as a parental favorite, it may increase levels of conflict and/or decrease closeness and there is evidence suggesting that, particularly early in life, children are particularly sensitive to parental investment favoring siblings (Sulloway, 1996). A study of the influence of perceptions of unequal parental treatment on sibling relationships in a Finnish population sample (Danielsbacka & Tanskanen, 2015) suggested unequal parental treatment was more frequently reported among those with half as opposed to only full siblings and that this has negative consequences for the quality of half sibling relationships in adulthood.

Current Study

The purpose of the current study was to (i) replicate previous findings of the effects of sex of sibling, genetic relatedness, age difference, and co-residence on sibling conflict and cooperation (Salmon & Hehman, 2015, 2021); and (ii) attempt to explain additional variance in conflict and cooperation by investigating the effects of other cues of relatedness and factors that may influence the sibling relationship (e.g., familial resemblance and perceived parental investment and favoritism).

Sibling Conflict Predictions

P1: Sex of sibling will influence the level of conflict such that greater conflict is expected between same-sex relative to opposite-sex siblings (conceptual replication; i.e., testing the same theoretical predictions using different measures of the variables).

P2: Less conflict will be experienced as the age difference between siblings increases (conceptual replication).

P3: Sibling conflict will increase with increasing genetic relatedness (conceptual replication).

P4: Familial resemblance will be associated with less conflict.

P5: Time spent with sibling will be associated with less conflict (conceptual replication).

P6: High levels of parental investment will be associated with less sibling conflict.

P7: Parental favoritism will be associated with greater sibling conflict.

Sibling Closeness Predictions

P8: Sex of sibling will influence sibling closeness such that greater closeness is expected between same-sex siblings relative to opposite-sex siblings (conceptual replication).

P9: Less closeness will be experienced as the age difference between siblings increases (conceptual replication).

P10: Sibling closeness will increase with increasing genetic relatedness (conceptual replication).

P11: Familial resemblance will be associated with more sibling closeness.

P12: Time spent with sibling will be associated with more closeness (conceptual replication).

P13: High levels of parental investment will be associated with greater sibling closeness.

P14: Parental favoritism will be associated with less sibling closeness.

Method

Participants

Participants included 548 adults (395 females and 153 males) between the ages of 17 and 47 ($M = 20.5$, $SD = 3.3$) who reported on 998 siblings. Out of the 998 siblings, 488 were same-sex siblings and 510 were opposite-sex siblings. There were 805 full siblings, 142 half siblings, 35 step siblings, and 16 adopted siblings. Participants were recruited from psychology courses at a northeastern US public university and were not compensated for their participation in the study.

Measures

Demographics

Participants were asked to self-report their sex, age, and number of siblings. For each sibling, participants were asked to report the sibling's sex, age, and degree of relatedness (full, half, step, or adopted sibling). Absolute age difference was calculated by subtracting the sibling's age from the participant's age. Genetic relatedness was calculated as 0.50 for full siblings, 0.25 for half siblings, and 0.00 for step and adopted siblings.

Parental and Familial Resemblance

All resemblance questions were asked on a 5-point scale where 0 indicated *not at all* and 4 indicated *extremely*. Participants were asked three resemblance questions for each parent and each sibling. To measure their own perceived resemblance to their parents, participants were asked to rate how much they physically resemble each parent, how often people say they resemble each parent, and whether each parent stated the participant resembled him/her. To measure sibling familial resemblance, participants were asked to rate how much that sibling resembled their father, their mother, and how much the participant and sibling physically resembled each other. Parental and familial resemblance scores were computed by summing responses to the three questions. Possible resemblance scores could range from 0 to 12 with higher scores indicating greater perceived parental or sibling familial resemblance. Cronbach's alphas indicated there was good internal consistency for father resemblance ($\alpha = 0.81$) and mother resemblance ($\alpha = 0.87$), but low internal consistency for sibling familial resemblance ($\alpha = 0.32$). Therefore, the composite scores were used for parental resemblance, but instead of using a composite score for sibling familial resemblance, the three sibling familial resemblance ratings were entered into the model individually.

Parental Investment

To measure perceived parental investment (PI), participants were asked 12 questions for each parent on a 5-point scale where 0 indicated *not at all* and 4 indicated *extremely*. For scoring purposes, five questions were reverse-scored [R]. The PI questions included the following: How much does your (mother/father) invest in you overall; how much time did/does (she/he) spend with you; how much time do you spend talking to (her/him); did/does (she/he) like to give you money; did/does (she/he) like to give you presents; did/does (she/he) yell at you [R]; did/does (she/he) physically punish you [R]; did/does (she/he) treat you better than your

siblings; did/does (she/he) treat you worse than your siblings [R]; how well do you think the two of you get along; how severe are arguments, if/when you have them [R]; and how angry does (she/he) get when you do something wrong [R]. After reverse-scoring the necessary questions, perceived PI scores were computed for each parent by summing responses to the questions. Possible scores could range from 0 to 48 with higher scores indicating greater perceived PI from that parent. Cronbach's alphas indicated there was good internal consistency for father PI ($\alpha=0.83$) and mother PI ($\alpha=0.78$).

Time Spent with Sibling

Using a 5-point Likert scale where 0 indicated *not at all* and 4 indicated *extremely*, for each sibling, participants were asked to indicate: How much time did/does [this sibling] spend with you.

Sibling Conflict

For each sibling, participants were asked four questions to measure sibling conflict on a 5-point scale where 0 indicated *not at all* and 4 indicated *extremely*. These questions included: How often did/do you fight with this person; how much did/do you resent this person; how strong is the competition between you; and how severe are arguments, if/when you have them. Conflict scores were calculated as the mean of the four questions. Possible scores ranged from 0 to 4 with higher scores indicating greater conflict with that sibling. Cronbach's alpha indicated there was good internal consistency for the sibling conflict scale ($\alpha=0.74$).

Sibling Closeness

For each sibling, participants were asked three questions to measure sibling closeness on a 5-point scale where 0 indicated *not at all* and 4 indicated *extremely*. These questions included: How well do you get along with this sibling; how much time do you spend talking with this sibling; and how close are the two of you. Closeness scores were calculated as the mean of the three questions. Possible scores ranged from 0 to 4 with higher scores indicating greater closeness with that sibling. Cronbach's alpha indicated there was good internal consistency for the sibling closeness scale ($\alpha=0.88$).

Procedure

Participants completed the survey in a quiet testing room. After giving informed consent, participants first responded to the demographic questions followed by the parental resemblance and investment questions, and lastly the sibling familial resemblance, conflict and closeness questions for

each sibling. All measures and procedures were approved by the Institutional Review Board of the second author's institution.

Results

The means (and standard deviations) of respondents' perceived parental investment (PI), resemblance to their parents, absolute age difference between siblings, sibling familial resemblance, time spent with the sibling, parental favoritism of the sibling over the respondent, and the sibling conflict and closeness scores appear in Table 1.

Predicting Sibling Conflict

A hierarchical linear regression analysis was conducted to test whether (i) same-sex siblings experienced greater conflict than opposite-sex siblings; (ii) sibling conflict increased with genetic relatedness; (iii) less conflict was experienced between siblings as their age difference increased; and (iv) other cues of relatedness and potential competition (i.e., perceived parental investment, familial resemblance, time spent with the sibling, and parental favoritism) explained additional variance in sibling conflict. To control for participant variables that may influence sibling relationships, participant variables were entered into the model before the relevant sibling variables. Participant variables entered in step 1 included respondent sex (coded as 0 = male, 1 = female), number of siblings, perceived PI from each parent, and perceived resemblance to each parent; and sibling variables entered in step 2 included sibling sex (coded as 0 = same

Table 1 Means (and standard deviations) of respondents' number of siblings, perceived parental investment (PI), resemblance to their parents, absolute age difference between siblings, sibling familial resemblance, time spent with the sibling, parental favoritism of the sibling over the respondent, and sibling conflict and closeness scores

Measure	<i>M</i>	<i>SD</i>
Number of siblings	2.58	1.50
Father PI	27.84	7.76
Mother PI	31.06	6.39
Father resemblance	4.80	2.83
Mother resemblance	6.14	3.15
Absolute age difference	4.73	3.30
Sibling father resemblance	1.93	1.29
Sibling mother resemblance	1.86	1.17
Sibling resemblance	1.93	1.27
Time spent with sibling	1.85	1.01
Parental favoritism of sibling	0.68	1.12
Sibling conflict	1.23	0.86
Sibling closeness	2.42	0.99

sex, 1 = opposite sex), percentage of genetic relatedness, sibling familial resemblance, time spent with the sibling, and parental favoritism of sibling over respondent. Results from this analysis are summarized in Table 2.

In step 1, the participant variables explained approximately 7.1% of the variance in sibling conflict, $F(6,991) = 12.58, p < 0.001$. Inspection of the standardized regression coefficients (β s) indicates the only variable that was not a significant unique predictor of sibling conflict was respondent sex. The main effect of number of siblings indicates conflict decreased as number of siblings increased. The main effects of father and mother PI indicate that sibling conflict increased as perceived PI decreased. The main effects of parental resemblance indicate that sibling conflict increased as perceived parental resemblance increased. In step 2, the sibling variables explained an additional 13.0% of the variance in sibling conflict, $F(8,983) = 20.00, p < 0.001$. Inspection of the standardized regression coefficients (β s) indicates the only variable that was not a significant unique predictor of sibling conflict was perceived sibling resemblance to their mother and that sibling father resemblance was marginal. The main effect of sibling sex indicates there was less conflict for opposite-sex siblings. The main effect of age difference indicates conflict decreased as the age difference increased. The main effect of genetic relatedness indicates conflict increased as the percentage of genetic relatedness increased. The marginal main effect of sibling father resemblance indicates conflict decreased as sibling father resemblance increased. The main effect of sibling resemblance to each other indicates conflict increased as sibling resemblance increased. The main effect of time spent with sibling indicates conflict decreased as time spent together increased. The main effect of parental favoritism

indicates that conflict increased as perceived parental favoritism of the sibling over the respondent increased. Overall, approximately 20% of the variance in sibling conflict was explained by the final regression model, $F(14,983) = 17.65, p < 0.001, R^2 = 0.201$.

Predicting Sibling Closeness

A separate hierarchical regression analysis was conducted to test whether (i) same-sex siblings experienced greater closeness than opposite-sex siblings; (ii) sibling closeness increased with genetic relatedness; (iii) less closeness was experienced between siblings as their age difference increased; and (iv) other cues of relatedness and potential competition (i.e., perceived parental investment, familial resemblance, time spent with the sibling, and parental favoritism) explained additional variance in sibling closeness. The variables were entered into the model following the same procedure described above (i.e., participant variables entered in step 1, and sibling variables entered in step 2). Results from this analysis are summarized in Table 3.

In step 1, the participant variables explained approximately 10.3% of the variance in sibling closeness, $F(6,991) = 18.94, p < 0.001$. Inspection of the standardized regression coefficients (β s) indicates the only variable that was not a significant unique predictor of sibling closeness was respondent sex. The main effect of number of siblings indicates closeness decreased as number of siblings increased. The main effects of father and mother PI indicate that closeness increased as perceived PI increased. The main effects of parental resemblance indicate that closeness increased as perceived resemblance increased. In step 2, the sibling variables explained an additional 50.2% of the

Table 2 Hierarchical linear regression analysis predicting sibling conflict as a function of respondent sex, number of siblings, perceived parental investment and resemblance, sibling sex, age difference, genetic relatedness, sibling familial resemblance, time spent with sibling, and parental favoritism of sibling

Step	Variable	<i>B</i>	<i>SE(B)</i>	β	ΔR^2
Step 1					.07 ($p < .001$)
	Respondent sex	.05	.06	.02 ($p = .47$)	
	Number of siblings	-.11	.02	-.20 ($p < .001$)	
	Father PI	-.10	.004	-.08 ($p = .01$)	
	Mother PI	-.02	.004	-.16 ($p < .001$)	
	Father resemblance	.03	.01	.11 ($p < .001$)	
	Mother resemblance	.02	.01	.07 ($p = .03$)	
Step 2					.13 ($p < .001$)
	Sibling sex	-.18	.05	-.10 ($p < .001$)	
	Age difference	-.06	.01	-.21 ($p < .001$)	
	Genetic relatedness	.78	.22	.12 ($p < .001$)	
	Sibling father resemblance	-.04	.02	-.06 ($p = .07$)	
	Sibling mother resemblance	-.01	.02	-.02 ($p = .64$)	
	Sibling resemblance	.04	.02	.07 ($p = .05$)	
	Time spent with sibling	-.08	.03	-.09 ($p = .004$)	
	Parental favoritism	.19	.02	.25 ($p < .001$)	

Table 3 Hierarchical linear regression analysis predicting sibling closeness as a function of respondent sex, number of siblings, perceived parental investment and resemblance, sibling sex, age difference, genetic relatedness, sibling familial resemblance, time spent with sibling, and parental favoritism of sibling

Step	Variable	<i>B</i>	SE(<i>B</i>)	β	ΔR^2
Step 1					.10 ($p < .001$)
	Respondent sex	-.07	.07	-.03 ($p = .33$)	
	Number of siblings	-.06	.02	-.08 ($p = .01$)	
	Father PI	.01	.004	.11 ($p < .001$)	
	Mother PI	.03	.01	.18 ($p < .001$)	
	Father resemblance	.03	.01	.09 ($p = .004$)	
	Mother resemblance	.03	.01	.08 ($p = .01$)	
Step 2					.50 ($p < .001$)
	Sibling sex	.05	.04	.03 ($p = .22$)	
	Age difference	.01	.01	.03 ($p = .22$)	
	Genetic relatedness	.24	.18	.03 ($p = .17$)	
	Sibling father resemblance	.02	.02	.03 ($p = .25$)	
	Sibling mother resemblance	.03	.02	.03 ($p = .18$)	
	Sibling resemblance	.05	.02	.06 ($p = .01$)	
	Time spent with sibling	.70	.02	.71 ($p < .001$)	
	Parental favoritism	-.01	.02	-.01 ($p = .54$)	

variance in sibling closeness, $F(8,983) = 156.03$, $p < 0.001$. Inspection of the standardized regression coefficients (β s) indicates the only two significant unique predictors of sibling closeness were sibling resemblance to each other and time spent with the sibling. The main effect of sibling resemblance indicates closeness increased as perceived sibling resemblance increased. The main effect of time spent with sibling indicates closeness increased as time spent together increased. Overall, approximately 60.5% of the variance in sibling closeness was explained by the final regression model, $F(14,983) = 107.43$, $p < 0.001$, $R^2 = 0.605$.

Discussion

Overall, predictions regarding sibling conflict were more frequently supported by the data. Sibling conflict increased in same-sex siblings (P1), siblings closer in age (P2), more genetically related siblings (P3), and where respondents reported greater parental favoritism (P7). Sibling conflict decreased with higher levels of parental investment (P6) and greater time spent with siblings (P5). Predictions regarding resemblance were mixed, but this could be due to a number of factors including type of resemblance (physical or behavioral), a self-serving bias in the respondent, or the relative ineffectiveness of the child's perceived resemblance on parental behavior. Predictions regarding sibling closeness proved far less reliable in this sample. While resemblance (P11), parental investment (P13), and time spent together (P12) increased closeness, sibling sex (P8), age differences (P9), genetic relatedness (P10), and parental favoritism (P14) showed no effects. Refer to Table 4 for a summary of the predictions and support (or lack thereof) for each.

Sibling Conflict

Similar to some previous studies on sibling relationships (Khan et al., 2020; Salmon & Hehman, 2015), men and women did not differ in their reports of sibling conflict. Contrary to our initial prediction, more siblings did not result in more conflict. However, sibling conflict increased as parental investment decreased (supporting prediction P6). One might expect that parental investment would decrease as the number of children increased, and therefore conflict would rise. But it is important to note that the majority of sibships in this study were between one and three siblings and the participants were from a college student population. As a result, we might assume that this number of siblings would be unlikely to create levels of resource shortage affecting parental investment in the relatively affluent US. Future studies could investigate this further by explicitly examining effects of sibship size in non-WEIRD (Western, Educated, Industrialized, Rich, Democratic) populations.

Consistent with Salmon and Hehman (2015, 2021) and as predicted (P1) same-sex siblings showed increased conflict compared to opposite-sex siblings. Same-sex siblings would more often prefer and compete for similar types of investment (similar belongings and types of parental interaction for example). The finding that birth spacing also affected conflict (that siblings who were born farther apart reported less conflict) is also in line with predictions (P2) and previous research (Salmon & Hehman, 2015, 2021). Siblings who are close in age, and therefore at similar developmental stages, may need or prefer the same types of investment and would be more likely to compete and clash.

Contrary to predictions (P4), we found that sibling conflict increased as perceived parental resemblance increased,

Table 4 Summary of a priori predictions, their corresponding descriptions, including whether each prediction was a conceptual replication (CR) and whether each prediction was supported

Predictions	Description	Supported
<i>P1</i>	Same-sex siblings will have more conflict than opposite-sex siblings (CR)	Supported
<i>P2</i>	Conflict will decrease as age difference increases (CR)	Supported
<i>P3</i>	Conflict will increase with increasing genetic relatedness (CR)	Supported
<i>P4</i>	Conflict will decrease as familial resemblance increases	Partially supported: Conflict increased as one's own paternal resemblance increased, but decreased as siblings' paternal resemblance increased. Not supported for maternal resemblance.
<i>P5</i>	Conflict will decrease as time spent with sibling increases (CR)	Supported
<i>P6</i>	Conflict will decrease as parental investment increases	Supported (for both paternal and maternal PI)
<i>P7</i>	Conflict will increase as parental favoritism increases	Supported
<i>P8</i>	Same-sex siblings will be more close than opposite-sex siblings (CR)	Not supported
<i>P9</i>	Closeness will decrease as age difference increases (CR)	Not supported
<i>P10</i>	Closeness will increase with increasing genetic relatedness (CR)	Not supported
<i>P11</i>	Closeness will increase as familial resemblance increases	Partially supported: Closeness increased as one's own parental resemblance and resemblance to sibling increased. Not supported for siblings' parental resemblance.
<i>P12</i>	Closeness will increase as time spent with sibling increases (CR)	Supported
<i>P13</i>	Closeness will increase as parental investment increases	Supported
<i>P14</i>	Closeness will decrease as parental favoritism increases	Not supported

but this is also nuanced; it has been shown that mothers (in computerized hypothetical scenarios) do not use child resemblance as a cue for parental investment (Platek et al., 2002) so we would not expect a large maternal effect here. The effect of maternal resemblance was small and far less than that of paternal resemblance (see Table 2). This would also explain why participant perceptions of their siblings' maternal resemblance did little to affect sibling conflict.

These data do show a larger effect of child perceived paternal resemblance on sibling conflict; sibling conflict increased as paternal resemblance increased. Research has consistently shown that paternal resemblance, as perceived by the father, does affect paternal favoritism and child treatment. Paternal perceptions of resemblance have been shown to affect how a man treats his partner and children (Burch & Gallup, 2000) and even how college age participants make investment choices in hypothetical children (Platek et al., 2002). There was also a marginal main effect of sibling father resemblance, such that sibling conflict decreased as sibling resemblance to father increased (supporting prediction P4). Further analysis and exploration of this is needed, as participants differed in their own resemblance to parents and this would impact both sibling resemblance and the effect of paternal resemblance on favoritism toward siblings. For example, if an individual does not resemble their father but their siblings do, these other siblings may obtain more care and resources, increasing sibling conflict. The current study also showed that sibling conflict increased as

perceived parental favoritism of the sibling over the respondent increased (supporting prediction P7). Future studies should examine the dynamics between relative resemblance, parental favoritism, and sibling conflict more closely.

It is also important to note that these findings are not as strong as those seen in previous literature on paternal resemblance, but this study measured perceptions of resemblance on the part of the child in the family, while other studies (like Burch & Gallup, 2000) investigated paternal perceptions. The child's opinion on how much they themselves resemble their parents would be less likely to change their parent's behavior than the parent's own perceptions. Studies have found, for example, that maternal friends and family attempt to make social ascriptions of paternal resemblance to persuade men to invest in their children and that men are skeptical and reluctant to shift their opinions (Daly & Wilson, 1982; Regalski & Gaulin, 1993; Alvergne et al., 2007). Clearly, the father's perception of resemblance has the greatest impact on child treatment, but we see here that children in the family may also be sensitive to resemblance and this can affect sibling dynamics.

Sibling conflict increased as both resemblance (counter to prediction P4) and genetic relatedness (supporting prediction P3) increased. While this seems counter-intuitive given the literature on resemblance and trust and cooperation (Debruine, 2002, 2004, 2005) and the literature on sibling conflict (Salmon & Hehman, 2021), it is possible that greater relatedness and resemblance heightened competition for parental resources and favor. We do see that conflict increased

as parental investment decreased and parental favoritism toward the sibling increased. These other factors may account for the variation found in the literature. Salmon and Hehman (2015) found that controlling for duration of co-residence, respondents experienced the greatest intensity of conflict with non-biological siblings, followed by their full siblings, and the least amount of conflict with their half siblings. Salmon and Hehman (2021) found that while degree of relatedness did not have a singular effect on the intensity of sibling conflict, conflict significantly increased for half siblings, the longer the duration of co-residence, and conflict between full siblings was not influenced by duration of co-residence. Clearly sibling relationships are not as simple or singularly dependent on relatedness as computerized cooperation studies (Debruine, 2005); these relationships are both intensely competitive and cooperative and are dependent on parental relationships, resources, resemblance, and residence.

We also see, as predicted (P5), that as the amount of time spent with a sibling increased, conflict decreased. Taken together, higher competition (same sex, similar ages, resemblance, and relatedness) for low parental resources (low parental investment, parental favor for other siblings) results in greater sibling conflict. Spending time together, particularly in noncompetitive contexts or in caregiving may be associated with reduced levels of sibling conflict.

Sibling Closeness

Just as respondent sex had no impact on sibling conflict, it also had no impact on sibling closeness. Surprisingly, sibling sex had no impact on sibling closeness (P8), nor did the age difference between siblings (P9). Just as the number of siblings decreased sibling conflict, it also decreased closeness. Families with large numbers of children had both lower sibling conflict and closeness. Sibling closeness also increased as time spent together increased and as perceived maternal and paternal investment increased, supporting predictions (P12; P13). This again supports the idea that parental favoritism may be playing a large role in sibling relationships. Furthermore, this is consistent with Danielsbacka and Tanskanen (2015) which found unequal parental treatment impairs full as well as half sibling relationships in adulthood. Results of the current study found that respondents with less parental investment felt less close and had more conflict with their siblings; however, if they had a higher number of siblings, they reported less closeness and less conflict. It appears that if the low parental investment was in part due to more children, those children may have a better understanding that parental resources are limited, reducing the likelihood of parental favoritism and reducing conflict. It is also possible that the increase in siblings caring for one another both compensates for lower parental investment and causes the siblings to spend more time together.

Genetic relatedness did not affect sibling closeness (contrary to prediction P10) even though it did influence sibling conflict. This is inconsistent with results of Tanskanen and colleagues (2021) who found full siblings reported more emotional closeness than half siblings. In the current study, sibling closeness, just as sibling conflict, increased as perceived parental and sibling resemblance increased, supporting predictions (P11). Once again (as with conflict), maternal resemblance had less of an effect than paternal resemblance. As all of these findings are synthesized, it becomes clear that sibling conflict and closeness are not polar opposites (a common misperception among the general population); siblings can be both close and intensely competitive or conflicting, and familial factors (like parental resemblance or number of children) can contribute to both. Comparison of these findings to previous research also suggests that closeness and cooperation are not the same thing. Bressan and colleagues (2009) found in their scenario study that when altruistic behavior is costly, the strongest predictor of altruism was co-residence duration. Interestingly, emotional closeness was only predictive of costly altruism among step siblings; it was not significant when siblings were genetically related (Bressan et al., 2009). Overall, predictions in the current study regarding sibling conflict were more frequently supported by the data than those regarding sibling closeness. This implies that different factors are playing a role in sibling closeness. Perhaps conflict relies on competition for resources and relatedness, while closeness relies more on psychological or personality variables, such as similarity, likability, or behavioral strategies. These differences should be examined in future research on sibling closeness and conflict.

Limitations and Future Directions

As with any study on childhood experiences using adult populations, memories may be inaccurate (Burch & Gallup, 2000). Attributions of resemblance may also be inaccurate or biased (Gallup et al., 2016). For example, Gallup et al. (2016) found psychological or behavioral similarities greatly affected parent/child relationships. This type of resemblance was not measured here and (to our knowledge) has not been studied in sibling relationships. In addition, this was a focal sibling self-report study. Future explorations should consider within-family studies, including parents and/or siblings. The current study also shares the limitation of relatively few step or adopted participants that previous studies have reported (Salmon & Hehman, 2015, 2021; Steinbach & Hank, 2018; Szynger et al., 2016; Tanskanen et al., 2016). Actively recruiting step and adopted children would be helpful to elucidating the impact of relatedness and resemblance. As indicated previously in the discussion, additional research comparing populations from societies with different social

and economic conditions is necessary, particularly in assessing the role of parental investment in shaping sibling relationships. While the sample of US college students used in the current study is not dissimilar to some previous samples (Bressan et al., 2009; Salmon & Hehman, 2015, 2021), some studies have also been conducted in other countries using national samples with a wider age range (e.g., Danielsbacka & Tanskanen, 2015; Tanskanen et al., 2021). The majority of this sibling research, however, has largely been conducted in WEIRD societies. Therefore, more research on sibling relationships in non-WEIRD societies is necessary. Additional incorporation of measures of perinatal sibling exposure could also add to our understanding of perceived cues of relatedness (Szyner et al., 2016; Tanskanen et al., 2021) as well as obtaining information for half siblings on whether they share a biological mother or father (Danielsbacka & Tanskanen, 2015; Gyuris et al., 2020). It is important to note that one challenge of comparing findings across different studies in this area can be the different measures by which certain variables are operationalized (i.e., parental investment and cooperation/closeness).

Conclusions

This study provided a conceptual replication of several factors that shape sibling relationships (Salmon & Hehman, 2015, 2021) and went beyond those studies by examining additional factors and explaining additional variance in sibling relationships. The results suggest that while sibling conflict and closeness are intricately entwined, they are not simply at opposite ends of a single spectrum. Siblings can be both close and competitive. Contributing to the existing literature, most of the variance in closeness to sibling was explained by time spent with and their perceived resemblance to the sibling, and not genetic relatedness. Whereas with conflict, the largest predictors were genetic relatedness, perceived parental favoritism of the sibling, and whether the sibling was same or opposite sex. While similar to the previous findings of Danielsbacka and Tanskanen (2015) and Tanskanen et al. (2021) on emotional closeness, the current results for closeness differ in predictive factors from previous findings on cooperation between siblings (Salmon & Hehman, 2021) which had indicated a strong role for genetic relatedness. This suggests that emotional closeness and cooperation are not directly tracking each other. It may be that closeness is shaped more by time spent together and sibling resemblance as ancestral cues of kinship, while cooperation and conflict are more strongly influenced by relatedness and parental investment inequities or favoritism.

Author Contribution All authors contributed to the study conception and design. Material preparation and data collection were performed by Rebecca L. Burch. Data analysis was performed by Jessica A. Hehman. All authors contributed to the writing of the manuscript and approved the final manuscript.

Declarations

Ethics Approval All measures and procedures were approved by the Institutional Review Board of the second author's institution.

Consent to Participate Informed consent was obtained from all participants in the study.

Consent for Publication All authors have consented to be listed on this publication.

Conflict of Interest The authors declare no competing interests.

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