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Original Article

Do parents favor their adoptive or biological children? Predictions from kin selection and compensatory models

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ABSTRACT

Evolutionary reasoning (Kin Selection Theory) predicts less favorable behaviors directed by parents toward their unrelated children, relative to their biologically related children. By extension, it may be argued that parents should also have less favorable perceptions of the intellectual, personality and other behavioral traits of unrelated children, compared with biologically related children. However, recent work has modified this expectation, given the distinction between unrelated adopted children (who are acquired intentionally) and unrelated stepchildren (who are acquired via mating effort). The compensatory model takes into account evolved desires for parenting and the evolutionarily novel availability of unrelated children. It predicts that adopted children may be viewed as favorably, or even more favorably, than biological children due to parents' compensation for the perceived challenges and stigma linked to their exceptional family structure. In the present study, IQ, Adjective Checklist and Child Behavior Checklist scale scores were available for 135 virtual twin pairs (same-age unrelated siblings raised together). Virtual twins included 41 adopted–biological pairs and 94 adopted–adopted pairs, with a mean age of 6.14 years (SD = 3.51). These unique data allowed tests of hypotheses and predictions concerning parenting perceptions, given the matched age and placement of the biological and adoptive siblings. Consistent with prior research, the IQ scores of the biological children exceeded those of the adopted children, both between and within pairs. A between-pair analysis revealed no difference between biological children and members of adopted–adopted pairs in ratings of favorable or unfavorable traits. However, more telling within-family comparisons of adopted–biological pairs revealed higher scores for adoptees on unfavorable traits, consistent with Kin Selection Theory, but no differences between adoptive and biological children on favorable traits, consistent with the compensatory model. These findings refine our understanding of parenting genetically related and unrelated offspring.

According to Kin Selection Theory (Hamilton, 1964), people have evolved to preferentially treat and impart resources onto their own offspring and relatives because such individuals share genetic material and are, thus, pathways for the transmission of genes related to altruism (Alexander, 1979; Daly & Wilson, 1995). This perspective is readily apparent in the way that people treat their own offspring versus biologically unrelated stepchildren: compared with children who reside with their biologically-related parents, stepchildren have been found to be 40 times more likely to be physically abused (Daly & Wilson, 1985) and up to 100 times more likely to be killed by their stepparents (Daly & Wilson, 2009). Stepchildren are genetically unrelated and acquired unintentionally through mating effort and as such, may receive less care and may be subject to greater rates of exploitation and harm (Daly & Wilson, 1988).

But what about cases of adoption in which genetically unrelated children are acquired *intentionally*? In traditional societies, adopters are often childless or older couples who take on the children of relatives who cannot effectively raise them (e.g., Silk, 1980). Such transactions fit within a kin-selection framework, given that these parents are investing resources in children with whom they share common genes (albeit less than the percentage they share with their own offspring), thereby indirectly enhancing their own biological fitness. As such, we would expect adopted children in traditional societies to fare better than unrelated stepchildren. In fact, adoption (i.e., movement of children within families and communities) occurs with relative ease among Polynesians and other relatively inbred island populations (Freedman, 1979) and some extended families (Hartman & Laird, 1990). In modern times, in which private domestic adoption, foster care and international adoption in the United States recently involved a total of 246,694 children (Bureau of Consular Affairs, 2014), adopters also tend to be childless or older (Ashe, 2015; Bamberger, 2013). However, a key difference is that people currently have many more options for acquiring *unrelated*

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children, including those of strangers who often are of a different ethnicity and live on the opposite side of the globe. Indeed, 59% of recently adopted children were biologically unrelated to their adopters. In such evolutionarily novel circumstances, how are adoptees treated by their adopting parents?

On one hand, according to a "Compensation" model (Hamilton, Cheng, & Powell, 2007), modern day adopters are especially motivated to be parents and, when taking on unrelated children, may compensate in their attitudes, cognitions, and behaviors for any natural inclinations to favor biological children. From an evolutionary perspective, adoption of children that are both genetically and socially unrelated to oneself likely involves a misfiring of evolved mechanisms promoting a desire for offspring, whereby in evolutionarily novel conditions there is a relatively large supply of unrelated children. Likewise, a motivation to compensate for biological favoritism may be a byproduct of the high parental motivation behind adoptive parenting. Furthermore, in an increasingly multi-ethnic and peaceful modern society, mechanisms for altruism and fairness, as well as for projecting social norm adherence, may be extending beyond one's own kin and ingroup members to include unrelated children.

However, evolved psychological mechanisms for enhancing inclusive fitness (Hamilton, 1964) through parenting may be unable to fully encompass the evolutionary novelty and fitness-reducing altruism of caring for children who are biologically and socially unrelated. That is, despite adopters having an initially strong desire to parent and any intentions of fairness, factors such as a lack of visual cues to genetic similarity (e.g., facial or bodily resemblance) and a lack of connections between the offspring and adopter's family members may contribute to lower levels of parental bonding and lead to less favorable attitudes toward, and treatment of, adoptees.

In this paper, we test the two alternative views by examining whether siblings of unique "virtual twin" pairs – where one child is biologically related to the parents, but the other, very close in age, is not – differ on a variety of key traits both objectively and as perceived by their parents. Thus, our investigation examines positive or negative bias in perceptions toward adoptees, and provides a window into whether parental motivation can induce individuals to supplant evolved psychological (kin-selection) mechanisms promoting investment in genetically related offspring. More broadly, the question is important as, increasingly, humans are living in conditions under which there is a mismatch between their evolved mechanisms and the evolutionary novelty of the current environment (e.g., Colarelli & Arvey, 2014; Hagen & Hammerstein, 2006; Kanazawa, 2004). In this rapidly changing context, it is increasingly important to identify key evolutionarily novel inputs and to understand the impact they have on relevant evolved psychologies.

1. Theoretical approaches

1.1. Kin Selection Theory

Evolutionary reasoning predicts less favorable treatment of unrelated children, relative to biological children. These expectations derive from Hamilton's (1964) Kin Selection Theory, namely that altruistic interactions between individuals should vary with their genetic relatedness. Hamilton asserted that behaviors incurring cost to the self (e.g., altruism) could evolve if such costs were outweighed by the benefit, multiplied by the coefficient of relatedness. He reasoned that natural selection should favor alleles predisposing individuals to behave in ways favoring transmission of those alleles. Alleles prompting individuals to behave altruistically toward others likely to carry copies of those alleles would allow indirect transmission of one's genes, enhancing inclusive fitness. A sizeable body of research supports increased cooperation and altruism with increasing genetic relatedness (Kurland & Gaulin, 2005; Neyer & Lang, 2003).

In particular, research shows that parents are more likely to protect and/or invest resources in biological than non-biological children. The higher rate of murder, abuse and neglect of stepchildren relative to biological children, has been partly explained by possible threats to the resources of stepparents' genetic children (Daly & Wilson, 1980; Wilson, Daly, & Daniele, 1995). Even in the absence of other genetic children in the home, stepparents may be unmotivated to provide optimal child care, given their acquisition of these children as a by-product of mating with individuals who are already parents. Investment in children with whom genes are not shared by descent does not enhance inclusive fitness, and reduces resources available to current and/or future biological children.

However, the notion that stepparenting might assist in mate acquisition is supported by a study of Israeli students embarking upon the "Great Journey" (i.e., a trip to Latin America or Asia by young adults upon completion of military service) (Tifferet, Jorey, & Nasanovitz, 2010). Individuals raised by stepfathers received greater financial support for the trip than individuals raised by stepmothers. Family income was not a significant predictor in the analysis. This suggests that males are more motivated than females to assist unrelated children to secure and maintain access to mates; also see Anderson, Kaplan, and Lancaster (1999). Thus, stepfathers may use parental investment as a mating strategy.

A similar picture emerges from studies of resource provision and family inheritance. In a review of research conducted in Oceania, Silk (1980) found that families raising both biological and adopted children apportioned their land so as to favor biological children. Case, Lin, and McLanahan (2000) found that American families with biological children spent 5% more on food than did families with non-biological children (adoptive, step and foster children). This pattern was also observed in South Africa where mothers raising biological children spent relatively more money on healthy foods and relatively less money on alcohol and cigarettes than mothers raising non-biological children (Case et al., 2000). These findings remained constant after controlling for number of children in the family. In this study, adoptees were disadvantaged to the same extent as other non-biological children. Unfortunately, comparison of food and other resources directed toward biological and non-biological children *within* the same family was generally not undertaken in the research reviewed above.

The foregoing themes were repeated in a study of relatedness and family investment among black South African children (Anderson, 2005). Data from a large nationally representative sample showed that the genetic relatedness of a "focal child" to household members positively predicted expenditures for food, health care and clothing; however, the first two findings held only for urban families, not for rural families. Possible explanations, such as reduced food and health care expenses available to rural families, were suggested. Again, a between-family, rather than a within-family, approach was taken.

Even when child care is provided by individuals outside the nuclear family, closely related kin tend to be more highly involved than less closely related kin. A review of forty-five cultures found that the presence of at least one care-taking non-parental relative was beneficial to child survival, and that maternal grandmothers and elder siblings contributed positively in this regard (Sear & Mace, 2008). Among the Efe foragers of the Democratic Republic of the Congo, kin are more than twice as likely to engage in alloparenting, whereas siblings and fathers are more than seventeen times more likely to do so than non-kin (Ivey, 2000).

In summary, research has generally found the parental favoring of biological over non-biological children, and more closely-related over less closely-related children. However, studies comparing the psychological attributes of parents and children in alternative family structures suggest that other factors may affect, and even overturn, the balance of resource provisioning, parenting experiences and child outcomes.

1.2. Alternative family structures reconceptualized

Recent research has laid a basis for reconceptualizing parental care and investment in unrelated children. This approach derives from the fundamental distinction between the rearing of adopted children and stepchildren. Stepchildren are acquired non-purposefully, and possibly unwillingly, such that their care is motivated via mating effort. That is, a person may care for a partner's previous children to the extent that it helps establish or maintain romantic relations with that partner. In contrast, adopted children are acquired purposefully and voluntarily, such that their care is motivated via parenting effort (Gibson, 2009). To the extent that this motivation is strong, the usual differential preference toward raising biological versus adopted children may lessen.

Support for a parental motivation model comes from families created intentionally via assisted reproductive technologies (ART), which are costly in time and money. In vitro fertilization (IVF), in which children are related to both parents, is the most common form of ART (Centers for Disease Control and Prevention, 2010). However, some ART children are related to only one parent (donor insemination) or to neither parent (embryo donation). Golombok, Cook, Bish, and Murray (1995) found higher levels of maternal warmth, parental interaction, and mothers' emotional involvement with children conceived via ART (IVF and donor insemination combined), relative to children conceived naturally. Adoptive parents did not differ significantly in this regard from donor insemination parents, but showed less maternal warmth than mothers conceiving by IVF. Interestingly, adoptive mothers and fathers were very similar in parenting quality (e.g., emotional involvement and quality of interaction) to mothers and fathers who conceived via ART, whose scores significantly exceeded those of parents conceiving naturally. (Direct comparisons between adoptive families and naturally conceiving families were not made.) It was also found that parenting stress scores were significantly higher for parents conceiving naturally than for parents acquiring children through ART or adoption. Children from these different families did not differ in behavioral outcomes or in the quality of parental relationships (Golombok et al., 1995). Thus, children raised by non-biological parents are not necessarily disadvantaged, or disadvantaged in all respects, relative to children raised by biological parents.

Subsequent research in this area has generally confirmed these findings (Golombok, MacCallum, & Goodman, 2001; van Balen, 1996). One exception was that IVF parents expressed greater warmth toward their children than did adoptive parents. Another was that children (adoptive and IVF combined) indicated less "reasoning" (e.g., discussion of issues) between themselves and their parents than did biological children (Golombok et al., 2001). Nevertheless, given the emotional and financial demands of ART, individuals who become parents through such means may have high parenting motivations.

Children conceived via embryo donation, in which the child is unrelated to both parents, but gestated by the mother, were not included in the forgoing studies. A recent analysis of 21 families found no differences in parenting quality between these parents and parents with IVF children, indicating that genetic relatedness is not a prerequisite for good parent-child relations (MacCallum, Golombok, & Brinsden, 2007). Parental efforts and commitment to having a family may explain this finding in the absence of genetic relatedness. It was also found that embryo donation parents did not show more positive parenting than adoptive parents, despite mothers' prenatal attachment to the child. However, it was suggested that the higher levels of emotional overinvolvement by embryo donation parents could reflect bonds developed during the pregnancy and/or the reductive procedures enabling the pregnancy.

1.2.1. Family Structures Theory

A comparison of parenting expectations from social and biological perspectives was presented by Hamilton et al. (2007). Family Structures Theory predicts less effective parenting and poorer child outcomes in families from alternative family arrangements (e.g., step and single parent families), due to lowered levels of parental investment. However, using data from the Early Childhood Longitudinal Study, Hamilton et al. (2007) detected an "adoptive advantage" in adoptive families over other family structures, associated with greater school involvement and resource allocation. Specifically, they reasoned that this benefit is partly due to adoptive families' higher income and educational levels, relative to those of biological families. After controlling for socioeconomic differences, adoptive families resembled biological families in level of child investment as compared with other non-traditional families. However, adoptive parents still showed higher levels of child investment than biological parents in some joint activities, such as playing games and building things.

1.2.2. Compensation Theory

Hamilton et al.'s (2007) proposed Compensation Theory suggested that parents of adoptees overcompensate in their rearing, due to their awareness of the lack of biological connectedness to their children and the social stigma posed by their family circumstances. Interestingly, MacCallum et al. (2007) found that embryo donation parents responded more defensively than IVF or adoptive parents when questioned about their child and family life. Also recall that embryo donation parents showed higher levels of overinvolvement in some parenting aspects than did the other mothers and fathers.

Hamilton et al. (2007) also referenced evolutionary theory, asserting that evolved psychological mechanisms that give rise to the desire for children may (perhaps incidentally) facilitate adoption and parenting processes. We speculate that evolved parenting mechanisms that remain unchanged for extended periods of time may affect cognitive processes, as well as general desires to engage such mechanisms. In some cases such desires may lead to adoption where it is an option. Increased efforts to acquire children may also lead to increased levels of parental investment and commitment (at a proximal level), possibly in attempts to overcome feelings of self-doubt about the parenting role (Hamilton et al., 2007). In our view, these dynamics likely reflect an evolutionary mismatch in which mechanisms related to desiring children and social norm adherence are operating in, and calibrating to, evolutionarily novel environments in which unrelated children are increasingly available for adoption and society and its norms are increasingly multi-ethnic and global, respectively.

Interestingly, Priel, Melamed-Hass, Besser, and Kantor (2000) found that adoptive parents expressed more positive views of their children than biological mothers, even though adoptive mothers recognized their children's more frequent behavioral problems. Kim, Shin, and Carey (1998) found that Korean-American adoptees did not display more problem behaviors than did the biological children from these families. However, the Kim et al. (1998) findings were presented as between-family, rather than within-family, comparisons and were based on a small sample.

1.2.3. Biological and adoptive children raised together

Relatively few studies have compared parenting qualities and child outcomes in families raising biological *and* adoptive children simultaneously. In the absence of such studies in which spousal relations, financial income and other family factors are constant across children, conclusions about parenting preferences and child outcomes are difficult to draw. An exception is a study by Gibson (2009) who found that parents invested more in adoptees' than in biological children's educational and personal areas. (The age difference between siblings in these families was not provided.) It was suggested that differential parental solicitude, rather than parental favoritism, might have been prompted by adoptive children's greater needs. Supporting this interpretation, the biological children in these families showed more positive life history outcomes, e.g., more years of education and better mental health.

Other research supports the view that biological children show more favorable developmental outcomes than adoptive children. Studies have reported lower IQ scores and higher problem behaviors among adoptees than among biological children (Cardon, 1994; Dumaret & Stewart, 1985; Sharma, McGue, & Benson, 1998), although most apply between-group comparisons. The only study to report IQ data on age-matched biological and adopted children raised together (virtual twins) found that biological children's IQ scores significantly exceeded those of their adopted siblings (Segal, McGuire, Graham, & Hoven Stohs, 2012a). Adoptees' higher frequency of behavioral problems may be explained by their feelings of rejection and/or lack of similarity to their rearing parents. Adoptees' heterogeneous biological backgrounds (e.g., having parents with tendencies toward hyperactivity or sexual impulsivity) may also contribute to their poorer outcomes.

Another within-family analysis reported less warm supportive communication between parents and their adopted adolescent children, compared with these same parents and their biological adolescent children (Rueter, Keyes, Iacono, & McGue, 2009). This study also found greater conflict between mothers and adoptees than between these same mothers and their biological children. A recent within-family study analyzed children's reports of parental care and emotional closeness, as a function of children's genetic relatedness to their rearing parents (Schnettler & Steinbach, 2011). Biological children reported more positive assessments than non-biological children even after controlling for parental education, length of co-residence and other measures. The age difference between siblings was not considered although presumably correlated with co-residence.

In summary, some parents may favor their adoptive children despite problems more commonly associated with adoptees than biological children. The relative dearth of within-family studies of biological and adoptive children has limited understanding of important parenting perceptions and processes.

1.3. Present study

The primary goal of the present study was to examine predictions regarding parents' relative perceptions and judgments of adopted versus biological children. Although behaviors – specifically, those pertaining to the differential allocation of resources – may be most directly relevant in an investigation regarding kin selection, there is much reason to study parents' child perceptions, especially parents raising both biological and non-biological children. In particular, a host of research suggests that behaviors are not only linked to perceptions, but are caused by them (Bargh, Chen, & Burrows, 1996; Dijksterhuis & van Knippenberg, 1998). For example, Frome & Eccles (1998) found that parents' perceptions mediated the association between children's grades, as well as children's self and task perceptions in English and math. Parents' perceptions were more strongly linked to children's perceptions than their grades. Indeed, research on the classic paradigm of cognitive dissonance (Festinger, 1957) suggests that humans are designed to have a high level of consistency between their attitudes and behaviors.

Predictions were generated by Kin Selection Theory (which, at base, predicts parental favoritism toward biological over unrelated adopted children), and by Compensation Theory (which follows from a mismatch view, suggesting that the relevant mechanisms are misfiring due to evolutionary novelty, and predicts increased parental efforts toward the quality care of unrelated children).[2] This goal was addressed using data gathered on the members of rare, twin-like siblings, i.e., virtual twins (VTs). VTs are same-age unrelated siblings raised together since birth who uniquely replicate twinship, but lack a genetic link. As such, these sibships provide a pure estimate of shared environmental influence on behavioral variation (Segal, 2010, 2012). Given that the pair members are the same age and share residential histories, family factors (e.g., variations in income or neighborhood quality) that might variously impact individuals differing in age and/or time of entry into the family are eliminated.

VTs are commonly composed of one biological child and one adoptee (VT–AB) or two adoptees (VT–AA). Couples unable to conceive may seek fertility treatments and/or adoption to have children. It sometimes happens that the birth of a child conceived via ART coincides with the availability of a child relinquished for adoption. This co-occurrence explains the creation of near-in-age biological-adoptive pairs in which the biological child is related to both parents, and the adoptee is unrelated to both parents and to the sibling. Alternatively, some couples for whom fertility treatments are unsuccessful, or who do not seek such assistance, are offered two children for adoption. In this case, neither child is related to the parents or to each other. Several unusual virtual twin pairs include those produced by the adoption of one child and the conception of a biological child using the father's sperm and an unrelated surrogate; and the adoption of one child and gestation by the adoptive mother of an unrelated donated embryo.

1.3.1. Hypotheses and predictions

It is conceivable that parents raising both biological and adopted children minimize qualitative behavioral contrasts between them. This could occur despite their children's actual behavioral differences, with biological children being somewhat favored. This minimization might reflect efforts at fair attitudes toward, and treatment of, their children. Another possibility is that parents make relative judgments of biological and adoptive children that are domain-specific. That is, parents may downplay differences in some areas, such as children's favorable traits. In contrast, parents may acknowledge, or emphasize, biological and adopted children's differential displays of problem behaviors, which tend to be more common among adoptees (Brodzinsky & Pinderhughes, 2013).

Consistent with a self-serving bias, parents may credit themselves for their children's positive personal qualities, but attribute their children's negative qualities to unknown events or events beyond their control. If so, parents of both adoptive and biological children might emphasize both children's favorable traits, which they feel they have nurtured. At the same time, parents might acknowledge adopted children's unfavorable traits that they may attribute to the child's biological background, and for which they do not hold themselves responsible. Of course, biological children also present negative traits, but parents may downplay them if such traits challenge their self-perceived value as parents. Research shows that higher status parents compensate for the differences, while lower status parents reinforce them, via differences in parental investment (see Schnettler & Steinbach, 2011). These possibilities, regarding how the positive and negative traits of biological versus adoptive children are viewed, are currently untested in families with both adoptive and biological children; however, most parents who adopt are well educated and financially secure.

Biological children are expected to be favored generally, although preferential investment in adoptive children could be prudent in some circumstances, e.g., poor health of a biological child who may be unlikely to contribute to the family's welfare. These possibilities suggest the social mediation of evolutionary contributions to family dynamics, as discussed by Hamilton et al. (2007).

Virtual twins offer an especially effective means for assessing these possibilities. The present study used a virtual twin design to evaluate hypotheses generated by Kin Selection Theory and Compensation Theory. Part I analyses were conducted at the individual level (all adoptive vs. biological children without reference to pair membership). The aim was to use structural equation modeling (SEM) to develop a model that would test hypotheses generated by these theories. Part II assessed hypotheses comparing adoptive and biological children *between* families (adopted children in VT–AA pairs vs. only biological children in VT–AB pairs). Part III used paired comparisons to assess the behaviors of adoptive vs. biological children *within* VT–AB pairs. These hypotheses are summarized below.

Part I Individual analyses (all adoptees vs. all biological children)

Evolutionary (Kin Selection) Theory:

- Parents will endorse a higher number of favorable behavioral traits for biological children than for adoptive children.
- Parents will endorse a higher number of unfavorable behavioral traits for adoptive children than for biological children.

Compensation Theory:

[2] Predictions from Kin Selection Theory are applied at face value.

- Parents will endorse an equal or higher number of favorable behavioral traits for adoptive children than for biological children.
- Parents will endorse an equal or higher number of unfavorable behavioral traits for biological children than for adoptive children.

Part II Between family analyses (biological children in VT–AB pairs vs. all adoptees in VT–AA pairs)

Evolutionary (Kin Selection) Theory:

- Parents will endorse a higher number of favorable behavioral traits for the biological members of VT–AB pairs than for adoptees in VT–AA pairs.
- Parents will endorse a lower number of unfavorable behavioral traits for biological members of VT–AB pairs than for adoptees in VT–AA pairs.

Compensation Theory:

- Biological children in VT–AB pairs will be rated lower than or equal to adoptees in VT–AA pairs in favorable traits.
- Biological children in VT–AB pairs will be rated higher than or equal to adoptees VT–AA in unfavorable traits.

Part III Within pair analyses (adoptees vs. biological siblings within VT–AB families)

Evolutionary (Kin Selection) Theory:

- Parents will endorse a higher number of favorable behavioral traits for biological versus adoptive children.
- Parents will endorse a lower number of unfavorable behavioral traits for biological versus adoptive children.

Compensation Theory:

- Adoptive children in VT–AB pairs will be rated higher than or equal to their biological siblings in favorable traits.
- Adoptive children will be rated lower than or equal to their biological co-siblings in unfavorable traits.

2. Materials and methods

2.1. Fullerton virtual twin study

Participating families were enrolled in the Fullerton Virtual Twin Study (FVTS). The FVTS, ongoing since 1991, gathers behavioral, physical and health-related data on virtual twins and their families.

Four strict criteria decided if a given sibling set qualified as a virtual twin pair for the study. These criteria were generated with a view toward replicating ordinary twinship as closely as possible.

1. Both children must be in the home by one year of age. This rule is based on the knowledge that parents tend to bond more closely with newborns and young infants than with older children. In addition, some ordinary twins spend time apart during the first year of life due to medical problems or other events.
2. The age difference between siblings must not exceed nine months. Most school grades include children born between September of one year and June of the following year, a span of approximately nine months; see below.
3. School-age siblings must be in the same school grade. Virtual twins may be in different classes or attend different schools, but must be in the same grade at the time of testing. This requirement preserves the twin-like nature of the relationship.
4. Both siblings must be free of adverse birth events that might affect behavior. Children exposed prenatally to drugs or alcohol, or who display significant behavioral problems (e.g., autism; selective mutism) are excluded from the study. When birth events are unknown, careful questioning of mothers to assess children's early behaviors is conducted.

Table 1
Age, age differences and gender composition of virtual twin pairs.

Pair type, *N* (pairs)	*N* (ind)	Age in years[a] (SD)[b]	Age difference in months[c] (SD)[d]	Gender[c]		
				MM	FF	MF
VT–AA (94)	186			25	23	46
Mean (SD)		5.98 (2.51)	2.06 (2.10)			
Range		3.88–22.72	0.00–8.93			
VT–AB (41)	76			12	10	19
Mean (SD)		6.52 (5.20)	4.91 (2.66)			
Range		4.01–35.08	0.03–9.23			
Total (135)	262			37	33	65
Mean (SD)		6.14 (3.51)	2.92 (2.63)			
Range		3.88–35.08	0.00–9.23			

[a] Ages based on individual data since four participants are in two pairs each and two participants are in three pairs each.
[b] $F = 9.14, p < .01$.
[c] Pair data.
[d] $F = 4.08, p < .05, t(62.70) = -6.10, p < .001$.

2.2. Participants

The current sample included 135 virtual twin pairs, organized into 41 adopted–biological pairs and 94 adopted–adopted pairs. Families with VTs were identified via publicity about the study (54.8%), personal referrals (30.4%) and other sources, such as the media (14.8%). The mean age of the sample was 6.14 years (SD = 3.51, range = 3.88–35.08), and the mean age difference between the pair members was 2.92 months (SD = 2.63, 0.00–9.23). Age did not differ between the two VT groups, although the age difference between VT–AB pair members significantly exceeded the age difference between VT–AA pair members. This may be associated, in part, with the fact that parents of VT–AB pairs often conceive their biological child via ART, thereby extending the time interval between the arrival of both children. The age, mean age difference and gender for the two types of pairs are displayed in Table 1.

The majority of families (93%) were two-parent households. Eight VT–AA pairs were raised by single mothers and one VT–AB pair was raised by a widow.[3] The mean ages of the mothers and fathers were 42.61 (SD = 5.93) and 44.31 (SD = 6.94), respectively. Approximately 60% of the mothers and 86% of the fathers held professional, technical or managerial positions. Increased age and financial security are characteristic of couples that delay the childbearing years and choose to adopt (Bamberger, 2013). Other demographic information about the sample is available in Segal, McGuire, and Hoven Stohs (2012b)

2.3. Tests and inventories

Children completed the age-appropriate version of the Wechsler Intelligence Scale and a brief social relationship survey. With only a few exceptions, these instruments were administered to pair members at the same time by different examiners to avoid biased findings. Parents (mostly mothers) completed demographic data forms, personality questionnaires, interest inventories and other measures for each of their children, and returned them by mail. Among the protocols were the Adjective Checklist (Gough & Heilbrun, 1983) and Child Behavior Checklist (Achenbach, 2009).

The Adjective Checklist (ACL) includes 300 adjectives that respondents endorse to describe either themselves or another individual. Parents of VTs described their children using this form. (Older participants additionally describe themselves, but given the aims of the present study only parent reports were utilized.) The separate ACL items are organized into five assessment scales: General Approach (e.g., Favorable,

[3] Families were counted just once even though several children (e.g., adoptees with unrelated twin siblings) were members of more than one VT pair. One family that provided two VT pairs at different times was counted twice because the parents were different ages at the time of participation.

Unfavorable), Need Scales (e.g., Order, Aggression), Topical Scales (e.g., Self-Control, Self-Confidence), Transactional Analysis (Free Child, Adapted Child) and Origence–Intellectence (e.g., High Origence–Low Intellectence, Low Origence–High Intellectence).

The Child Behavior Checklist (CBCL) is a parent report form that obtains ratings of children's behavioral and emotional problems. Versions appropriate to children 1.5 to 5 years of age and 6 to 18 years of age are available. The items yield scores on eight syndrome scales (e.g., Attention Problems, Aggressive Behavior) and two higher order factors labeled Internalizing Behaviors (e.g., Withdrawn, Somatic Complaints) and Externalizing Behaviors (e.g., Delinquent Behavior, Aggressive Behavior). A Total Problem Behavior score is also derived.

2.4. Analysis plan

Part I. (all adoptees vs. biological children). Relevant variables from the Adjective Checklist and Child Behavior Checklist, as well as IQ and relationship status (adopted or biological), were chosen for structural equation modeling. Assumptions regarding normality, multicollinearity, missing values and outliers were satisfied. Inspection of correlational patterns identified variables with meaningful relationships to one another, and these were chosen for further analysis (Ullman, 2001). Favorable traits included IQ (Intelligence Quotient), ORDER (values neatness and organization, e.g., conscientiousness, efficiency and INTELLECTENCE (Low Origence–High Intellectence; values rationality over emotion, e.g., logic, persistence). Unfavorable traits included UNFAVORABLENESS (expresses socially undesirable traits, e.g., affectation, arrogance) and EXTERNALIZING BEHAVIOR (expresses outwardly directed emotional problem behaviors, e.g., cheating, stealing; T-score). The variable labels and descriptions are summarized in Table 2.

Prior to model fitting, a series of simple regressions was performed with RELATIONSHIP STATUS (adopted or biological) as the predictor and the five ACL and CBCL variables as the dependent measures. A significant effect was found for IQ [$B = 5.48$, $p < .01$], showing that RELATIONSHIP STATUS significantly predicted general intelligence, with biological children outscoring adoptive children.

The data were analyzed with Mplus 7.11 using individual level data (all adoptees versus all biological children). RELATIONSHIP STATUS was an exogenous observed variable in the model, with paths to the latent factors of MENTAL ABILITY and BEHAVIOR PROBLEMS. All variables, with the exception of IQ and RELATIONSHIP STATUS, were age- and sex-corrected according to the methods of McGue and Bouchard (1984). The hypotheses and model structure were generated from the Kin Selection and Compensation Theories described above. Specifically, it was reasoned that in two key developmental domains (mental ability and conduct problems) parents might view their children differently as a function of their relationship status (biological or adopted). Mental ability (as a latent variable) would be reflected in a child's IQ score, organization and attitude toward intellectual activities. Behavior problems (as a second latent variable) would be captured by unfavorable attributes and aggressive, noncompliant behavior.

Table 2
Variables Used in the model.

Variable	Definition (Source)
ORDER	Order: emphasizes neatness, organization and planning activities (ACL)
INTELLECTENCE	Low Origence–High Intellectence: intellectence valued more than emotion (ACL)
UNFAVORABLENESS	Unfavorable: number of undesirable adjectives endorsed (ACL)
EXTERNALIZING BEHAVIOR	Externalizing Behavior T-score: aggressive, hyperactive, noncompliant, and undercontrolled behavior (CBCL)
IQ	IQ (Wechsler IQ Test: Preschool or Child Form)
RELATIONSHIP STATUS	Relationship Status (Adopted or Biological)

The covariance matrix was examined using robust full information maximum likelihood estimation. The error variance of the variable ORDER was set to zero given its negative valence. While the non-independent nature of the observations may have inflated the fit statistics, it should have had little effect on the parameter estimates (see Johnson, Bouchard, Krueger, McGue, & Gottesman, 2004).

Parts II and III used analysis of variance and multilevel modeling techniques, respectively, to assess the specified hypotheses.

3. Results

For descriptive statistics, means and standard deviations for IQ and for the selected ACL and CBCL scales were computed for the full sample and for the VT pairs according to relationship status (adopted, biological). These data are displayed in Table 3.

3.1. Part I. Individual analyses (all adoptees vs. biological children)

The robust maximum likelihood chi-square test of model fit [$\chi^2(df = 7) = 11.264$, $p = .13$] was non-significant, indicating that the proposed model generally reflected the nature of the data. Comparative fit statistics were .984 (CFI), .036 (SRMR) and .048 (RMSEA), with a 90% CI of .000–.097. These results were favorable according to criteria specified by Hu and Bentler (1999), especially given that the MENTAL ABILITY factor was set to 1.00.

The key aim of this analysis was to examine differences between biological children and adoptees; however, differences were not found. RELATIONSHIP STATUS predicted neither MENTAL ABILITY (F1) nor BEHAVIOR PROBLEMS (F2). The final model is shown in Fig. 1.

Both ORDER (1.00) and INTELLECTENCE (.67) significantly predicted the latent construct MENTAL ABILITY (F1), as expected. The positive coefficients indicated that higher levels of organization and preference for intellect over emotion were linked to higher levels of general mental ability. Also, as expected, EXTERNALIZING BEHAVIOR (.58) and UNFAVORABLENESS (.94) significantly predicted the latent construct BEHAVIOR PROBLEMS (F2). Higher levels of externalizing behavior and a higher number of unfavorable descriptors were associated with higher levels of conduct problems. An unanticipated finding was a moderate significant path from INTELLECTENCE (.34) to BEHAVIOR PROBLEMS (F2). This showed that higher levels of intellect in the absence of emotion predicted higher levels of behavioral problems.

3.2. Part II. Between-family analyses (adoptees in VT–AA pairs vs. biological children in VT–AB pairs)

Analysis of variance was used to compare the group of biological children to the adoptees in the VT–AA pairs.[4] Significant group differences were observed only for IQ [$F(1,224) = 8.23$, $p = .005$, $\eta^2_p = .035$], with the biological children (109.85, SD = 12.48) outscoring the adopted children (103.90, SD = 11.78).

The combined group of biological and adoptive members of VT–AB pairs was also compared with the VT–AA adoptees. Specifically, this analysis could shed light on parents' views of raising the two types of VTs. Analysis of variance showed significant group differences for two measures: IQ [$F(1,264) = 7.23$, $p = .008$, $\eta^2_p = .027$] and UNFAVORABLENESS [$F(1,266) = 12.16$, $p = .001$, $\eta^2_p = .04$]. For both IQ and UNFAVORABLENESS, the members of VT–AB pairs (IQ: 108.21, SD = 12.50; UNFAVORABLENESS: 9.63, SD = 8.67) scored significantly higher than the members of VT–AA pairs (IQ: 103.90, SD = 11.78; UNFAVORABLENESS: 6.56, SD = 5.82). The direction of the IQ difference was expected given prior findings from this study and previous VT analyses, despite the small effect sizes. The magnitude and direction of the

[4] The members of one VT-AB pair were omitted from these analyses because each was the biological child of a parent in a same-sex couple.

Table 3
Means and standard deviations for the observed variables.

Observed variable	Adop children ($N = 223$)	Bio children ($N = 41$)	Full sample ($N = 264$)
IQ[a], mean (SD)	104.24 (11.84)	109.76 (12.24)	105.10 (12.05)
ORDER, mean (SD)	2.13 (4.99)	3.68 (5.63)	2.38 (5.11)
INTELLECTENCE, mean (SD)	7.45 (4.56)	8.40 (4.59)	7.59 (4.57)
EXTERNALIZING BEHAVIOR, mean (SD)	49.51 (9.77)	46.76 (11.80)	49.08 (10.14)
UNFAVORABLENESS, mean (SD)	7.41 (6.58)	7.88 (8.80)	7.48 (6.95)

NOTE: Six individuals were entered more than once given that they were included in multiple pairs.
Complete data records were available for 132 VT pairs (264 individuals). Two adult VT pairs lacked CBCL data because the CBCL is not designed for individuals older than eighteen years, and one young VT pair lacked IQ data.
[a] Bio > Adop, $t(262) = -2.73$, $p = .007$.

UNFAVORABLENESS difference were of particular interest and will be addressed in the Discussion.

3.3. Part III. Within-pair analyses of VT–AB pairs: biological vs. adoptive siblings

The SPSS MIXED procedure was used to analyze within-pair differences between siblings in VT–AB pairs. This technique applies mixed effect regressions to control for the correlated nature of the data.

The mean IQ score was higher for the biological (109.85, SD = 12.48) than adoptive siblings (106.58, SD = 12.45), a difference that approached statistical significance [$F(1,39) = 3.09$, $p = .087$]. There was a significant amount of variability around the average IQ score due to family, $\sigma^2 = 85.93$, $p = .003$. The intra-class correlation due to nesting within family was .55.

The two negative traits both showed significant within-pair differences. Adoptees (11.15, SD = 8.24) received higher scores on UNFAVORABLENESS [$F(1,39) = 11.32$, $p = .002$] than their biological siblings (8.10, SD = 8.91). Adoptees (50.23, SD = 12.40) also scored higher on EXTERNALIZING BEHAVIOR [$F(1,38) = 6.75$ $p = .013$] than their biological siblings (47.03, SD = 12.03). As was observed for IQ, there was a significant amount of variability due to family around the mean scores of both these variables. These values were $\sigma^2 = 52.70$, $p < .001$ for UNFAVORABLENESS and $\sigma^2 = 119.44$, $p < .001$ for EXTERNALIZING BEHAVIOR. The intraclass correlations due to nesting within family were .74 and .80, respectively.

The adoptees and their biological siblings did not differ in the favorable traits of INTELLECTENCE and ORDER. A significant amount of variability around the average INTELLECTENCE score due to family, $\sigma^2 = 17.73$, $p = .000$ was detected. The intraclass correlation due to nesting within family was .73. The estimate of random effects could not be computed for ORDER.

As a check on the results reported above for siblings in VT–AB pairs, the same within-pair analyses were conducted for siblings in VT–AA pairs. Siblings in adoptive–adoptive pairs, organized by age difference (younger vs. older), did not differ on any of the measures. Note that the mean age difference between VT–AA adoptees was only 2.06 months (SD = 2.10) and that the correlations between age and the five behavioral measures were negligible ($rs = -.11$ to .02, $n = 186$–188). Organizing the members of VT–AA pairs by relative age was, therefore, unlikely to have affected the findings.

4. Discussion

4.1. Summary of findings

The present study compared mental ability and externalizing behavior in a unique sample of unrelated sibling pairs, with reference to different, but related theoretical frameworks. The key finding from Part I was that being an adopted or biological child does not predict ability-related or conduct-related behaviors. The exception was IQ in which the biological children significantly outscored the group of adoptees. However, this measure, while known to the parent, was obtained by an independent examiner and is a standard psychometric measure of children's ability. Overall, the Part I findings are more compatible with Compensation Theory in describing parenting processes for the children in the current sample. That is because differences in positive traits may have been minimized between siblings.

Part II analyses showed that the biological children in VT–AB pairs scored significantly higher than the members of VT–AA pairs in IQ

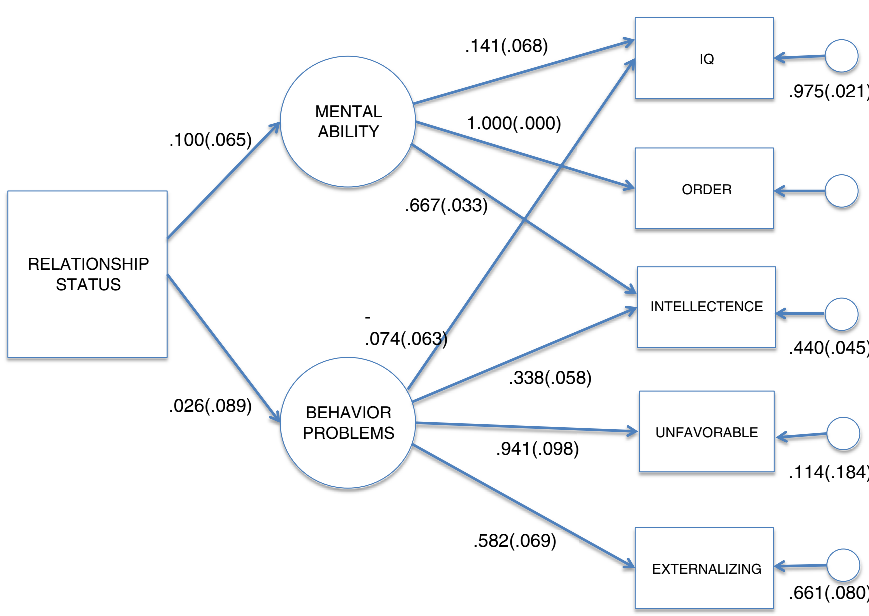

Fig. 1. Final standardized model showing relationships among the latent factors (MENTAL ABILITY and BEHAVIOR PROBLEMS) and observed variables (RELATIONSHIP STATUS: adopted, biological, IQ: Intelligence Quotient; ORDER neatness, organization; INTELLECTENCE: high intellectence; UNFAVORABLE: unfavorable traits and EXTERNALIZING: outwardly directed emotional problem behaviors; T-score.) Error terms associated with an observed variable are indicated by the small circles on the right. Values are standardized parameter estimates; values in parentheses are standard errors.

only. However, an interesting picture emerged from the Part II analyses in that the members of the VT–AB pairs were viewed less favorably than the members of the VT–AA pairs. This may reflect parental conflicts associated with adoptees when biological children are present in the home. This interpretation agrees with that of Rueter et al. (2009), who found less warm supportive communication between parents and adopted adolescents and greater parent-adoptive adolescent conflict when families also had a biological child.

Two theoretical models were proposed to account for the findings of Rueter et al. (2009). The first, the main effects model, posits that conflicted interactions come from behavioral differences between adopted and biological adolescents, assuming a lack of difference in parental treatment. The second, the goodness-of-fit model, holds that behavioral mismatches between adoptees and their parents might evoke certain classes of less favorable responses from family members. Deciding between these explanatory frameworks was beyond the scope of the Rueter et al. (2009) study and our own, but is an important topic for future research. Note that Rueter et al. (2009) did not conduct paired analyses, and the siblings in that study were not matched in age, suggesting a source of sibling and parental conflict.

To our knowledge, Part III presented the first analysis of behaviors between age-matched unrelated biological and adoptive siblings raised together since birth. Consistent with extant studies, the biological children in the VT–AB pairs scored higher in IQ than their adopted co-siblings, a difference that approached statistical significance. Previous analyses of virtual twins have reported a significant IQ difference between VT–AB co-siblings, possibly because older pairs were included in these studies (Segal et al., 2012b). The IQ scores of unrelated siblings have been shown to decrease in similarity from childhood to adolescence as shared family influences wane, nonshared environmental influences gain salience and/or new genetic effects are expressed (Segal et al., 2012b). Recall that the regression results identified relationship status as a significant predictor of IQ.

There were several key findings in Part III. First, the adoptive siblings in the VT–AB pairs were rated less favorably than their biological siblings on the two negative traits, but did not differ from them on the two positive traits. These findings support Compensation Theory, in that parents may acknowledge their adoptive child's negative traits for which they feel they could not have been responsible. At the same time, parents may equalize or overestimate their adopted children's positive traits, relative to those of their biological children, thereby minimizing differences between them. This explanation concurs with Priel et al. (2000) findings that adoptive parents express more positive views of their children than biological parents, despite recognizing their adoptive children's behavioral difficulties. Accentuating adoptive children's positive traits may help overcome perceived shortcomings associated with being an adoptive parent and/or having an atypical family structure.

Overall, the Part III findings challenge the conventional wisdom that parents view adoptive children less favorably than biological children across all domains. In so doing, the findings encourage a fresh look at how Kin Selection Theory, which predicts general parental favoritism of biological vs. adoptive children, is operating in modern, evolutionarily novel environments. Clearly, further research is needed to identify the processes by which parents raising both biological and adoptive children assess their children's positive and negative behavioral traits, and how such processes are related to the differential allocation of parental resources.

4.2. Implications

The goal of the current study was to assess predictions from Kin Selection Theory and Compensation Theory regarding parents' perceptions of biological and adoptive children. The study used data from a novel sibship that facilitated fulfillment of this goal. The data showed that, relative to adoptees, biological children are not favored in all respects. These findings refine, rather than refute, predictions from evolutionary psychology concerning preference for closely related individuals over distant relatives or non-relatives. Specifically, the findings highlight the social mediation of evolutionary contributions to parenting in the modern world. Raising adoptive children is viewed as a meaningful alternative to raising biological children as it appeals to and satisfies human tendencies to care for infants and young children. The finding that such family arrangements can be successful reflects humans' behavioral resiliency. Parental investment in biological children and other relatives may be expected generally, but may not hold across all family circumstances.

The Part I analyses failed to find meaningful associations between rearing status and behavior, with the exception of IQ in which the biological children excelled. The Part II analyses found that parents judge children from VT–AB pairs less favorably than children from VT–AA pairs on UNFAVORABLENESS. Perhaps greater tension between VT–AB members (biological and adoptive children raised together) over family resources and/or parents' own conflicts over child treatment explains these findings. Most biological children in the VT–AB pairs were younger, conceived naturally or via ART following the adoption of the sibling. New parents might feel uncertain, anxious and/or guilty over how they apportion resources between these two children. Compensating adoptees may be a solution.

The Part III within-pair analyses of the VT–AB siblings were the most telling. Here, it appears that parents may have minimized differences between their age-matched biological and adoptive children on positive traits, while recognizing adoptive children's shortcomings. By equalizing biological and adopted children's positive characteristics, parents may be enhancing their own personal status and social standing as mothers and fathers. These results support concepts and predictions from Compensation Theory. However, parents viewed adoptees less favorably than biological children in negative traits, consistent with expectations from Kin Selection Theory.

Hamilton et al. (2007) reported that with respect to investing in children, adoptive parents resemble biological parents to a greater degree than parents in other nontraditional families. They noted that because this pattern is inconsistent with kin selection mechanisms developed in the environment of evolutionary adaptiveness (EEA), an implication is that kin selection mechanisms may have misfired in adoptive parents as some evolutionary researchers have claimed. Although this interpretation is consistent with our view, they also reasoned that if this were the case, then all non-traditional parents (e.g., adoptive, foster, step) should be indistinguishable from one another regarding child care, and that has not been found. Reconciling this dilemma appears to come from the important difference between being an adoptive parent versus a stepparent.

Specifically, stepchildren are more likely to be acquired in a second marriage via mating effort, possibly after having one's own biological children. Parenting an unrelated child in such circumstances may conflict with investment in one's own children. It may also conflict with investment in biological nieces and nephews who share 25% of their genes, on average, with their aunts and uncles. In contrast, adoptive children appeal to the fundamental pleasure of parenting, especially in the event of infertility. The motivation to adopt may be especially strong (Silk, 1990) and, thus, may overcome the usual barrier of genetic relatedness associated with raising others' children. Gibson's (2009) point that the difference in discriminative parental solicitude results from “prolonged parenting effort [like adoptive families], not mating effort like stepfamilies” (p. 184) seems especially relevant.

4.3. Limitations and future directions

The current study is not without limitations. As is true of much other research, mostly mothers' reports of their children were available. Greater efforts are required to recruit fathers for participation. Fathers generally spend less time with young children so fathers may be less sensitive than mothers to their children's behavioral differences. In fact, knowledge of the time that each parent spends with children, both individually and as a pair, would be informative with respect to their evaluation of each child. Kin Selection Theory would predict greater time spent with biological children than adoptees, but it may be that adoptees' problem behaviors warrant greater attention.

Teachers interact with children in very different contexts than do parents. Teacher ratings, available from the Teacher Report Form (the parallel version of the CBCL), could be an informative addition to the present findings; however, these data show little to modest agreement with parent reports (Grigorenko, Geiser, Slobodskaya, & Francis, 2010). Given the pattern of parental perceptions that emerged in PART III (within-pair VT–AB analyses), it will be important to further compare these ratings against data from other sources. Specifically, the suggestion that parents minimize differences between biological and adoptive children on positive traits, but recognize their adoptive children's shortcomings, requires confirmation.

Larger sample sizes can add power to the analyses and should be possible given that the Fullerton Virtual Twin Study is ongoing. Longitudinal parental assessments of adoptive and biological children would complement the current findings, allowing tests of related predictions. It is conceivable that as children's interests and talents gain definition, parents become less constrained to minimize or overlook differences between them. Thus, affirming one's role as a parent may be more important when adoptive children are young.

Furthermore, all the parents in this study were aware of their children's rearing status. An ideal (albeit unlikely) study would obtain parental evaluations of VT–AB children in which one "biological" child was really unrelated. This rare situation has occurred in approximately seven switched-at-birth twin cases, in which one infant twin was accidentally exchanged with an unrelated infant in the nursery (Segal, 2011). This event creates a VT–AB pair (one twin and an unrelated child) thought to be a dizygotic twin (DZ) pair. (The truth about such pairs is typically discovered when one MZ twin is mistaken for the other.) The current number of such pairs is too small for drawing conclusions. The available information (mostly anecdotal) suggests that parents love both children and never doubt that both are biologically related twins. However, parents describe different behaviors and different parenting relationships with each of their two children (Segal, 2011).

Finally, our study examined parental perceptions, which we believe are linked to parenting behaviors. To fully investigate hypotheses relating to Kin Selection Theory, future research in this area should also include an examination of parental resource allocation toward biological versus virtual twin adoptees. A more complete understanding will likely require uncovering both perceptions and behaviors, and specific environmental cues, as well as their interactions (e.g., perceptions and attitudes, which are influenced by specific cues, may mediate resource allocation processes).

4.4. Conclusion

The present study underlined some complexities surrounding the parenting of biological and adoptive children. The overall pattern of results showed some shifts across the different stages of analysis, with Part III (within-pair comparisons) being especially revealing. Social mediation of evolutionary contributions to parenting processes is recognized. The generally positive judgments of adoptive children in this study highlight the universal interest and pleasure that come from parenting experiences, and the role that modern, evolutionarily novel inputs play in affecting evolved psychological mechanisms. Identifying and understanding the nature and origins of atypical outcomes is a vital undertaking, providing a desired synthesis of concepts and ideas surrounding familial care and concerns.

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