WORD COUNT: 9,362

Do Parents Favor Their Adoptive or Biological Children? Predictions from Kin Selection and
Compensatory Models

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

24 compensatory model. These findings refine our understanding of parenting genetically
25 related and unrelated offspring.

26 Key words: kin selection, compensatory model, adoption, virtual twins, parenting,
27 stepparenting.

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

39 But what about cases of adoption in which genetically unrelated children are
40 acquired *intentionally*? In traditional societies, adopters are often childless or older
41 couples who take on the children of relatives who cannot effectively raise them (e.g., Silk,
42 1980). Such transactions fit within a kin-selection framework, given that these parents are
43 investing resources in children with whom they share common genes (albeit less than the
44 percentage they share with their own offspring), thereby indirectly enhancing their own
45 biological fitness. As such, we would expect adopted children in traditional societies to
46 fare better than unrelated stepchildren. In fact, adoption (i.e., movement of children

47 within families and communities) occurs with relative ease among Polynesians and other
48 relatively inbred island populations (Freedman, 1979) and some extended families
49 (Hartman & Laird, 1990). In modern times, in which private domestic adoption, foster
50 care and international adoption in the United States recently involved a total of 246,694
51 children (Bureau of Consular Affairs, 2014), adopters also tend to be childless or older
52 (Bamberger, 2013; Ashe, 2015). However, a key difference is that people currently have
53 many more options for acquiring *unrelated* children, including those of strangers who
54 often are of a different ethnicity and live on the opposite side of the globe. Indeed, 59%
55 of recently adopted children were biologically unrelated to their adopters. In such
56 evolutionarily novel circumstances, how are adoptees treated by their adopting parents?

57 On hand, according to a “Compensation” model (Hamilton, Cheng, & Powell,
58 2007), modern day adopters are especially motivated to be parents and, when taking on
59 unrelated children, may compensate in their attitudes, cognitions, and behaviors for any
60 natural inclinations to favor biological children. From an evolutionary perspective,
61 adoption of children that are both genetically and socially unrelated to oneself likely
62 involves a misfiring of evolved mechanisms promoting a desire for offspring, whereby in
63 evolutionarily novel conditions there is a relatively large supply of unrelated children.
64 Likewise, a motivation to compensate for biological favoritism may be a byproduct of the
65 high parental motivation behind adoptive parents. Furthermore, in an increasingly multi-
66 ethnic and peaceful modern society, mechanisms for altruism and fairness, as well as for
67 projecting social norm adherence, may be extending beyond one’s own kin and ingroup
68 members to include unrelated children.

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

77 In this paper, we test the two alternative views by examining whether siblings of
78 unique "virtual twin" pairs – where one child is biologically related to the parents, but the
79 other, very close in age, is not – differ on a variety of key traits both objectively and as
80 perceived by their parents. Thus, our investigation examines positive or negative bias in
81 perceptions toward adoptees, and provides a window into whether parental motivation
82 can induce individuals to supplant evolved psychological (kin-selection) mechanisms
83 promoting investment in genetically related offspring. More broadly, the question is
84 important as, increasingly, humans are living in conditions under which there is a
85 mismatch between their evolved mechanisms and the evolutionary novelty of the current
86 environment (e.g., Hagen & Hammerstein, 2006; Colarelli & Arvey, 2014; Kanazawa,
87 2004). In this rapidly changing context, it is increasingly important to identify key
88 evolutionarily novel inputs and to understand the impact they have on relevant evolved
89 psychologies.

90 1.1 Kin Selection Theory

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

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

112 However, the notion that stepparenting might assist in mate acquisition is
113 supported by a study of Israeli students embarking upon the "Great Journey" (i.e., a trip

114 to Latin America or Asia by young adults upon completion of military service) (Tifferet,
115 Jorey, & Nasanovitz, 2010). Individuals raised by stepfathers received greater financial
116 support for the trip than individuals raised by stepmothers. Family income was not a
117 significant predictor in the analysis. This suggests that males are more motivated than
118 females to assist unrelated children to secure and maintain access to mates; also see
119 Anderson, Kaplan and Lancaster (1999). Thus, stepfathers may use parental investment
120 as a mating strategy.

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

134 The foregoing themes were repeated in a study of relatedness and family
135 investment among black South African children (Anderson, 2005). Data from a large
136 nationally representative sample showed that the genetic relatedness of a “focal child” to

137 household members positively predicted expenditures for food, health care and clothing;
138 however, the first two findings held only for urban families, not for rural families.
139 Possible explanations, such as reduced food and health care expenses available to rural
140 families, were suggested. Again, a between-family, rather than a within-family, approach
141 was taken.

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

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

155

156 1.2.Alternative family structures reconceptualized

157 Recent research has laid a basis for reconceptualizing parental care and
158 investment in unrelated children. This approach derives from the fundamental distinction
159 between the rearing of adopted children and stepchildren. Stepchildren are acquired non-

160 purposefully, and possibly unwillingly, such that their care is motivated via mating effort.
161 That is, a person may care for a partner's previous children to the extent that it helps
162 establish or maintain romantic relations with that partner. In contrast, adopted children
163 are acquired purposefully and voluntarily, such that their care is motivated via parenting
164 effort (Gibson, 2009). To the extent that this motivation is strong, the usual differential
165 preference toward raising biological versus adopted children may lessen.

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

183 or in the quality of parental relationships (Golombok et al., 1995). Thus, children raised
184 by non-biological parents are not necessarily disadvantaged, or disadvantaged in all
185 respects, relative to children raised by biological parents.

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

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

205 1.2.1.Family Structures Theory. A comparison of parenting expectations from
206 social and biological perspectives was presented by Hamilton, Cheng, & Powell (2007).
207 Family Structures Theory predicts less effective parenting and poorer child outcomes in
208 families from alternative family arrangements (e.g., step and single parent families), due
209 to lowered levels of parental investment. However, using data from the Early Childhood
210 Longitudinal Study, Hamilton et al. (2007) detected an “adoptive advantage” in adoptive
211 families over other family structures, associated with greater school involvement and
212 resource allocation. Specifically, they reasoned that this benefit is partly due to adoptive
213 families’ higher income and educational levels, relative to those of biological families.
214 After controlling for socioeconomic differences, adoptive families resembled biological
215 families in level of child investment as compared with other non-traditional families.
216 However, adoptive parents still showed higher levels of child investment than biological
217 parents in some joint activities, such as playing games and building things.

218 1.2.2.Compensation Theory. Hamilton et al.’s (2007) proposed Compensation
219 Theory suggested that parents of adoptees overcompensate in their rearing, due to their
220 awareness of the lack of biological connectedness to their children and the social stigma
221 posed by their family circumstances. Interestingly, MacCallum et al. (2007) found that
222 embryo donation parents responded more defensively than IVF or adoptive parents when
223 questioned about their child and family life. Also recall that embryo donation parents
224 showed higher levels of overinvolvement in some parenting aspects than did the other
225 mothers and fathers.

226 Hamilton et al. (2007) also referenced evolutionary theory, asserting that evolved
227 psychological mechanisms that give rise to the desire for children may (perhaps

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

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

246 1.2.3. Biological and adoptive children raised together. Relatively few studies
 247 have compared parenting qualities and child outcomes in families raising biological *and*
 248 adoptive children simultaneously. In the absence of such studies in which spousal
 249 relations, financial income and other family factors are constant across children,
 250 conclusions about parenting preferences and child outcomes are difficult to draw. An

251 exception is a study by Gibson (2009) who found that parents invested more in adoptees'
252 than in biological children's educational and personal areas. (The age difference between
253 siblings in these families was not provided.) It was suggested that differential parental
254 solicitude, rather than parental favoritism, might have been prompted by adoptive
255 children's greater needs. Supporting this interpretation, the biological children in these
256 families showed more positive life history outcomes, e.g., more years of education and
257 better mental health.

258 Other research supports the view that biological children show more favorable
259 developmental outcomes than adoptive children. Studies have reported lower IQ scores
260 and higher problem behaviors among adoptees than among biological children (Dumaret
261 & Stewart, 1985; Cardon, 1994; Sharma, McGue, & Benson, 1998), although most apply
262 between-group comparisons. The only study to report IQ data on age-matched biological
263 and adopted children raised together (virtual twins) found that biological children's IQ
264 scores significantly exceeded those of their adopted siblings (Segal, McGuire, Graham, et
265 al., 2013). Adoptees' higher frequency of behavioral problems may be explained by their
266 feelings of rejection and/or lack of similarity to their rearing parents. Adoptees'
267 heterogeneous biological backgrounds (e.g., having parents with tendencies toward
268 hyperactivity or sexual impulsivity) may also contribute to their poorer outcomes.

269 Another within-family analysis reported less warm supportive communication
270 between parents and their adopted adolescent children, compared with these same parents
271 and their biological adolescent children (Rueter, Keyes, Iacono, et al., 2009). This study
272 also found greater conflict between mothers and adoptees than between these same
273 mothers and their biological children. A recent within-family study analyzed children's

274 reports of parental care and emotional closeness, as a function of children's genetic
275 relatedness to their rearing parents (Schnettler & Steinbach, 2011). Biological children
276 reported more positive assessments than non-biological children even after controlling for
277 parental education, length of co-residence and other measures. The age difference
278 between siblings was not considered although presumably correlated with co-residence.

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

283 1.3.Present study

284 The primary goal of the present study was to examine predictions regarding
285 parents' relative perceptions and judgments of adopted versus biological children.
286 Although behaviors – specifically, those pertaining to the differential allocation of
287 resources – may be most directly relevant in an investigation regarding kin selection,
288 there is much reason to study parents' child perceptions, especially parents raising both
289 biological and non-biological children. In particular, a host of research suggests that
290 behaviors are not only linked to perceptions, but are caused by them (Bargh, Chen, &
291 Burroughs, 1996; Dijksterhuis & van Knippenberg, 1998). For example, Frome & Eccles,
292 1998) found that parents' perceptions mediated the association between children's grades,
293 as well as children's self and task perceptions in English and math. Parents' perception s
294 were more strongly linked to children's perceptions than their grades. Indeed, research on
295 the classic paradigm of cognitive dissonance (Festinger, 1957) suggests that humans are
296 designed to have a high level of consistency between their attitudes and behaviors.

297 Predictions were generated by Kin Selection Theory (which, at base, predicts
298 parental favoritism toward biological over unrelated adopted children), and by
299 Compensation Theory (which follows from a mismatch view, suggesting that the relevant
300 mechanisms are misfiring due to evolutionary novelty, and predicts increased parental
301 efforts toward the quality care of unrelated children).¹ This goal was addressed using data
302 gathered on the members of rare, twin-like siblings, i.e., virtual twins (VTs). VTs are
303 same-age unrelated siblings raised together since birth who uniquely replicate twinship,
304 but lack a genetic link. As such, these sibships provide a pure estimate of shared
305 environmental influence on behavioral variation (xx, 2012; xx et al., 2012). Given that
306 the pair members are the same age and share residential histories, family factors (e.g.,
307 variations in income or neighborhood quality) that might variously impact individuals
308 differing in age and/or time of entry into the family are eliminated.

309 VTs are commonly composed of one biological child and one adoptee (VT-AB)
310 or two adoptees (VT-AA). Couples unable to conceive may seek fertility treatments
311 and/or adoption to have children. It sometimes happens that the birth of a child conceived
312 via ART coincides with the availability of a child relinquished for adoption. This co-
313 occurrence explains the creation of near-in-age biological-adoptive pairs in which the
314 biological child is related to both parents, and the adoptee is unrelated to both parents and
315 to the sibling. Alternatively, some couples for whom fertility treatments are unsuccessful,
316 or who do not seek such assistance, are offered two children for adoption. In this case,
317 neither child is related to the parents or to each other. Several unusual virtual twin pairs
318 include those produced by the adoption of one child and the conception of a biological

319 child using the father's sperm and an unrelated surrogate; and the adoption of one child
320 and gestation by the adoptive mother of an unrelated donated embryo.

321

322 1.3.1.Hypotheses and predictions. It is conceivable that parents raising both
323 biological and adopted children minimize qualitative behavioral contrasts between them.
324 This could occur despite their children's actual behavioral differences, with biological
325 children being somewhat favored. This minimization might reflect efforts at fair attitudes
326 toward, and treatment of, their children. Another possibility is that parents make relative
327 judgments of biological and adoptive children that are domain-specific. That is, parents
328 may downplay differences in some areas, such as children's favorable traits. In contrast,
329 parents may acknowledge, or emphasize, biological and adopted children's differential
330 displays of problem behaviors, which tend to be more common among adoptees
331 (Brodzinsky & Pinderhughes, 2013).

332 Consistent with a self-serving bias, parents may credit themselves for their
333 children's positive personal qualities, but attribute their children's negative qualities to
334 unknown events or events beyond their control. If so, parents of both adoptive and
335 biological children might emphasize both children's favorable traits, which they feel they
336 have nurtured. At the same time, parents might acknowledge adopted children's
337 unfavorable traits that they may attribute to the child's biological background, and for
338 which they do not hold themselves responsible. Of course, biological children also
339 present negative traits, but parents may downplay them if such traits challenge their self-
340 perceived value as parents. Research shows that higher status parents compensate for the
341 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:

364 • Parents will endorse a higher number of favorable behavioral traits for
365 biological children than for adoptive children.

366 • Parents will endorse a higher number of unfavorable behavioral traits for
367 adoptive children than for biological children.

368 Compensation Theory:

369 • Parents will endorse an equal or higher number of favorable behavioral traits for
370 adoptive children than for biological children.

371 • Parents will endorse an equal or higher number of unfavorable behavioral traits
372 for biological children than for adoptive children.

373

374 Part II. Between Family Analyses (Biological Children in VT-AB Pairs vs. All Adoptees
375 in VT-AA Pairs)

376 Evolutionary (Kin Selection) Theory:

377 • Parents will endorse a higher number of favorable behavioral traits for the
378 biological members of VT-AB pairs than for adoptees in VT-AA pairs.

379 • Parents will endorse a lower number of unfavorable behavioral traits for
380 biological members of VT-AB pairs than for adoptees in VT-AA pairs.

381 Compensation Theory:

382 • Biological children in VT-AB pairs will be rated lower than or equal to adoptees
383 in VT-AA pairs in favorable traits.

384 • Biological children in VT-AB pairs will be rated higher than or equal to
385 adoptees VT-AA in unfavorable traits.

386

387 Part III. Within Pair Analyses (Adoptees vs. Biological Siblings within VT-AB Families)

388 Evolutionary (Kin Selection) Theory:

389 • Parents will endorse a higher number of favorable behavioral traits for
390 biological versus adoptive children.

391 • Parents will endorse a lower number of unfavorable behavioral traits for
392 biological versus adoptive children.

393 Compensation Theory:

394 • Adoptive children in VT-AB pairs will be rated higher than or equal to their
395 biological siblings in favorable traits.

396 • Adoptive children will be rated lower than or equal to their biological co-
397 siblings in unfavorable traits.

398

399 **2. Materials and Methods**

400 2.1. Fullerton Virtual Twin Study

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

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

407 1. Both children must be in the home by one year of age. This rule is based on the
408 knowledge that parents tend to bond more closely with newborns and young infants than

409 with older children. In addition, some ordinary twins spend time apart during the first
 410 year of life due to medical problems or other events.

411 2. The age difference between siblings must not exceed nine months. Most school
 412 grades include children born between September of one year and June of the following
 413 year, a span of approximately nine months; see below.

414 3. School-age siblings must be in the same school grade. Virtual twins may be in
 415 different classes or attend different schools, but must be in the same grade at the time of
 416 testing. This requirement preserves the twin-like nature of the relationship.

417 4. Both siblings must be free of adverse birth events that might affect behavior.
 418 Children exposed prenatally to drugs or alcohol, or who display significant behavioral
 419 problems (e.g., autism; selective mutism) are excluded from the study. When birth events
 420 are unknown, careful questioning of mothers to assess children's early behaviors is
 421 conducted.

422

423 2.2.Participants

424 The current sample included 135 virtual twin pairs, organized into 41 adopted-
 425 biological pairs and 94 adopted-adopted pairs. Families with VTs were identified via
 426 publicity about the study (54.8%), personal referrals (30.4%) and other sources, such as
 427 the media (14.8%). The mean age of the sample was 6.14 years ($SD = 3.51$, range = 3.88
 428 – 35.08), and the mean age difference between the pair members was 2.92 months ($SD =$
 429 2.63, 0.00 - 9.23). Age did not differ between the two VT groups, although the age
 430 difference between VT-AB pair members significantly exceeded the age difference
 431 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.² 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 XX (2012).

Table 1 about here

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, 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.

466

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.

Table 2 about here

Prior to model fitting, a series of simple regressions was performed with relationship status or RELATONSHIP 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). RELATONSHIP 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 RELATONSHIP 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.

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, et al., 2004).

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

508

509

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.

513 Table 3 about here

514

515 3.1.Part I. Individual analyses (all adoptees vs. biological children)

The robust maximum likelihood chi-square test of model fit [χ^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: .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.

522 The key aim of this analysis was to examine differences between biological
523 children and adoptees; however, differences were not found. RELATIONSHIP STATUS

524 predicted neither MENTAL ABILITY (F1) nor BEHAVIOR PROBLEMS (F2). The
 525 final model is shown in Figure 1.

526 Figure 1 about here

527
 528 Both ORDER (1.00) and INTELLECTENCE (.67) significantly predicted the
 529 latent construct MENTAL ABILITY (F1), as expected. The positive coefficients
 530 indicated that higher levels of organization and preference for intellect over emotion were
 531 linked to higher levels of general mental ability. Also, as expected, EXTERNALIZING
 532 BEHAVIOR (.58) and UNFAVORABLENESS (.94) significantly predicted the latent
 533 construct BEHAVIOR PROBLEMS (F2). Higher levels of externalizing behavior and a
 534 higher number of unfavorable descriptors were associated with higher levels of conduct
 535 problems. An unanticipated finding was a moderate significant path from
 536 INTELLECTENCE (.34) to BEHAVIOR PROBLEMS (F2). This showed that higher
 537 levels of intellect in the absence of emotion predicted higher levels of behavioral
 538 problems.

539
 540 3.2. Part II. Between-family analyses (adoptees in VT-AA pairs vs. biological children in
 541 VT-AB pairs)

542 Analysis of variance was used to compare the group of biological children to the
 543 adoptees in the VT-AA pairs.³ Significant group differences were observed only for IQ [F
 544 (1,224) = 8.23, $p = .005$, $\eta^2_p = .035$], with the biological children (109.85, SD = 12.48)
 545 outscoring the adopted children (103.90, SD = 11.78).

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

558

559 3.3. Part III. Within-pair analyses of VT-AB pairs: Biological vs. adoptive aiblings

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

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

568 The two negative traits both showed significant within-pair differences. Adoptees
 569 (11.15, SD = 8.24) received higher scores on UNFAVORABLENESS [$F(1,39) = 11.32$,
 570 $p = .002$] than their biological siblings (8.10, SD = 8.91). Adoptees (50.23, SD = 12.40)
 571 also scored higher on EXTERNALIZING BEHAVIOR [$F(1,38) = 6.26$, $p = .017$] than
 572 their biological siblings (47.03, SD = 13.03). As was observed for IQ, there was a
 573 significant amount of variability due to family around the mean scores of both these
 574 variables. These values were $\sigma^2 = 52.70$, $p < .001$ for UNFAVORABLENESS and $\sigma^2 =$
 575 116.57 , $p = .000$ for EXTERNALIZING BEHAVIOR. The intraclass correlations due to
 576 nesting within family were .74 and .80, respectively.

577 The adoptees and their biological siblings did not differ in the favorable traits of
 578 INTELLECTENCE and ORDER. A significant amount of variability around the average
 579 INTELLECTENCE score due to family, $\sigma^2 = 17.73$, $p < .001$ was detected. The
 580 intraclass correlation due to nesting within family was .73. The estimate of random
 581 effects could not be computed for ORDER.

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

589

590
591

592 **4.Discussion**

593 4.1.Summary of findings

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

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

612 Two theoretical models were proposed to accounts for the findings of Rueter et al.
613 (2009). The first, the main effects model, posits that conflicted interactions come from

614 behavioral differences between adopted and biological adolescents, assuming a lack of
615 difference in parental treatment. The second, the goodness-of-fit model, holds that
616 behavioral mismatches between adoptees and their parents might evoke certain classes of
617 less favorable responses from family members. Deciding between these explanatory
618 frameworks was beyond the scope of the Rueter et al. (2009) study and our own, but is an
619 important topic for future research. Note that Rueter et al. (2009) did not conduct paired
620 analyses, and the siblings in that study were not matched in age, suggesting a source of
621 sibling and parental conflict.

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

632 There were several key findings in Part III. First, the adoptive siblings in the VT-
633 AB pairs were rated less favorably than their biological siblings on the two negative traits,
634 but did not differ from them on the two positive traits. These findings support
635 Compensation Theory, in that parents may acknowledge their adoptive child's negative
636 traits for which they feel they could not have been responsible. At the same time, parents

637 may equalize or overestimate their adopted children's positive traits, relative to those of
638 their biological children, thereby minimizing differences between them. This explanation
639 concurs with Priel et al's. (2000) findings that adoptive parents express more positive
640 views of their children than biological parents, despite recognizing their adoptive
641 children's behavioral difficulties. Accentuating adoptive children's positive traits may
642 help overcome perceived shortcomings associated with being an adoptive parent and/or
643 having an atypical family structure.

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

652

653 4.2.Implications

654 The goal of the current study was to assess predictions from Kin Selection Theory
655 and Compensation Theory regarding parents' perceptions of biological and adoptive
656 children. The study used data from a novel sibship that facilitated fulfillment of this goal.
657 The data showed that, relative to adoptees, biological children are not favored in all
658 respects. These findings refine, rather than refute, predictions from evolutionary
659 psychology concerning preference for closely related individuals over distant relatives or

660 non-relatives. Specifically, the findings highlight the social mediation of evolutionary
661 contributions to parenting in the modern world. Raising adoptive children is viewed as a
662 meaningful alternative to raising biological children as it appeals to and satisfies human
663 tendencies to care for infants and young children. The finding that such family
664 arrangements can be successful reflects humans' behavioral resiliency. Parental
665 investment in biological children and other relatives may be expected generally, but may
666 not hold across all family circumstances.

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

677 The Part III within-pair analyses of the VT-AB siblings were the most telling.
678 Here, it appears that parents may have minimized differences between their age-matched
679 biological and adoptive children on positive traits, while recognizing adoptive children's
680 shortcomings. By equalizing biological and adopted children's positive characteristics,
681 parents may be enhancing their own personal status and social standing as mothers and
682 fathers. These results support concepts and predictions from Compensation Theory.

683 However, parents viewed adoptees less favorably than biological children in negative
684 traits, consistent with expectations from Kin Selection Theory.

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

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

706

707 4.3.Limitations and future directions

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

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

725 Larger sample sizes can add power to the analyses and should be possible given
726 that the Fullerton Virtual Twin Study is ongoing. Longitudinal parental assessments of
727 adoptive and biological children would complement the current findings, allowing tests
728 of related predictions. It is conceivable that as children's interests and talents gain

729 definition, parents become less constrained to minimize or overlook differences between
730 them. Thus, affirming one's role as a parent may be more important when adoptive
731 children are young.

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

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

751 4.4.Conclusion

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

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This work was supported, in part, by the National Science Foundation (SBR-9712875), and CSU Fullerton faculty awards to the first author. The virtual twins and their families are gratefully acknowledged for their participation and support. This work was completed, in part, while the first author was in residence at the Singapore Management University, in Singapore, January 2013. Several colleagues completed critical readings of the manuscript prior to submission.

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Figure Captions

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921 Figure 1. Final standardized model showing relationships among the latent factors

922 (MENTAL ABILITY and BEHAVIOR PROBLEMS) and observed variables

923 (RELATIONSHIP STATUS: adopted, biological, IQ: Intelligence Quotient; ORDER

924 neatness, organization; HINTELLECTENCE: high intellectence; UNFAVORABLE:

925 unfavorable traits and EXTERNALIZING: outwardly directed emotional problem

926 behaviors; T-score.) Error terms associated with an observed variable are indicated by

927 the small circles on the right. Values are standardized parameter estimates; values in

928 parentheses are standard errors.

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Footnotes

¹ Predictions from Kin Selection theory are applied at face value.

² 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.

³ 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 1
Age, Age Differences and Gender Composition of Virtual Twin Pairs

Pair Type	N	Age ¹	Age Difference ²	Gender ²		
N (pairs)	(ind)	(years) (SD) ³	(months) ⁴ (SD)	MM	FF	MF
VT-AA (94) Range	186	5.98 (2.51) 3.88 – 22.72	2.06 (2.10) 0.00 – 8.93	25	23	46
VT-AB (41) Range	76	6.52 (5.20) 4.01 – 35.08	4.91 (2.66) 0.03 – 9.23	12	10	19
Total (135) Range	262	6.14 (3.51) 3.88 – 35.08	2.92 (2.63) 0.00 – 9.23	37	33	65

¹Ages based on individual data since four participants are in two pairs each and two participants are in three pairs each.

²Pair data.

³F = 9.14, p< .01.

⁴F = 4.08, p< .05, t (62.70) = -6.10, p < .001

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)
RELSTAT	Relationship Status (Adopted or Biological)

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 ¹ (SD)	104.24 (11.84)	109.76 (12.24)	105.10 (12.05)
ORDER (SD)	2.13 (4.99)	3.68 (5.63)	2.38 (5.11)
INTELLECTENCE (SD)	7.45 (4.56)	8.40 (4.59)	7.59 (4.57)
EXTERNALIZING BEHAVIOR (SD)	49.51 (9.77)	46.76 (11.80)	49.08 (10.14)
UNFAVORABLENESS (SD)	7.41 (6.58)	7.88 (8.80)	7.48 (6.95)

¹Bio > Adop, $t(262) = -2.73$, $p = .007$.

NOTE: Six individuals are 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.

Figure 1