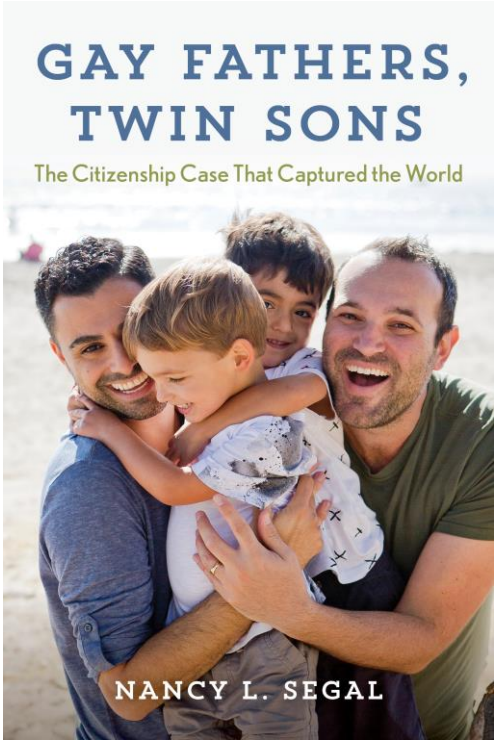

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Gay Fathers, Twin Sons

The Citizenship Case That Captured the World

By Nancy L. Segal

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About the Book

The January 2018 headline story in the Los Angeles Times was riveting. Andrew from the United States and Elad Dvash-Banks from Israel married in Canada in 2010 when gay couples could not marry in these countries. The couple conceived fraternal twins, Aiden and Ethan, with a Canadian surrogate by means of egg and sperm donation. The two boys were born just four minutes apart. Aiden was conceived with a donated egg and Andrew's sperm cell, and Ethan was conceived with a donated egg (from the same woman) and Elad's sperm cell.

Andrew and Elad wished to raise their children in the United States, but when they arrived at the American Consulate in Toronto to apply for citizenship, a staff member fired off a series of "shocking" and humiliating questions, and informed the couple of her authority to require a DNA test to determine each parents' relatedness to each twin—she warned that without these tests neither twin would be granted US citizenship. Andrew and Elad knew which twin each had fathered and had planned on keeping this information confidential. They knew this because DNA analyses had already been performed, but the consulate insisted that these costly tests be repeated using their designated laboratory.

Having no alternative, DNA testing was arranged, and results submitted to the consulate. Soon, two envelopes arrived at their home, bearing both welcome and dreaded news: United States citizenship was offered to Aiden, whose father was a US citizen, but not to Ethan, whose father was Israeli. And, thus, their ground-breaking legal journey began. The couple's high-profile lawsuit nearly reached the US Supreme Court, capturing worldwide attention along the way.

Nancy Segal brings the story to life through firsthand accounts of each father's life history and analysis of the legal intricacies that threatened to deny US citizenship to one of their twin sons.

About the Author

Nancy L. Segal, PhD, is a Psychology Professor, and Director and Founder of the Twin Studies Center at California State University, Fullerton. She has authored over 300 scholarly articles and eight books. Her 2012 book, Born Together-Reared Apart: The Landmark Minnesota Twin Study, won the American Psychological Association's William James Book Award. Her recent work, Deliberately Divided: Inside the Controversial Study of Twins and Triplets Adopted Apart, was the focus of a July 2022 BBC-TV documentary. Her work has been featured in the New York Times and Atlantic Monthly. She has appeared on national and international televised programs, including the Oprah Winfrey Show, Good Morning America, the Today Show and the BBC. Her latest book is an annotated collection of photographs taken at the Holocaust twins' 40th anniversary reunion and hearing on Josef Mengele's war crimes. Segal lives and works in southern California.

Praise for the Book

"This book is both a heart-warming and heart-breaking tale…Nancy Segal weaves scientific ideas and personal experiences into a flawless tapestry that affords the reader a profound educational experience."
—**Thomas J. Bouchard Jr.**, PhD, Professor Emeritus, Department of Psychology, University of Minnesota

"*Gay Fathers, Twin Sons* is at once gripping, infuriating, heartbreaking, and uplifting…A brilliant read."
—**Michael Shermer**, Publisher of *Skeptic* magazine, author of *The Moral Arc and Conspiracy: Why the Rational Believe the Irrational*

"Segal cogently focuses on the terrifying reality that not all families are treated equally under our law."
—**Lisabeth Fisher DiLalla**, PhD, Professor of Behavioral Sciences, Southern Illinois University School of Medicine, Director of the Southern Illinois Twins/Triplets and Siblings Study (SITSS)

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Developmental trends in intelligence revisited with novel kinships: Monozygotic twins reared apart *v.* same-age unrelated siblings reared together

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ABSTRACT

Prior research has reported convergence of monozygotic (MZ) cotwins' intelligence scores over time, with divergence observed between dizygotic (DZ) cotwins. These patterns have been variously explained with reference to the increased influence of genetic factors (MZ and DZ twins) and nonshared environmental factors (DZ twins), and the reduced effects of shared environmental events (DZ twins). Studies of unrelated siblings have found modest within-pair resemblance in intelligence, with increasing divergence over time. This subject is revisited in a study using three novel kinships: young reared-apart MZ twins from China (CTA-MZ), adult reared-apart twins from Denmark (D-MZA) and findings from a previous study of same-age unrelated siblings (virtual twins or VTs). Despite modest sample sizes, the anticipated trends described above were observed, replicating extant findings. Intraclass correlations for overall IQ score at Time 1 and Time 2, respectively, were r_is = 0.51, 0.81 (CTA-MZs) and r_is = 0.64, 0.74 (D-MZAs). The hypothesis that VTs would show score divergence at Time 2 was confirmed. Increased genetic influence (CTA-MZ, D-MZA and VT), reduced impact of shared environments (VT), and increased effects of nonshared environments (VT) appear to best explain the findings. These results also inform parent and educator expectations regarding twins' and siblings' academic performance.

1. Introduction

1.1. Intellectual landscape: nature and nurture

Factors affecting the development of general intelligence have engaged the interest of behavioral science professionals, educators, and members of the public for years. A meta-analysis of twin studies conducted between 1967 and 1985 by McCartney, Harris, and Bernieri (1990) failed to find an age effect for the IQ resemblance of MZ and DZ twins raised together. However, an important limitation of this analysis was that the study was cross-sectional in nature; the twins were not tested at more than one time point. Indeed, the authors noted the contrast in findings between their study and the landmark work of Wilson (1978), more recently labelled the *Wilson Effect* (Bouchard, 2013). Using IQ data gathered on reared-together twins tested periodically between three months and fifteen years of age, Wilson (1978) found that MZ twins showed increasing IQ convergence, in contrast with DZ twins who showed increasing IQ divergence. The McCartney et al. (1990) study proposed that the unique social dynamics between MZ twins raised together may partly explain their findings. That is, they reasoned that efforts toward social differentiation between MZ co-twins may have contributed to their somewhat different intellectual outcomes.

Bouchard (2013) reinforced Wilson's finding in his comprehensive review of twin and adoption studies of general intelligence, conducted across different countries with different populations and protocols. Even the somewhat lowered heritability of 0.62 evidenced by 80-year-old reared-together Swedish twins (McClearn et al., 1997), relative to a heritability of 0.77 based on adult reared-apart twins from the Minnesota Study of Twins Reared Apart, is persuasive of genetic effects (Johnson et al., 2007). Consistent with these findings is the reduced and diminishing resemblance of adopted siblings assessed over time (Loehlin, Horn & Willerman, 1989; Scarr, Weinberg, & Waldman, 1993; Segal, McGuire, Havlena, Gill, & Hershberger, 2007). Collectively, these studies variously highlight the increasing effects of emerging genetic factors, the importance of nonshared environments, and the reduced effects of shared experiences on shaping intellectual development.

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Surprisingly, an analysis of reared-apart twins IQ-tested at more than one time point has not appeared in the extant literature, with the exception of Juel-Nielsen's classic (1980) study. Juel-Nielsen did not detect a meaningful age effect on the twins' mean IQ score upon dividing the pairs into those above and those below fifty-five years of age. This is not surprising, given that all participants were adults at both test sessions, such that their general intelligence level would have been stable. It is curious that Juel-Nielsen did not compute the Time 2 IQ intraclass correlation for comparison with the correlation at Time 1, an analysis that was conducted in the present study. It is also unfortunate that the Raven Progressive Matrices test was administered to the Danish twins at Time 1, but not at Time 2, as such a comparison would have relevance to the hypotheses currently under investigation.

Perhaps the most important gap in the relevant literature is the absence of a reared-apart twin analysis of developmental changes in IQ using children. Such an undertaking would provide findings more comparable to those from the few adoptive studies that have followed subjects from childhood through adolescence. Thus, the present study is the first to do so, using a unique sample of mostly young Chinese twins who grew up apart. The rarity and expense of gathering longitudinal data have been emphasized, as has the value of obtaining data at multiple time points. As Lykken (2007) noted, psychological measures vary around their stable set-points due to environmental fluctuations, such that data collected on even two occasions offers more accurate estimates of heritability. Findings from such a study, contrasting CTA-MZA pairs (Chinese MZ twins reared apart) and D-MZA pairs (Danish twins reared apart) with previously reported findings from an exceptional subset of unrelated sibling pairs, i.e., virtual twins (VTs: same-age unrelated siblings reared together who replicate twinship, but without a genetic link), are presented.

1.2. Hypotheses

(a) CTA-MZ and D-MZA Twin Pairs: IQ similarity will increase and within-pair IQ score differences will decrease from Time 1 to Time 2.
(b) The interval (time) between Time 1 and Time 2 will be uncorrelated with the IQ within-pair difference scores of the CTA-MZ and D-MZA twin pairs.
(c) Age at separation and contact time between Time 1 and Time 2 will be uncorrelated with the IQ within-pair difference scores of the reared-apart twins.
(d) IQ heritability derived from the reared-apart twins, and environmental effects based on the virtual twins will be higher using two IQ measures, compared to using one.

2. Materials and method

2.1. Participants

The members of three unique participant groups comprised the samples for the present study. Descriptions of these samples are provided below.

2.2. CTA-MZ twins

The first sample in the present study included young MZ reared-apart twins, mostly from China, who were separated as an indirect consequence of that nation's One-Child Policy (CTA). This policy, in effect from 1980 to 2016, limited urban families to one child and rural families to two children (Buckley, 2015). Many pregnant women underwent forced sterilizations and abortions, while others abandoned their children on the steps of orphanages and police stations (Evans, 2008). Given the preference for male children in Chinese culture, the majority of abandoned children were female, and among them were twins; the complete project sample included only one male twin from an opposite-sex pair. Twins in two pairs from Vietnam and twins in one pair from Taiwan were reared apart due to adverse family circumstances, e.g., single parent stigma and/or insufficient financial resources.

Both monozygotic (MZ) and dizygotic (DZ) twins have been enrolled in the *Fullerton Study of Chinese Twins Adopted Apart and Together* since its inception in 2006. Reared-apart twins in the present study were variously identified through the media (63.5 %), referrals (13.6 %), self-referrals (18.2 %), and other means (4.7 %). Parents of twins received an informed consent letter and a packet of demographic questionnaires and behavioral inventories to complete for their children. Several twins older than eighteen years of age received similar materials; parents' responses were used for respondent consistency, with the exception of contact time as reported by older pairs at Time 2.

The first sample includes MZ reared-apart twins only (CTA-MZ). These pairs offer simple, elegant, and convenient control of genetic and environmental effects when contrasted with other genetically and environmentally informative kinship pairs, as explained below. The CTA-MZ sample ($N = 15$ pairs) had a mean age of $\overline{x} = 10.69$ years ($SD = 7.20$) at Time 1, and a mean age of $\overline{x} = 13.93$ ($SD = 6.91$) at Time 2. (One pair with incomplete data was omitted from the Time 2 analyses). Other features important to the present study, e.g., age at adoption and test-retest interval, are summarized in Table 1a ($N = 30$ individuals). Additional information about the origins and progress of the study is available in Segal, Niculae, Becker, and Shih (2021) and references therein. The CTA-DZ twin sample was too modest in size to provide meaningful IQ findings.

2.3. D-MZA twins

A detailed volume describing the origins, methods, participants, results, and conclusions of a Danish study of adult reared-apart twins was the source of IQ data used in the present analysis (Juel-Nielsen, 1980). The twelve twin pairs comprising the sample are unique in that they represent the entire population of separated sets in Denmark, identified between 1954 and 1957. The first set came to the investigator's attention via his association with the psychiatric unit of the State Hospital in Riskov. The second set was referred to him by a journalist covering the twins' story. The remaining ten sets were identified through the twin registry of the Institute of Human Genetics at the University of Copenhagen. Their mean age at first participation was $\overline{x} = 51.42$ years, $SD = 16.70$.

The study was a comprehensive medical and psychological investigation. In addition to general intelligence testing, assessments were made of personality, general health, physical traits, and early environmental differences. The quantitative findings are supplemented with detailed biographical sketches of each separated pair. One or both cotwins in three pairs did not complete the second wave of data collection, leaving nine complete pairs ($N = 18$ individuals) for examining the IQ-related hypotheses listed above. Age, age at separation and test-retest interval are displayed in Table 1b. Some data displayed in the tables and used in the analyses differ slightly from Juel-Nielsen's, given that

Table 1a
Age, age difference at testing, and age at adoption of CTA-MZ twins at Time 1 and Time 2 [$N = 14$–15 pairs]; ($N = 28$–30 individuals).

Measure	Time	Mean	SD	Range
Age at testing in years				
($N = 30$)	1	10.69	7.20	3.19–24.98
($N = 28$)	2	13.93	6.91	5.42–29.95
Age difference at testing in days				
[$N = 15$]	1	12.73	10.86	0.00–41.00
[$N = 14$]	2	0.09	0.10	0.01–0.40
Age at adoption[1] in months ($N = 30$)		19.60	38.30	4.20–218.20
Test-retest interval in years [$N = 14$]		4.18	2.04	2.02–9.12

(N) = 30 individuals [N] = 14 pairs or families.

Table 1b
Age, age at separation, and test-retest interval of adult Danish twins (D-MZA) at Time 1 and Time 2.

Measure	Time	Mean	SD	Range
Age at testing in years[a]	1	51.42	16.70	22.00–77.00
[$N = 12$]	2			
Age at separation in Months [$N = 12$]		16.42	21.53	0.03–66.00
Test-retest interval[b] in months ($N = 18$)		11.17	(6.57)	6.00–31.00

(N) = 18 individuals. [N] = 9 pairs or families.
[a] Age at second testing not given.
[b] The mean test-retest interval was based on 9 complete twin pairs.

only complete pairs were included in the present study.

2.4. VTs

Detailed information about the VTs is provided in the original paper (Segal et al., 2007), so only selected features of this kinship are summarized here. VTs are same-age unrelated siblings reared together soon after birth that can be organized into one of two main types: adopted-adopted or adopted-biological. Defining criteria for virtual twinship are age difference of nine months or less, entry into the home by age one year, enrollment in the same school grade, and absence of adverse birth events that would affect cognitive performance (Segal, 1997). Thus, VTs afford sensitive comparisons with MZ twins, regardless of twin' rearing status. Specifically, VTs' matched age and closely timed entry into the home distinguish them from ordinary adoptive sibling pairs—as indicated, VTs replay twinship, but without genes shared by descent (Segal, Tan, & Graham, 2015). In the comparison presented here the VTs provide a direct estimate of shared environmental effects, whereas the CTA-MZs and D-MZAs provide a direct estimate of genetic effects. Age, age differences in testing, age at adoption, and test-retest interval for the VTs twin pairs are displayed in Table 1c.

The VTs (N = 43 pairs) were a subset of the sample of 170 pairs currently enrolled in the Fullerton Virtual Twin Study. The mean age of the VTs (N = 84 individuals; 2 individuals were in more than one pair) was $\bar{x}$= 5.11 years (SD = 1.10) at Time 1 and $\bar{x}$ = 10.77 (SD = 1.61) at Time 2. The sample included 30 adopted-adopted pairs (70 %) and 13 adopted-biological pairs (30 %). Additional information about the Fullerton Virtual Twin Study is available in Segal (2006), Segal et al. (2007), Segal and Niculae (2019), and Segal et al. (2021).

2.5. Procedures and protocols

2.5.1. Zygosity diagnosis (twins)

The monozygosity of 14 of the 15 CTA-MZ twin pairs was established by DNA analysis derived from buccal smears (saliva samples). These assignments aligned with results from a standard, widely used physical resemblance questionnaire, devised by Nichols and Bilbro (1966) and completed by the twins' mother. Cross-validation in the composition of the form showed that approximately 95 % of the development sample could be diagnosed with greater than 90 % accuracy. The single pair in the present sample that did not undergo DNA testing was classified as MZ, based on questionnaire scores. The zygosity of the D-MZA twins was assigned by resemblance in the highly heritable physical traits of blood/serum groups, eye color, hair color and dermatoglyphic features.

Table 1c
Age, age difference at testing, age at adoption and test-retest interval of virtual twins at Time 1 and Time 2 [N = 43 pairs]; (N = 84 individuals).

Measure	Time	Mean	SD	Range
Age at testing in years	1	5.11	1.10	4.00–8.70
($N = 84$)	2	10.77	1.61	7.18–13.67
Age difference at testing in months	1	3.05	2.62	0.00–8.93
[$N = 43$]	2	3.02	2.64	0.00–8.93
Age at adoption[a] in months ($N = 84$)		1.09	2.21	0.00–9.87
Test-retest interval in years ($N = 84$)		5.65	1.68	1.70–8.96

(N) = 84 individuals; one adoptee paired with triplets was counted only once in. Individual analyses [N] = 43 pairs or families.
[a] Age at entry into the family for adoptive children; age at hospital release for biological children.

2.5.2. General intelligence testing

2.5.2.1. CTA-MZ. The age-appropriate Wechsler IQ test was administered locally to the members of CTA-MZ pairs by different trained testers who were blind to the hypotheses and questions under investigation. Upon receipt, scoring was reviewed by the PI, allowing questions to be resolved prior to data processing. Efforts were made to minimize cotwins' interval between the two test sessions.

The use of separate testers for each pair member is a prudent practice in twin and sibling research, a field in which genetic findings have been challenged from time to time (Segal, 2012). However, such precautions made in the interest of avoiding biased administration and scoring appear unnecessary if the rules specified in the test manuals are closely followed (Segal & Russell, 1991).

2.5.2.2. D-MZA. The Danish twins completed the Wechsler-Bellevue test of intelligence-Form I (Wechsler, 1939). Cotwins were tested independently, but at the same time to avoid exchange of information. It appears that the same investigator tested both twins initially, but without knowledge of their biographical histories. Retesting was performed by this same examiner for six pairs and for one-cotwin in another pair. A second examiner administered the test to both co-twins in two pairs, yielding nine complete pairs who completed the test on two occasions.

2.5.2.3. VTs. The members of forty-one of the forty-three VT sets (eighty-two individuals) completed a second intelligence test during their participation in TAPS (Twin, Adoptees, Peers, and Siblings), a project that examined intelligence, friendship, adjustment and parenting of twins, full siblings, adoptees, and friends (McGuire & Segal, 2013). Cotwins in two pairs were tested twice as part of the original Fullerton study (Segal et al., 2007). Like CTA-MZs, the VTs completed the age-appropriate Wechsler IQ test. Recall that VTs resided in the same home. Therefore, with only a few exceptions, siblings were routinely tested by different examiners on the same day at both Time 1 and Time 2 to avoid biased administration and/or scoring; but see above. Time 2 scores for VTs were calculated from two verbal subtests (Information and Vocabulary) and two nonverbal subtests (Block Design and Picture Arrangement) from the WISC-III. The composite score derived from this process correlates higher than $r = 0.90$ with the IQ score derived from the complete protocol (Sattler, 1989).

2.6. Analytical procedures

Data analysis was organized into two parts: Part I. Descriptive features of the Time 1 and Time 2 IQ scores (e.g., means, standard deviations, range, and test-retest correlations) were obtained and compared. Intraclass correlations for IQ scores and the mean within-pair difference score were calculated and examined with reference to hypotheses a-b. Correlations between age at separation and contact time were examined with reference to hypothesis c. Part II: The cross-twin – cross-time correlation (R_{ct}) and retest correlation (R_{wt}) were used to recalculate IQ heritability (reared-apart twins) and environmentality (virtual twins). The R_{ct}/R_{wt} ratio estimates the true or disattentuated resemblance of the cotwins'/cosibs' trait set-points (Lykken, 2007).

Table 2a
CTA-MZ Twins' IQ scores at time 1 and time 2.

Time	Mean[a]	(SD)	Range	*r* (T1,T2)
Full scale IQ score[b]				
1	109.96	(14.31)	79–136	0.83***
2	109.46	(16.82)	71–136	
T2-T1[c]	−0.50	(9.45)	−23–17	
Interval (years)	4.20	(2.03)	2.00–9.00	

[a] Individual Data ($N = 28$).
[b] Time 2 v. Time 1 non-significant.
[c] Signed Mean Difference.
*** $p < .001$.

3. Results

3.1. Part I

3.1.1. Intelligence test scores: CTA-MZ

The mean IQ and within-pair difference scores of the CTA-MZs are displayed in Table 2a. The CTA-MZs' mean Full Scale IQ scores were nearly identical at Time 1 and Time 2. The correlation between tests taken at Time 1 and Time 2 was statistically significant ($r = 0.83$, $p < .001$). The IQ test-retest correlation exceeds values reported in the psychological literature for diverse groups of biological children (*rs* = 0.57 to 0.63), tested at ages 7–8 years and again at 17–18 years (Scarr et al., 1993). A more recent survey reported correlations of 0.47 -. 78 for tests (WPPISI and WISC) taken between young childhood, middle childhood, and adolescence (Deary, Whalley, Lemmon, Crawford, & Starr, 2000). The mean interval (time) between the two test administrations was $\bar{x} = 4.20$ years ($SD = 2.03$).

3.1.2. Intelligence test scores: D-MZA

The mean IQ and within-pair difference scores of the D-MZs are displayed in Table 2b. The D-MZAs' mean Full Scale IQ scores were several points higher at Time 2, a difference that was statistically significant. The test-retest correlation between tests taken at Time 1 and Time 2 also reached statistical significance ($r = 0.88$, $p < .001$); this correlation aligns well with the reliabilities (*rs* = 0.90–0.91) reported in four studies of typical individuals (Derner, Aborn, & Canter, 1950). The mean interval (time) between the two test administrations was $\bar{x} = 11.17$ months ($SD = 6.57$) and was unrelated to the within-pair difference at Time 2. Age at separation was also uncorrelated with the twins' IQ scores and within-pair difference scores at both Time 1 and Time 2.

3.1.3. Intelligence test scores: VT

The VTs' Full Scale IQ score was significantly higher at Time 2 than at Time 1, as reported previously (Segal et al., 2007). The test-retest correlation ($r = 0.50$, $p < .01$) was generally consistent with values reported for diverse child groups, cited above. The mean interval (time) between test sessions was $\bar{x} = 5.65$ years ($SD = 1.68$). These data are displayed in Table 2c.

Table 2b
D-MZA Twins' IQ scores at time 1 and time 2.

Time	Mean[a]	(SD)	Range	*r* (T1,T2)
Full Scale IQ Score[b]				
1	105.44	(10.31)	91–125	0.88***
2	108.61	(10.08)	96–135	
T2-T1[c]	3.17	(4.93)	−6–14	
Interval (months)	11.17	(6.57)	6–31	

$t(17) = -2.73$, $p < .01$.
[a] Individual Data ($N = 18$).
[b] Time 2 v. Time 1 non-significant.
[c] Signed mean difference.
*** $p < .001$.

Table 2c
Virtual twins' IQ scores at time 1 and time 2.

Time	Mean[a,2]	(SD)	Range	*r* (T1,T2)
Full scale IQ Score[2]				
1	105.86	(11.41)	83–135	
2	108.89	(13.25)	81–145	
T2-T1[b]	3.03	(12.38)	−28-31	0.50**
Interval (years)	5.65	(1.58)	1.70–8.96	

[a] Individual data ($N = 84$).
[2] $t(83) = -2.25$, $p < .05$.
[b] Signed mean difference.
** $p < .01$.

Table 3a
Chinese reared-apart twins: IQ intraclass correlations, within-pair differences, and 95 % confidence intervals at Time 1 and Time 2.

Time 1	r_i	95 % CI	Within-pair diff[1]	(SD)	Range
Full IQ					
1	0.51*	(0.03, 0.80)	11.93	(7.49)	1–30
2	0.81***	(0.52, 0.93)	7.93	(7.14)	0–22

$N = 15$ pairs, Time 1; $N = 14$ pairs, Time 2.
[1] $t(13) = 2.12$, $p < .05$.
* $p < .05$.
*** $p < .001$.

3.1.4. IQ similarities and differences: hypothesis testing

The IQ intraclass correlation for the CTA-MZ twins showed the anticipated increase in from Time 1 to Time 2 ($r_i = 0.51$ to 0.81), although the difference was not statistically significant. The anticipated reduction in the within-pair difference scores was also observed. These values for CTA-MZs at Time 1 and Time 2, respectively, were $\bar{x}= 11.93$ ($SD = 7.49$) and $\bar{x} = 7.93$ ($SD = 7.14$). These data are displayed in Table 3a. The mean test-retest interval of $\bar{x} = 4.20$ years, $SD = 2.03$ correlated significantly with the absolute within-pair difference (*rs* = −0.45, $p = .018$), but in a counterintuitive direction—larger intervals were associated with smaller within-pair IQ differences. Age at separation and age at adoption were uncorrelated with the IQ within-pair difference at both Time 1 and Time 2. Contact time subsequent to the first test session was unrelated to the IQ within-pair difference score at Time 2.

In addition to the hypotheses assessed above, it was observed that age at adoption correlated significantly with twins' IQ score at both Time 1 ($r = -0.48$, $p < .01$) and Time 2 ($r = -0.38$, $p < .05$). The direction of

Table 3b
Danish reared-apart twins: IQ intraclass correlations, within-pair differences, and 95 % confidence intervals at Time 1 and Time 2.

Time	r_i	95 % CI	Within-pair diff[a]	(SD)	Range
Full IQ					
1	0.64**	(0.15, 0.88)	7.25	(4.03)	1–14
2	0.74**	(0.23, 0.93)	6.56	(3.84)	3–15

$N = 12$ pairs Time 1; $N = 9$ pairs Time 2.
** $p < .01$.
[a] $t(8) = ns$.

Table 3c
Virtual twins: IQ intraclass correlations, within-pair differences, and 95 % confidence intervals at time 1 and time 2.

Time	r_i	95 % CI	Within-pair diff[1]	(SD)	Range
Full IQ					
1	0.30*	(0.01, 0.55)	10.74	(8.31)	0–40
2	0.11	(−0.19, 0.39)	14.12	(10.39)	0–50

($N = 43$ pairs).
[1] $t(42) = -2.03$, $p < .05$.

the correlations indicates that earlier adoption was associated with a higher IQ.

An increase in the magnitude of the intraclass correlation for the D-MZA pairs was noted, but was not statistically significant, nor was the relationship between the test-retest interval and the within-pair difference at the second testing. The within-pair IQ difference showed a slight decrease at Time 2, as shown in Table 3b; unfortunately, this finding could not be evaluated with reference to contact time between test sessions, due to the absence of this information in Juel-Nielsen's original study. However, contact time during "upbringing" was rated as "none," "slight," and "moderate." These ratings were unrelated to IQ scores and within-pair difference scores at both Time 1 and Time 2.

As expected, the test interval was also unrelated to the within-pair IQ difference. Age at separation was unrelated to the within-pair IQ difference at Time 1 and Time 2. However, in contrast with the CTA-MZ twins, a significant increase in IQ score from Time 1 to Time 2 was noted.

3.1.5. IQ similarity and differences: hypothesis testing (VT)

As reported earlier (Segal et al., 2007), the intraclass correlation for IQ showed the anticipated decrease from r_i = -0.30 to 0.11. The anticipated increase in the within-pair difference scores was also observed, a difference that was statistically significant ($p < .05$). These values at Time 1 and Time 2, respectively, were $\bar{x}$ = 10.74. (*SD* 8.31) and $\bar{x}$ = 14.12 (*SD* = 10.39). The mean test-retest interval showed a negligible correlation with the within-pair IQ difference score. These data are displayed in Table 3c.

3.2. Part II

3.2.1. Heritability and environmentality recalculated

The CTA-MZ correlation of the Time 1 and Time 2 scores (*R* of Means = 0.69) exceeded the Time 1 correlation, but not the Time 2 correlation. In contrast, the comparable D-MZA correlation exceeded the Time 1 and Time 2 correlations, the latter albeit slightly (*R* of Means = 0.76). As expected, the estimated heritability for both reared-apart samples increased when the R_{ct}/R_{wt} was used, compared with the Mean of *Rs* (0.65 *v.* 0.70 and 0.68 v. 0.75, respectively), consistent with Lykken's (2007) discussion. In contrast, the estimated environmentality for the VTs decreased, as expected (R_{ct}/R_{wt} = 0.12), indicating that shared environments contribute less to the IQ similarity of adoptive siblings over time. These findings are summarized in Table 4.

4. Discussion

4.1. Part I findings

The first longitudinal prospective study of young reared-apart MZ twins (CTA-MZ) showed convergence in IQ similarity (increased intraclass correlation and reduced within-pair difference) over time, as anticipated. However, these results require cautious interpretation given the small sample size. The lack of statistical significance in the Time 1 and Time 2 correlations most likely reflects that limitation. Nevertheless, the uniqueness of these data (longitudinal in nature) and the participant group (young reared-apart twins) lends the findings greater meaning than they might have otherwise. Furthermore, reared-apart twins offer significantly greater power than reared-together twins (Lykken, Geisser, & Tellegen, 1981). Despite their different homes, educational experiences, and (in some cases) residences in different countries, the twins appear to have interacted with their environments in ways that aligned with their genetic propensities. This supports the notion that environments do not act randomly in fashioning developmental outcomes—rather, individuals behave selectively and actively with respect to the people, places and events that engage and challenge them.

The foregoing explanation illustrates the simple, but profound concept of *nature* via *nurture* (Bouchard Jr., Lykken, McGue, Segal, & Tellegen, 1990, p. 228). The idea is that genetic factors are expressed "by influencing the character, selection, and impact of experiences during development." Of course, environments here refer to the normal range of settings that support human development; unusual or extreme environments that reduce or deprive individuals of emotional and/or physical sustenance can leave enduring effects on intelligence (Turkheimer, Haley, Waldron, d'Onofrio, & Gottesman, 2003; Segal & Montoya, 2018).

The CTA-MZ's nearly identical mean IQ scores at Time 1 to Time 2 may not be so surprising. While children show increased intellectual capacities from ages 2 to 12 years (Volkova, 2014), they change in ways that are generally consistent with their peers. Of course, none of the reported correlations approached 1.0. An association between earlier age at adoption and higher IQ was observed. This association is sometimes attributed to the relatively good health of an infant who appears more favorable to prospective adoptive parents. However, parents adopting children from China do not choose a child, but are assigned a child prior to their arrival. It is plausible that earlier age at adoption allows for earlier access to the adoptive family's resources and reduced time in the orphanage, but this explanation requires further study with pairs of MZ cotwins adopted at different times. A final point is that, in contrast with age at adoption, age at separation did not correlate with the twins' IQ scores. Age at separation and age at adoption are different (albeit, related) measures. Age at separation may arise if one twin is kept by the family, the twins are placed in different temporary foster care situations and adopted separately, or other circumstances. In contrast, age at adoption (in the present study) is the child's age upon entry into the adoptive family, not the age of legal adoption. Lastly, contact during the Time 1 to Time 2 interval had no effect on young twins' IQ resemblance, weakening critics' assertion that such factors affect intellect in meaningful ways; see Farber (1981) and Segal (2012).

Table 4
Heritability estimates for Wechsler IQ data for monozygotic twins reared apart and environmentality.

Estimate for Virtual Twins								
Study	*N* (pairs)	Time 1[a]	Time 2[b]	Mean of *Rs*	*R* of Means[c]	R_{wt}	R_{ct}	R_{ct}/R_{wt}
CTA-MZ	15/14	0.51*	0.81***	0.65	0.69**	0.82***	0.57***	0.70
D-MZA	12/9	0.64**	0.74**	0.68	0.76**	0.88***	0.66***	0.75
VT	43	0.30*	0.11	0.21	0.18	0.50**	0.06	.12

CTA-MZ: Chinese MZ twins reared apart; D-MZA: Danish MZ twins reared apart; VT: Virtual twins.
R_{wt}: Retest; R_{ct}: Cross Time-Cross Twin IQ Correlation; R_{ct}/R_{wt}: Estimate of Set-Point Heritability.
* p <.05.
** p <.01.
*** p < .001.
[a] Intraclass correlation, CTA-MZ: N = 15 pairs; D-MZA: N = 12 pairs; VT: N = 43 pairs.
[b] Intraclass correlation, CTA-MZ: N = 14 pairs; D-MZA: N = 9 pairs; VT: N = 43 pairs.
[c] Correlation of mean IQ scores.

Changes in IQ similarity among the adult Danish twins were slight, but in the predicted directions. The significant increase in IQ score at Time 2 is worth noting. Only nine complete pairs participated in the second phase of the study. Inspection of IQ scores of the three pairs present at Time 1, but not at Time 2, did not suggest that they were atypical in any way; however, some pairs with higher Time 1 IQ scores remained, possibly explaining the mean IQ increase at Time 2. Unfortunately, only age at separation, but not age at adoption, was provided in that study, but showed no relation to IQ performance as in the CTA-MZ analysis.

The VTs' results were discussed previously and they are summarized briefly above. Again, developmental trends reflected reduced IQ resemblance and increased within-pair difference. These findings most likely reflect the effects of new genetic factors and/or nonshared environments, as well as the declining effects of the shared experiences of same-age unrelated siblings growing up together. These results depart from those of the twins in the present study, especially the CTA-MZ pairs.

4.2. Part II findings

Consistent with Lykken's (2007) paper, the estimates of IQ heritability for the CTA-MZ twins, based on two IQ measures, exceeded the estimates based on the *R* of Means. This reflects the greater stability of the repeated data than the single time scores, although additional longitudinal measures would be desirable. When IQ heritability was estimated in this way for the D-MZA twins, the *R* of Means and ratio (R_{ct}/R_{wt}) were nearly the same. This difference between the two samples most likely speaks to the greater continuity of the adult IQ scores from Time 1 to Time 2. For VTs, the reduced IQ resemblance over time is a likely result of the waning effects of shared environmental influences on IQ, consistent with the ordinary adoptive sibling studies cited above.

4.3. Limitations

Limitations to the present study are the small sample sizes that urge careful interpretation of the findings. Nevertheless, confirmation of the hypotheses specified at the outset is encouraging. It is fortunate that continued IQ analyses are planned using participants in the Minnesota Study of Twins Reared Apart who have been IQ tested on two occasions (Segal, 2012). Further analyses of the CTA-MZ twins are also planned and will, hopefully, identify additional participants for study.

4.4. Implications

The findings reported here should offer parents and educators insights into the academic performances and interests of twins and adoptees. MZ twins can be expected to achieve similar results on school tests, whereas unrelated siblings can be expected to achieve different outcomes. Knowing this will help parents and educators tailor their treatment, resource provision, and expectations of different children within families. In doing so, they may avoid the frustration that may come from encouraging and/or expecting outcomes and goals that may be outside the child's inclinations. Even parents and teachers of nontwin children can benefit from acknowledging the variety of influences that shape general intelligence.

CRediT authorship contribution statement

Nancy L. Segal: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Writing – original draft, Writing – review & editing. **Elizabeth Pratt-Thompson:** Data curation, Writing – review & editing.

Declaration of competing interest

The authors have nothing to declare.

Data availability

The data that have been analyzed are confidential.

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References

Bouchard, T. J., Jr., Lykken, D. T., McGue, M., Segal, N. L., & Tellegen, A. (1990). Sources of human psychological differences: The Minnesota study of twins reared apart. *Science, 250*(4978), 223–228.

Bouchard, T. J. (2013). The Wilson effect: The increase in heritability of IQ with age. *Twin Research and Human Genetics, 16*(5), 923–930.

Buckley, C. (29 October, 2015). "China ends one-child policy, allowing families two children." New York Times, https://www.nytimes.com/2015/10/30/world/asia/china-end-one-child-policy.html.

Deary, I. J., Whalley, L. J., Lemmon, H., Crawford, J. R., & Starr, J. M. (2000). The stability of individual differences in mental ability from childhood to old age: Follow-up of the 1932 Scottish mental survey. *Intelligence, 28*(1), 49–55.

Derner, G. F., Aborn, M., & Canter, A. H. (1950). The reliability of the Wechsler-Bellevue subtests and scales. *Journal of Consulting Psychology, 14*(3), 172–179.

Evans, K. (2008). *The lost daughters of China: Adopted girls, their journey to America, and the search for a missing past.* New York: TarcherPerigee.

Farber, S. L. (1981). *Identical twins reared apart.* NY: Basic Books.

Johnson, W., Bouchard, T. J., Jr., McGue, M., Segal, N. L., Tellegen, A., Keyes, M., & Gottesman, I. I. (2007). Genetic and environmental influences on the verbal-perceptual-image rotation (VPR) model of the structure of mental abilities in the Minnesota study of twins reared apart. *Intelligence, 35*(6), 542–562.

Loehlin, J. C., Horn, J. M., & Willerman, L. (1989). Modeling IQ change: Evidence from the Texas Adoption Project. *Child Development, 60*(4), 993–1004.

Lykken, D. T. (2007). A more accurate estimate of heritability. *Twin Research and Human Genetics, 10*(1), 168–173.

Lykken, D.T., Geisser, S., & Tellegen, A. (1981). Heritability estimates from twin studies: The efficiency of the MZA design. (unpublished manuscript).

McCartney, K., Harris, M. J., & Bernieri, F. (1990). Growing up and growing apart: A developmental meta-analysis of twin studies. *Psychological Bulletin, 107*(2), 226–237.

McClearn, G. E., Johansson, B., Berg, S., Pedersen, N. L., Ahern, F., Petrill, S. A., & Plomin, R. (1997). Substantial genetic influence on cognitive abilities in twins 80 or more years old. *Science, 276*(5318), 1560–1563.

McGuire, S. A., & Segal, N. L. (2013). Peer networks: Overlap in twin, sibling and friend dyads. *Child Development, 84*(2), 500–511.

Nichols, R. C., & Bilbro, W. C., Jr. (1966). The diagnosis of twin zygosity. *Acta Genetica et Statistica Medica, 16*(3), 265–275.

Sattler, J. M. (1989). *Assessment of children's intelligence* (2nd ed.). Philadelphia: W.B. Saunders.

Scarr, S., Weinberg, R. A., & Waldman, I. D. (1993). IQ correlations in transracial adoptive families. *Intelligence, 17*(4), 541–555.

Segal, N. L. (1997). Twin research perspective on human development. In N. L. Segal, G. E. Weisfeld, & C. C. Weisfeld (Eds.), *Uniting psychology and biology: Integrative perspectives on human development* (pp. 145–173). Washington, D.C.: APA Press.

Segal, N. L. (2006). Fullerton Virtual Twin Study. *Twin Research and Human Genetics, 9*(6), 963–964.

Segal, N. L. (2012). *Born together-reared apart: The landmark Minnesota Twin Study.* Cambridge, MA: Harvard University Press.

Segal, N. L., McGuire, S. A., Havlena, J., Gill, P., & Hershberger, S. L. (2007). Intellectual similarity of virtual twin pairs: Developmental trends. *Personality and Individual Differences, 42(7)*, 1209–1219.

Segal, N. L., & Montoya, Y. S. (2018). *Accidental brothers: The story of twins exchanged at birth and the power of nature and nurture.* New York: St: Martin's Press.

Segal, N. L., & Niculae, F. J. (2019). Fullerton Virtual Twin Project: Overview and 2019 update. *Twin Research and Human Genetics, 22*(6), 731–734.

Segal, N. L., Niculae, F. J., Becker, E. N., & Shih, E. Y. (2021). Reared-apart/reared-together Chinese twins and virtual twins: Evolving research program and general intelligence findings. *Journal of Experimental Child Psychology, 207*, 105106.

Segal, N. L., & Russell, J. (1991). IQ similarity in monozygotic and dizygotic twin children: Effects of the same versus separate examiners: A research note. *Journal of Child Psychology and Psychiatry, 32*(4), 703–708.

Segal, N. L., Tan, T. X., & Graham, J. L. (2015). Twins and virtual twins: Do genetic (as well as experiential) factors affect developmental risks? *Journal of Experimental Child Psychology, 136*, 55–69.

Turkheimer, E., Haley, A., Waldron, M., d'Onofrio, B., & Gottesman, I. I. (2003). Socioeconomic status modifies heritability of IQ in young children. *Psychological Science, 14*(6), 623–662.

Volkova, E. V. (2014). Age dynamics of intelligence in adolescence and early adulthood. *Procedia-Social and Behavioral Sciences, 140*, 440–446.

Wilson, R. S. (1978). Synchronies in mental development: An epigenetic perspective: Early mental development of twins and siblings is analyzed within the framework of evolutionary theory. *Science, 202*(4371), 939–948.

THE TWIN CHILDREN OF THE HOLOCAUST

STOLEN CHILDHOOD AND THE WILL TO SURVIVE

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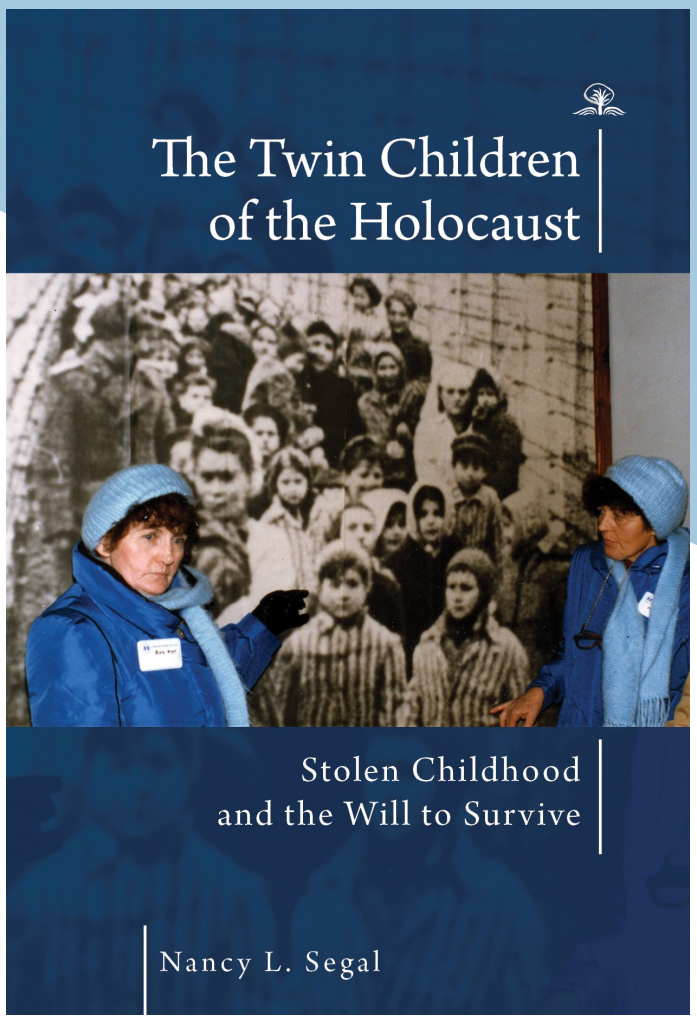

SUMMARY

The Twin Children of the Holocaust: Stolen Childhoods and the Will to Survive is an annotated collection of original, informative, and moving photographs of the twins who survived the brutal medical experiments conducted at the Auschwitz-Birkenau death camp (1943-1945). The experiments were conducted by the infamous physician, Josef Mengele. These never-before-seen photographs were taken by the author (Segal) at the 40th anniversary of the camp's liberation (1985) and the public hearing on Mengele's crimes at *Yad Vashem* (Hand and Name) in Jerusalem that followed. Other memorable moments, captured in photographs include traveling to Krakow, visiting Warsaw, and hearing survivors' testimonies. The photographs are organized into ten sections that unfold chronologically—each section is accompanied by a brief essay to provide compelling context and each photograph has an informative caption.

ABOUT THE AUTHOR

Dr. Nancy L. Segal is Psychology Professor and Director, Twin Studies Center, at California State University, Fullerton. Her book, *Born Together-Reared Apart*, won the American Psychological Association's William James Book Award. Her work has been featured in the *New York Times* and *Atlantic Monthly*. She has appeared on the *Oprah Winfrey Show*, *Good Morning America*, and the *BBC* .

"Archfiend Josef Mengele escaped earthly justice for his ghoulish experiments on child twins and other Auschwitz victims, but Nancy Segal gives them a voice and lights an eternal candle in their memory. A testament to the power of love over evil."

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"'For us, forgetting was never an option' observed Elie Wiesel. In this very moving and significant book of photographs, Dr. Segal has ensured the twins, who endured horrific experiments at the hands of Josef Mengele, will be remembered as Jews who had families before the war and built meaningful new lives after the war. The Germans sought to strip them of their identities and their humanity, but the Jews prevailed against all odds."

— Dr. Alex Grobman, senior resident scholar at the John C. Danforth Society

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Assortative parenting and assortative cross-parenting: New views of parental preference for selected children

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ABSTRACT

Two novel parenting terms are introduced into the literature on parent-child relationships. The first term, *assortative parenting*, references a familiar, but poorly defined concept regarding parental affinity for a given child. The second term, *assortative cross-parenting*, denotes a previously unrecognized relationship phenomenon, namely parental attraction to a child who displays favored qualities expressed by the parent's partner. These terms derived from interviews with same-sex couples, but easily apply to heterosexual couples, as well. The proposed concepts and labels should initiate new lines of inquiry that can illuminate unstudied aspects of family dynamics. Given that improved reproductive techniques and revised societal attitudes are continually creating novel family structures, studies of personal relationships and the families in question would benefit by admitting these concepts into ongoing research programs.

> "I liked to think that Bonnie was you, a little girl again. She was so like you, so willful, so brave and gay and full of high spirits, and I could pet her, and spoil her–just as I wanted to pet you."
>
> Rhett Butler, in *Gone with the Wind* [1]

1. Introduction

The origins of parental preference for selected children in a family have been investigated and debated by human developmental researchers. Studies have variously found that birth order, sex, genetic relatedness, health, quality of sibling relations and perceived parent-child similarities and differences in appearance, personality, interests, and talents are associated with "parental favoritism," as judged by adolescent and adult child respondents [2–4]. I will argue that parental favoritism is an inappropriate label for a broad concept that fails to capture some vital factors influencing parent-child relations. Another caveat is that research in this area has been based largely on the views of children, rather than their parents.

Assigning a name to a principle, concept or process facilitates control, communication and clarity [5]. "New conceptions require new terms." (p. 181) [6]. These two citations reference developments in mathematics and social justice, respectively, but I will cite examples from the field of evolutionary psychology. This is done for illustrative purposes and because evolutionary concepts relevant to the present paper will be considered in the discussion.

The term *evolutionary psychology* was most likely used by Ghiselin in 1973 [7] and later popularized by Barkow, Cosmides, and Tooby in 1992 [8]. Barkow et al. (1992) explain that "Evolutionary psychology is psychology informed by the fact that the inherited architecture of the human mind is the product of the evolutionary process." (p. 7). Mayr, in 1961 [9], popularized terms distinguishing between two forms of causation: proximate (immediate, individual level causes of development or physiology) and ultimate (historical, population-level statistical causes in evolutionary biology), both used today. Hamilton's 1963 theory of altruism was assisted by Maynard Smith's 1964 term *kin selection,* to denote the self-sacrificing behaviors performed by individuals for the benefit of genetic relatives [10].

This commentary introduces two new terms into the early human developmental literature: *assortative parenting* and *assortative cross-parenting*. These terms derive from the well-known phenomenon of assortative mating, namely the non-random pairing of significant others, based mostly on behavioral similarities, such as verbal cognition and values [11]. These new terms emerged from interviews I conducted with several married same-sex male couples who became fathers of twins via egg donation and surrogacy. In two cases, each father had contributed

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sperm for the creation of one of the two embryos, yielding heteropaternal twins; these twins are genetically related as half-siblings, sharing 25 % of their genes, on average, by descent. This assisted reproductive procedure replays the natural process of *superfecundation.* In a third case, the twin embryos were created with sperm from each father, but with eggs provided by different donors. These twins share no common genes by descent. It is theoretically possible, but practically impossible, for such twins to occur naturally [12]. A family with heteropaternal twins is displayed in Fig. 1.

Superfecundation occurs naturally, yielding heteropaternal twins if a woman engages in sexual relations with different men within a given window of time. Specifically, once eggs are released they can last for twelve to forty-eight hours, while sperm are viable for seven to ten days [13,14]. Of course, if a woman engages in sexual relations with the same partner close in time, she may conceive twins that are superfecundated, but not heteropaternal. Superfecundation is presumed to be rare, but some cases may be unreported or even undetected.

2. Novel concepts

Assortative parenting denotes the attraction and affinity experienced and expressed by a mother or father toward a child in whom that parent perceives shared characteristics. Such feelings have been expressed by parents of very young children, even within the first two years of life. This concept is not unrecognized, yet has been poorly defined in the extant literature. It does not imply favoritism over other children in the family, but rather a unique like-mindedness felt by the parent toward a particular child that may eventuate in enhanced mutual support and understanding. Relevant to this discussion is the extended twin-family research design, a method of choice for exploring genetic and environmental influences on behavioral traits [15]. It arises when monozygotic (MZ) and dizygotic (DZ) twins and their unrelated partners conceive and raise children. In these families, MZ twin aunts/uncles segue into the "genetic mothers/fathers" of their co-twin's children, while DZ twin aunts/uncles maintain conventional family relationships. Research shows that MZ twin aunts/uncles express great social closeness toward nieces/nephews, relative to DZ twin aunts/uncles, possibly rooted in their perceptions of behavioral resemblance [16].

Assortative cross-parenting, in contrast, *is* a label for a novel phenomenon. It conveys the previously overlooked concept that a parent can feel a special affinity with a child who expresses traits that are common to his or her significant other. In fact, such traits are likely to be those that initially attracted the parent to the partner and which the parent continues to value. Examples include calmness, exuberance, and happiness. Again, this feeling by a parent does not imply favoritism or differential love for one child over another. Instead, it implies a particular facet of the parent-child relationship that may lay the basis for a unique form of attraction and/or affiliation that is not shared with other children.

Assortative parenting and *assortative cross-parenting* are not limited to same-sex couples and/or to families with twins. However, the fact that each gay father I spoke with created just one twin possibly allowed the traits of his partner to be perceived with greater clarity than might be true of heterosexual couples who conceive jointly. The quote at the start

Fig. 1. Heteropaternal twins with their parents. Photo credit: Images of Life by Ashli.

of this essay, albeit from a work of fiction, beautifully captures the sentiments that a parent may feel toward a child whose behavioral predispositions are reminiscent of the other parent. Of course, given the random combination of genetic factors transmitted across generations, as well as changing environmental contexts and contingencies, it is possible that some parents do not perceive their partner's traits in a child. The members of one same-sex male couple with whom I spoke failed to find such commonalities, but both fathers understood the concept and endorsed its credibility.

3. Twins and another informative pairing

3.1. MZ twins

MZ twins show greater resemblance than any other pair of individuals, yet twin studies of intelligence, personality and other behaviors consistently yield correlations equal to less than 1.0. Therefore, environmental effects, including prenatal (e.g., intrauterine growth restriction), perinatal (e.g., mode of delivery), and/or postnatal influences (e.g., illnesses) can variously conspire to create early differences between MZ cotwins [17]. (Recent work has revealed genetic differences between MZ twins, although full significance of these differences has not been described [18]). DZ cotwins also show early differences due to the events listed above, but also due to genetic differences between them.

Observational data have found that mothers of prematurely born infant twins consistently responded more positively toward their healthier baby at eight months of age, relative to his or her less healthy cotwin. The psychological mechanisms driving this behavior are uncertain, especially given the small sample size, but they align with predictions from evolutionary approaches, i.e., parental investment theory [19]. For example, care for a particular child should maximize parental reproductive fitness, while reducing care for another child. However, the possibility that mothers perceive greater trait resemblance between themselves (or their partners) and features of the healthier twin cannot be dismissed; it is likely assortative parenting and/or assortative cross-parenting work in concert with other factors. Longitudinal MZ twin research has found that three-year-old twins who experienced less negative parental feelings than their cotwin showed greater self-control at age seven. Similarly, twins' self-control differences at age four predicted negative parental feelings at age seven, suggesting a bidirectional effect. (This association was not detected between the ages of seven and nine years [20].) Again, differential parental perceptions of similarity toward a child, between themselves and/or their partner, may be linked to cotwin differences in relatively positive and negative parental feelings and actions.

3.2. Biracial twins

The label *biracial twins* is an unfortunate choice for DZ twins born to mixed race couples. That is because these twins are equally biracial, but have inherited different sets of genes from their parents, causing them to look quite different in appearance *and* to possibly resemble one parent or partner more than the other in behavioral and physical characteristics [21]. (Nontwin siblings born to biracial couples can also inherit different sets of genes underlying appearance and behavior.) I have been studying a small, but growing, sample of biracial twins to better understand the twins' different life experiences and associated parenting challenges. Such twins are also well-suited to examining assortative parenting and assortative cross-parenting, especially given opportunities to track parent-child relations during early infancy and beyond. Two pairs of biracial twins are shown in Fig. 2a and b.

It is possible that physical resemblance is a more salient factor for parental affinity when infants are young, but may change over time as children's abilities and personalities emerge with greater clarity during development. At present, firm conclusions regarding parental attraction to a specific biracial cotwin cannot be drawn, but several parents have emphasized the importance of similarity in personality, rather than appearance, as a factor affecting time spent with one young twin. Various family members (e.g., grandparents, aunts and uncles) also express views regarding which twin resembles which parent, possibly contributing to assortative parenting and assortative cross-parenting processes.

4. Summary: rethinking family dynamics

Assortative parenting and *assortative cross-parenting* are not mutually exclusive processes. Parents may experience the former with one child, the latter with another child, or both with a single child. Either could conceivably foster envy or jealousy by one child toward another if he or she witnessed exceptional understanding between a sibling and a parent. This understanding, if present, would most likely apply only to selected behavioral domains or activities. It is also conceivable that a parent might experience assortative parenting and/or cross-parenting with an adopted child whose traits mimic those of the self or partner. Regardless,

Fig. 2. a. These same-sex dizygotic "biracial" male twins have a Caucasian mother and African American father.
b. These opposite-sex dizygotic "biracial" twins have a Caucasian mother and Black Hispanic/Latino father. Photo courtesies: The twins' families.

at the practical level, acknowledging and embracing children's individual differences remains an essential component of effective parenting.

Assortative parenting and cross-parenting are meaningful at multiple theoretical levels. Proximal interpretations would acknowledge the happiness and satisfaction parents derive from nurturing the interests and talents of a child that they see in themselves and/or their partner. They would also enjoy the close attachment likely to emerge from that association. Ultimate explanations might acknowledge the increased chance of altruism directed toward a particular child, given the genetic relatedness of parent and child, i.e., 50 %. Greater altruism might also be directed toward a child who expresses traits shared with the partner–such traits may be those that explain the couple's attraction, both as a companion and co-parent. However, while greater altruism is not necessarily implied, it is conceivable as a consequence of the like-mindedness and mutuality arising from assortative parenting and cross-parenting.

4.1. Future lines of inquiry

The concepts and labels described herein promise to initiate new lines of human developmental inquiry for understanding early and evolving family dynamics. This is especially true today, given the novel families that are continually evolving, due to improved reproductive techniques and revised societal outlooks [22]. Researchers might track the allocation of resources by parents to children for evidence of differential distribution. For example, a sports-minded parent might support the interests of an athletically talented child at the expense of a child inclined toward more sedentary activities (assortative parenting). It would also be worth exploring if a parent, who was enamoured of and benefitted from their partner's extraordinary emotional understanding, perceived this ability in a child and made concerted attempts to nurture it (assortative cross-parenting). Parents' recordings of time spent alone with each child and the nature of the activity would be another informative approach to isolating these processes. Comparing outcomes from assortative parenting and cross-parenting in adoptive and biological children raised together could be insightful. Interestingly, but not surprisingly, successful adoptions are more likely those in which children and parents perceive similarities between them [23].

These proposed studies would benefit from an indirect approach—parents rarely admit to favoritism or preference when it comes to their children. Furthermore, as stated above, I believe that concepts such as like-mindedness that eventuate in unique forms of parent-child support and understanding are more refined reflections of assortative parenting and cross-parenting than preference or favoritism.

Parents may be unaware of, or even deny, treating children in ways that align with their own traits and/or their partner's traits. Their actions may masquerade as favoritism, causing specific children to feel variously overlooked and dejected. Parental knowledge of assortative parenting and assortative cross-parenting may help parents apply rearing practices in more balanced fashion, thus mitigating unfavorable child reactions. Professional awareness of these new terms and concepts may assist them in alleviating family tensions. It is my hope that giving names to these family processes will provide the control, communication and clarity they deserve.

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Author contributions

The author was solely responsible for the crafting of this brief report. This included conceiving the idea, conducting the literature search and composing the manuscript.

CRediT authorship contribution statement

Nancy L. Segal: Conceptualization, Data curation, Project administration, Writing – original draft, Writing – review & editing.

Declaration of competing interest

The author has no conflict of interest to declare.

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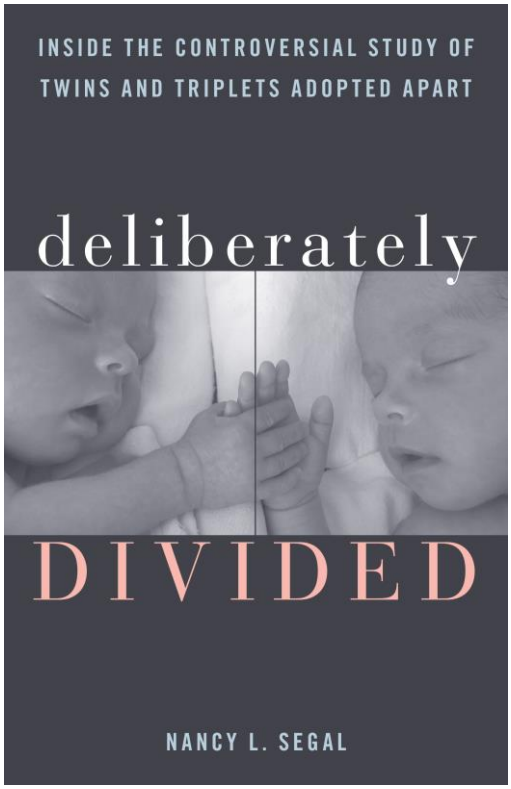
References

[1] M. Mitchell, Gone With the Wind, Macmillan, NY, 1936, p. 1018.
[2] P.A. Rohde, K. Atzwanger, M. Butovskaya, A. Lampert, I. Mysterud, A. Sanchez-Andres, F.J. Sulloway, Perceived parental favoritism, closeness to kin, and the rebel of the family: the effects of birth order and sex, Evol. Hum. Behav. 24 (4) (2003 Jul 1) 261–276.
[3] J. Fitness, Favouritism and rejection in Families: black sheep and golden-haired children, in: Proceedings of the Australian Psychology Society's Psychology of Relationships Interest Group (4th Annual Conference) 63, 2004 Nov 8, pp. 63–67.
[4] Y. Zhao, F. Chen, C. Yuan, R. Luo, X. Ma, C. Zhang, Parental favoritism and mobile phone addiction in Chinese adolescents: the role of sibling relationship and gender difference, Child Youth Serv. Rev. 120 (2021 Jan 1), 105766.
[5] L. Graham, The power of names, Theol. Sci. 9 (1) (2011) 157–164.
[6] P. Sands, East West Street: On the Origins of "Genocide" and "Crimes Against Humanity", Vintage, Visalia, CA, 2016.
[7] M.T. Ghiselin, Darwin and evolutionary psychology: Darwin initiated a radically new way of studying behavior, Science 179 (4077) (1973 Mar 9) 964–968.
[8] J. Tooby, L. Cosmides, J. Barkow (Eds.), The Adapted Mind. Evolutionary Psychology and the Generation of Culture, Oxford University Press, New York, 1992.
[9] R.L. Brown, Proximate versus ultimate causation and evo-devo, in: L. Rosa, G. Müller G. (Eds.), Evolutionary Developmental Biology: A Reference Guide, Springer, Cham, 2021, pp. 425–433.
[10] A. Gardner, S.A. West, G. Wild, The genetical theory of kin selection, J. Evol. Biol. 24 (5) (2011 May) 1020–1043.
[11] V.S. Knopik, J.M. Neiderhiser, C. DeFries, R. Plomin, Behavioral Genetics, 7th ed., Worth Publishers, New York, 2017.
[12] N.L. Segal, Gay Fathers, Twin Sons: The Citizenship Case That Captured the World, Rowman & Littlefield, Lanham, MD, 2023.
[13] E. Ambach, W. Parson, C. Brezinka, Superfecundation and dual paternity in a twin pregnancy ending with placental abruption, J. Forensic Sci. 45 (1) (2000 Jan 1) 181–183.
[14] New Jersey Judge Rules Twin Girls Have Different Fathers. https://www.cnn.com/2015/05/08/us/new-jersey-twins-two-fathers/index, 2015. (Accessed 8 November 2023).
[15] T. Baier, E.M. Eilertsen, E. Ystrøm, I.M. Zambrana, T.H. Lyngstad, An anatomy of the intergenerational correlation of educational attainment–learning from the educational attainments of Norwegian twins and their children, Res. Soc. Stratif. Mobil. 79 (2022 Jun 1), 100691.
[16] N.L. Segal, D.A. Arch, K.S. Preston, W.D. Marelich, Social closeness revisited in monozygotic and dizygotic twin families: aunt/uncle-niece/nephew relations, Personal. Individ. Differ. 157 (2020 Apr 15), 109815.
[17] xxxx N, Twin Mythconceptions: False Beliefs, Fables, and Facts About Twins, Academic Press, New York, 2017.
[18] H. Jonsson, E. Magnusdottir, H.P. Eggertsson, O.A. Stefansson, G.A. Arnadottir, O. Eiriksson, F. Zink, E.A. Helgason, I. Jonsdottir, A. Gylfason, A. Jonasdottir, Differences between germline genomes of monozygotic twins, Nat. Genet. 53 (1) (2021 Jan) 27–34.
[19] J. Mann, Nurturance or negligence: maternal psychology and behavioral preference among preterm twins, in: J. Barkow, L. Cosmides, J. Tooby (Eds.), The Adapted Mind: Evolutionary Psychology and the Generation of Culture, Oxford University Press, Oxford, 1992, pp. 321–344.
[20] C.A. Cecil, E.D. Barker, S.R. Jaffee, E. Viding, Association between maladaptive parenting and child self-control over time: cross-lagged study using a monozygotic twin difference design, Br. J. Psychiatry 201 (4) (2012 Oct) 291–297.
[21] xxxx, 'Biracial'-looking twins: a new twin type?, Twin Res. Hum. Genet. 20 (3) (2017) 260–265. Jun.
[22] S.A. Grover, Z. Shmorgun, S.I. Moskovtsev, A. Baratz, C.L. Librach, Assisted reproduction in a cohort of same-sex male couples and single men, Reprod. BioMed. Online 27 (2) (2013 Aug 1) 217–221.
[23] Adoption: dealing with genetic differences. https://www.familyeducation.com/kids/adoption/adoption-dealing-genetic-differences, 2022. (Accessed 21 November 2023).



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In the early 1960s, the head of a prominent New York City Child Development Center and a psychiatrist from Columbia University launched a study designed to track the development of twins and triplets given up for adoption and raised by different families. The controversial and disturbing catch? None of the adoptive parents had been told that they were raising a twin—the study's investigators insisted that the separation be kept secret. Here, Nancy Segal reveals the inside stories of the agency that separated the twins, and the collaborating psychiatrists who, along with their cadre of colleagues, observed the twins until they turned twelve. This study, far outside the mainstream of scientific twin research, was not widely known to scholars or the general public until it caught the attention of documentary filmmakers whose recent films, Three Identical Strangers and The Twinning Reaction, left viewers shocked, angered, saddened and wanting to know more.

Interviews with colleagues, friends and family members of the agency's psychiatric consultant and the study's principal investigator, as well as a former agency administrator, research assistants, journalists, ethicists, attorneys, and—most importantly--the twins and their families who were unwitting participants in this controversial study, are riveting. Through records, letters and other documents, Segal further discloses the investigators' attempts to engage other agencies in separating twins, their efforts to avoid media exposure, their worries over informed consent issues in the 1970s and the steps taken toward avoiding lawsuits while hoping to enjoy the fruits of publication. Segal's spellbinding stories of the twins' separation, loss and reunion offers readers the behind-the-scenes details that, until now, have been lost to the archives of history.

About the Author

Nancy L. Segal, PhD, is Professor of Psychology at California State University, Fullerton and Director of the Twin Studies Center. She has authored over 300 scientific articles and six books on twins and twin development—a recent survey placed her among the top 2% of well-cited scientists worldwide. Born in Boston and raised in New York City, she lives in southern California.

Praise for the Book

"The documentary *Three Identical Strangers* captivated viewers with the story of identical triplets who were separated at birth, studied by psychiatrists, and kept unaware of one another's existence. *Deliberately Divided* is the inside story of the history and science behind this disturbing event, told by a leading researcher and a gifted expositor."**—Steven Pinker, Johnstone Professor of Psychology, Harvard University, and author of "The Blank Slate" and "Rationality"**

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