



# What virtual twins reveal about general intelligence and other behaviors

Nancy L. Segal<sup>a,\*</sup>, Shirley A. McGuire<sup>b</sup>, Joanne Hoven Stohs<sup>a</sup>

<sup>a</sup> California State University, Fullerton, Department of Psychology, United States

<sup>b</sup> University of San Francisco, Department of Psychology, United States

## ARTICLE INFO

### Article history:

Available online 23 December 2011

### Keywords:

Virtual twins  
Intelligence  
Twins  
Siblings

## ABSTRACT

The Fullerton Virtual Twin Study has been assessing the behaviors of an unusual sibship since 1991. Virtual twins (VTs) are same-age, unrelated siblings reared together since infancy. They replicate the rearing situation of twins but without the genetic link, enabling direct assessment of shared environmental effects on behavior. An updated analysis of IQ data, based on an increased sample of 142 VT pairs (7.87 years,  $SD = 8.22$ ), is presented. Intraclass correlations of .28 (IQ) and .11 (subtest profile) indicated modest shared environmental influences on intelligence. Findings from the Twins, Adoptees, Peers and Siblings (TAPS) project that studies virtual twins and other kinships are described.

© 2011 Elsevier Ltd. All rights reserved.

## 1. Introduction

Virtual twins (VTs) are same-age, unrelated siblings reared together since infancy. They replicate the rearing situation of twins, but without the genetic link, enabling direct assessment of shared environmental effects on behavioral and physical traits. Most VT pairs include two adopted children, or one adoptee and one biological child of the rearing parents. The research advantages of VTs, compared with ordinary adoptive siblings, are that members of VT pairs share their age, residential histories and many life experiences. An updated VT analysis of IQ data from the Fullerton Virtual Twin Study is presented, followed by findings from the TAPS (Twins, Adoptees, Peers and Siblings) project. This work illustrates the usefulness of including VTs in psychological research.

### 1.1. Virtual twins and IQ

A 2005 report found little VT similarity in general intelligence ( $r_1 = .26$ ,  $n = 113$  pairs), suggesting modest shared environmental influences (Segal & Hershberger, 2005). This result was expected, given previous twin and adoption studies indicating genetic and non-shared environmental effects on general ability. Results from a study using a larger VT sample concurred with these findings (Segal, 2010). In related work, the IQ intraclass correlation for a VT subsample ( $n = 43$  pairs) tested twice decreased from .30 (age 5.11 years) to .11 (age 10.77 years), demonstrating the waning of shared environmental influences and the increasing effects of other sources of influence on intelligence during development (Segal, McGuire, Miller, & Havlena, 2008).

## 2. Materials and methods

### 2.1. Participants

Virtual twins must meet specified guidelines:

- Adoptees must be in their homes by age 1 year.
- Sibling age differences must be less than 9 months.
- Siblings must attend the same school grade.
- Participants must be free of adverse birth events
- Participants must be minimally 4 years of age.

Same-sex and opposite-sex siblings are accepted into the study because DZ twins may be same-sex or opposite-sex. Siblings of different ethnicities also qualify because DZ twins with interracial parents may appear different physically (Segal, 2000a).

Virtual twins occur most commonly when couples adopt two near-in-age infants almost simultaneously, as shown in Table 1. However, a substantial minority of VT pairs result when mothers conceive children while seeking adoption. The present study included several pairs created in other ways, as explained later.

Participants' mean age was 7.87 years ( $SD = 8.22$ ) and the mean age difference was 3.22 months ( $SD = 2.77$ ). The mean ages of mothers and fathers were 43.24 years ( $SD = 7.20$ ) and 45.72 years (9.66), respectively. Most mothers (60%) and fathers (78%) were engaged in professional-level occupations. (Ages were missing for three mothers and 22 fathers, and occupational data were missing for 10 fathers.) Older age and higher occupational status are characteristic of adoptive parents who often delay child-bearing and undergo prescreening by social workers. Additional sample characteristics are shown in Table 2.

\* Corresponding author.

E-mail address: [nsegal@fullerton.edu](mailto:nsegal@fullerton.edu) (N.L. Segal).

**Table 1**  
Virtual twins: pair types.

PAIR TYPE	N	BB	GG	BG
Adop–Adop	93	23	21	49
Adop–Biol <sup>a</sup>	49	16	12	21
Total	142	39	33	70

<sup>a</sup> Same-sex couple, each with a biological child.

**Table 2**  
Descriptive characteristics of virtual twins.

Measure	Mean	SD	Range
Age difference in mon [142]	3.22	2.77	0–9.2
Age at testing in Years (275)	7.87	8.22	4.01–54.8
Test interval in days [142]	4.22	24.07	0–255
Age difference at testing in mon [142]	3.28	2.80	0–9.9
Age at adoption in days (224)	56.46	91.68	0–373
Number of previous living situations (221) <sup>a</sup>	0.67	1.02	0–8

(N) = individuals; [N] = pairs or families.

<sup>a</sup> Data were missing for three individuals.

## 2.2. Materials

Virtual twins were located throughout the United States and Canada. Most pairs (85%) were identified through newspaper or magazine articles, and personal referrals. The remainder was located via television, radio, self-referral and other sources. Families received materials by mail (among them an informed consent letter, family demographic questionnaire, Child Behavior Checklist, Adjective Checklist, medical/dental history and personality checklist), to complete and return to the laboratory. Children also completed the Wechsler IQ test, administered by testers recruited in the cities where families resided. With only a few exceptions, pair members were tested by different examiners to avoid biased administration and scoring, and were tested on the same day to prevent discussion of items. Test protocols were reviewed for scoring accuracy upon receipt. Additional discussion of procedures is provided in Segal (1997, 2000b).

## 3. Results

### 3.1. Mean IQ scores

The VTs' mean IQ score, shown in Table 3, was 105.83 (SD = 13.37), somewhat above the average IQ score of 100 and with slightly smaller variance, consistent with expectations for a volunteer sample raised in predominantly upper-middle class homes. The intraclass correlation of .28, an index of shared environmental influence, replicated findings from previous analyses of smaller VT samples (.21–.26). The mean IQ difference of 12.71 (SD = 9.76) was somewhat less than the 14-point difference for full siblings and the 17-point difference expected for unrelated individuals selected randomly (Plomin & DeFries, 1980); twins and non-twins on which these data are based ranged from age three to the mid-twenties. The lower than expected IQ difference is most likely due to the more salient effects of family environments on behavior when children are young. Support for this interpretation comes from adoption studies documenting increasing IQ dissimilarity between unrelated siblings approaching adolescence (Scarr, Weinberg, & Waldman, 1993). Recall from Section 1.1 that a subsample of 43 VT pairs tested twice declined in IQ resemblance between 5 and 10 years of age (Segal, McGuire, Havlena, Gill, & Hershberger, 2007).

**Table 3**  
VTs' IQ scores and related data (N = 142 pairs).

	Mean <sup>a</sup>	SD	Range	$r_i$	95% CI	Diff. <sup>b</sup>	SD	Range
Full IQ	105.83	13.37	70–148	.28***	(.12–.42)	12.71	9.76	0–45
Verbal IQ	105.25	14.03	62–150	.22**	(.06–.37)	13.49	10.90	0–53
Performance IQ	105.36	13.2	70–144	.26***	(.10–.41)	13.66	9.40	0–41

<sup>a</sup> Individual data (N = 275).

<sup>b</sup> Pair data (N = 142).

\*  $p < .05$ .

\*\*  $p < .01$ .

\*\*\*  $p < .001$ .

### 3.2. Correlations between IQ and other measures

Age at testing correlated modestly, but significantly, with IQ (.24,  $p < .01$ ), Verbal IQ (.19,  $p < .01$ ) and Performance IQ scores (.24,  $p < .01$ ), showing that older children outperformed younger children. This might reflect the greater IQ stability of children above age seven. Pair type (biological–adopted or adopted–adopted) also correlated positively with IQ (.22,  $p < .01$ ), Verbal IQ (.17,  $p < .01$ ) and Performance IQ (.22,  $p < .01$ ), with members of biological–adoptive pairs outscoring members of adopted–adopted pairs. This result may reflect the transmission of both genes and environments conducive to high intelligence by the generally professional-level biological parents to their biological children. Adopted children in these homes would have also been likely to benefit from the enriched environment. Age at entry into the family (full sample) and age at adoption (225 adoptees) showed modest negative, but significant correlations with IQ and Verbal IQ (–.15 to –.18,  $p < .01$ ), indicating that earlier arrival in the home predicted better performance. This most likely reflected the better health of infants before being released to their biological or adoptive families.

### 3.3. IQ differences and pair characteristics

Mean pair age correlated modestly, but significantly, with intra-pair differences in IQ (.23,  $p < .01$ ) and Verbal IQ (.24,  $p < .01$ ), but not Performance IQ. Specifically, differences were larger for older pairs than younger pairs. IQ differences were not associated with age difference, difference in age at testing, test interval, pair sex (same or different), pair type (adopted–biological/adopted–adopted) or ethnicity (same/different). However, the intrapair Verbal IQ difference correlated significantly with attending the same class (.27,  $p < .01$ ) and with the percentage of years that siblings attended the same class (–.25,  $p < .01$ ). Common classroom placement was associated with a smaller Verbal IQ difference, but the causal relationship between these measures was uncertain.

### 3.4. IQ profile correlations

A concordance estimate for the VTs' IQ subtest profiles was calculated using a two-factor mixed design with repeated-measures on one factor, adapted for twin research (Wilson, 1979). Findings from an earlier twin study provided comparative data (Segal, 1985). Profile correlations and 95% confidence intervals for the three sibships were MZ: .45 (.24 to .62), DZ: .24 (–.09 to .53) and VT: .11 (–.06 to .27) and all were statistically significant. The MZ twin profile correlation significantly exceeded the DZ twin profile correlation ( $z = 3.37$ ,  $p < .001$ ), and the VT profile correlation ( $z = 6.17$ ,  $p < .001$ ); the DZ correlation exceeded the VT correlation, but the difference was not significant. In addition, the percentages

متن کامل مقاله

دریافت فوری ←

**ISI**Articles

مرجع مقالات تخصصی ایران

- ✓ امکان دانلود نسخه تمام متن مقالات انگلیسی
- ✓ امکان دانلود نسخه ترجمه شده مقالات
- ✓ پذیرش سفارش ترجمه تخصصی
- ✓ امکان جستجو در آرشیو جامعی از صدها موضوع و هزاران مقاله
- ✓ امکان دانلود رایگان ۲ صفحه اول هر مقاله
- ✓ امکان پرداخت اینترنتی با کلیه کارت های عضو شتاب
- ✓ دانلود فوری مقاله پس از پرداخت آنلاین
- ✓ پشتیبانی کامل خرید با بهره مندی از سیستم هوشمند رهگیری سفارشات