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Genetic and experiential influences on behavior: Twins reunited at seventy-eight years

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ABSTRACT

Twins living in different countries offer opportunities to explore associations between observed differences and experiential effects. This report compared the life histories, cognitive abilities, personality traits, psychomotor skills, medical characteristics, job satisfaction, social support and social relations of dizygotic (DZ) female twins reunited at 78, the world's longest separated set. The twins' advanced age also enabled a study of how co-twin differences in aging may be associated with current behavioral and social differences. Consistent with previous studies, these dizygotic reared apart (DZA) twins showed discordance across some, but not all, traits. Their different rearing situations and life histories may explain current differences in their responses to meeting their twin. This case highlights the importance of both genetic and rearing factors on behavior, but does not allow firm conclusions regarding the extent to which these sources explain individual developmental differences. However, such data contribute to the growing number of cross-culturally separated twins, generating novel hypotheses that may be assessed using larger samples.

1. Introduction

Twins reared apart help identify genetic and environmental influences on behavioral development (Segal, 2012). Monozygotic twins reared apart (MZA) allow direct estimates of genetic effects on behavior and health, because they share all their genes, but differ in their environments. Dizygotic twins reared apart (DZA) differ in their environments, but share only half their genes, on average. Greater MZA than DZA resemblance demonstrates genetic influence on measured traits (Martin, Boomsma, & Machin, 1997). Inclusion of DZA twins also allows tests of interactions between genes and environments. Unfortunately, past reared-apart twin studies did not recruit DZA twins (Juel-Nielsen, 1965; Newman, Freeman, & Holzinger, 1937; Shields, 1962), although Shields provided limited data on 11 pairs. The Minnesota Study of Twins Reared Apart (MISTRA) was the first to accept participants without reference to zygosity (Tellegen et al., 1988).

A criticism of reared-apart twin research is that co-twins are generally raised or living in similar cultures. It is reasoned that twins' common circumstances limit the range of behavioral expression resulting from possible gene × environment interactions, obscuring environmental effects on behavior. Studies including twins raised in different countries were the MISTRA (12/137 pairs) and an ongoing study of young separated Chinese twins (2/15 pairs; Segal, Stohs, & Evans, 2011). However, confidentiality generally mandates that data from these pairs be part of group findings.

Recently, due largely to Internet searches, some twins reared in different countries have been identified and studied, with results published as case studies (Segal & Cortez, 2014; Segal & Hur, 2008). Data from accumulated cases can be pooled and examined for trends.

1.1. Current study

Most reunited twins are MZA, because their matched appearance eases identification, or leads to unexpected discovery of twinship. Most recently reunited pairs are young adults, perhaps because younger individuals use the Internet more frequently

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Fig. 1. US (left) and UK. Photo credit: Matthew Gush.

and skillfully than older individuals (Pew, 2014). Consequently, DZA and older twins are less likely to be reunited and studied than MZA and younger twins. The current report bridges these gaps via a behavioral assessment of DZA female twins reunited at age seventy-eight. Both were raised in England, although one relocated to the United States in her late twenties. Both twins live in small cities outside urban areas.

1.2. Identification of the twins

The twins came to the attention of the first author in June 2013 via e-mail from the son (S) of the twin in the United States (US). US received a letter in April 2013 from her twin sister's (UK) daughter (D) inquiring about US's maternal family. US and S called D and it was determined that D had located her mother's twin. Raised by her biological mother, US knew she was a twin. UK knew she was adopted, but was unaware of her twinship. The twins were reunited at seventy-eight, in May 2014, in California. They and their adult children participated in a two-day assessment at a nearby university. The twins are shown in Figure 1.

2. Methods

2.1. Materials and measures

Following informed consent procedures, the twins separately completed interviews and tasks described below. Protocol evaluation was completed by two individuals blind to the other rater's scores for consistency. D and S completed modified versions of the assessment.

Given the twins' advanced age and UK's reading difficulties, many items were read to both twins and recorded by an examiner. UK remembers having a severe illness at about age five which impaired her reading skills. This may have affected other cognitive functions. D assisted in some administrations of her mother's interviews.

The twins were DZ based on discordance for five/fifteen short tandem repeat (STR) markers. DNA analysis was performed by *Affiliated Genetics*, in Salt Lake City, Utah.

2.1.1. Life History Interview

The Life History Interview covered the twins' separation and subsequent life experiences. It was adapted from the MISTRA Life History Form.

2.1.2. Cognitive and general intelligence tests

Twins were administered the Mini-Mental State Examination (MMSE; Folstein, Folstein, & McHugh, 1975) to assess basic cognitive status, such as awareness of dates/places. They also completed the Stroop Color and Color Word Tasks (Trenerry, Crosson, DeBoe, & Lever, 1989), Word List Memory Task (immediate/delayed recall and recognition) from the Consortium to Establish a Registry for Alzheimer's Disease (CERAD: Morris, Mohs, Rogers, Fillenbaum, & Heyman, 1989) and Trail Making Tasks A and B (Army Individual Test Battery, 1944).

The Wechsler Adult Intelligence Scale (WAIS-IV) was administered to each twin by different outside examiners (Pearson Education, 2008). Cognitive tasks from the Hawaii Ability Battery (DeFries et al., 1979) and Kit of Factor-Referenced Cognitive Tests (Ekstrom, French, Harman, & Dermen, 1976) included Visual Memory (immediate/delayed), Different Uses (spontaneous flexibility), Thing Categories (ideational fluency), and Word Beginnings and Endings (word fluency). UK could not complete the Word Beginnings and Endings test.

2.1.3. Personality inventories

The twins completed the 300-item Adjective Checklist (ACL), indicating which were self-descriptive (Gough & Heilbrun, 1983). The adult children used the ACL to describe their mother. Other questionnaires included the Personality Mini-Markers (Saucier, 1994) and 60-item NEO-PI-R (McCrae & Costa, 2004), yielding scores on the Big Five personality traits.

2.1.4. Medical health

The twins' heights and weights were measured. They also completed a detailed medical questionnaire.

2.1.5. Psychomotor skills

Handedness was classified using the Crovitz and Zener (1962) Group Test for Assessing Hand and Eye Dominance. All fourteen items were administered behaviorally. Eye dominance was assessed by having twins focus on an object, then narrow their field of vision until using one eye.

Psychomotor skills were evaluated with the Grooved Pegboard Test (Trites, 2002), assessing dexterity and complex visual-motor coordination. Participants match the groove of 25 pegs with the grooves of the board. Participants use their dominant hand to place the pegs in a left to right direction (Trial 1); participants use the non-dominant hand in the opposite direction (Trial 2).

2.1.6. Job satisfaction

Twins completed the 20-item form of the Minnesota Job Satisfaction Questionnaire (Weiss, Dawis, England, & Lofquist, 1967). The questionnaire yields scores for Extrinsic, Intrinsic and Overall Job Satisfaction. A separate overall job satisfaction item was included.

2.1.7. Perceived social support

The Medical Outcomes Study Social Support Scale (MOS-SSS; Sherbourne & Stewart, 1991) assessed the availability of overall functional support and four functional support indices: emotional, tangible, affectionate, and positive social interaction.

2.1.8. Twin relationship

The psychological significance of meeting their twin was assessed via individual and joint videotaped interviews.

3. Results

3.1. Results presented by assessment

3.1.1. Life History Interview

The twins were born on February 28, 1936 to a thirty-three-year-old mother in a small town near London. Given financial