Mental Representations of Attachment in Identical Female Twins with and without Conduct Problems

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Abstract Insecure mental representations of attachment, a nearly invariant feature of cluster B personality disorders, have never previously been studied in twins. We conducted the Adult Attachment Interview (AAI) on 33 pairs of monozygotic (MZ) female twins reared together as an initial exploration of causal influences on mental representations of attachment. As predicted by attachment theory, we observed substantial twin-twin concordance for attachment security (odds ratio 13.8; $P = 0.001$), a similar level of concordance between twins and their non-twin siblings, and an inverse relationship between attachment security and current level of aggression ($P = 0.01$). These data indicate that there are minimal effects of non-shared environmental influences

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(or measurement error) on attachment classifications derived from the AAI. In this sample of twins with and without histories of Conduct Disorder, mental representations of attachment appear to be highly familial, i.e., strongly influenced by either shared environmental factors, genetic factors, or both.

Keywords   Adult Attachment Interview · Twins · Internal mental representation · Aggression

Introduction

A large body of research in both humans and in non-human primates has demonstrated substantial links between the quality of infants' earliest (prototypic) relationships and long-term social developmental outcome [1–4]. The precise mechanism, however, by which social experience might translate into enduring patterns of interpersonal behavior is not well understood. One possible mechanism is that attachment-related experiences are incorporated into an *internal working model* (mental representation) of social attachment that is utilized on a moment-to-moment basis in the context of social interaction [5–7]. Internal mental representations provide a possible framework from which to organize and respond to the complex array of stimuli inherent in social interaction [8].

Over the past 2 decades, an instrument for measuring mental representations of social experience, the Adult Attachment Interview (AAI), has been developed and tested with respect to its ability to predict specific aspects of social behavior (relating to interpersonal attachment) in adolescents and adults [6, 9, 10]. The AAI ascertains a subject's overarching description of the quality of his/her relationships with early caregivers, assesses whether he/she can retrieve and coherently recount actual memories that support those descriptions, and inquires about the subject's perspective on how those experiences affect his or her current approach to relationships with people. Scoring of the AAI does not rely on the historical accuracy of the subject's retrospective account, but on the internal consistency of the narrative across these three domains of the interview.

In clinical studies involving the AAI, 90–95% of individuals with cluster B personality disorder have been found to have insecure mental representations of attachment [11–14], compared to approximately 40% in the general population. The current study represents an initial approach to understanding causal influences on mental representations of attachment, as measured by the AAI. A review of the PsycInfo and Medline databases at the time of this writing revealed no previously published genetically-informative studies of AAI classifications, except for an intriguing intergenerational study by Benoit and Parker [9], which demonstrated substantial continuity of attachment security from grandmothers to mothers to their infants.

Studies of monozygotic (MZ) twins represent an alternative approach to establishing the familiality of a trait. Although MZ twin studies do not allow for the resolution of effects of individual genes or specific family environmental factors, they allow for *all* causal variation on a trait of interest to be decomposed into two primary domains of influence: (a) familial influences (the sum total of genetic and shared environmental influence, which operate to make MZ twins similar for the trait of interest) and (b) non-shared environmental influences which, by definition, operate to render numbers of an MZ twin pair distinct with respect to the trait of interest [15].

Once these complementary parameters are established, dizygotic (DZ) twins or non-twin siblings (who share, an average, of half of their genetic material with their siblings, in contrast to the 100% shared by MZ twins) can subsequently be studied and incorporated into analyses that further decompose familial influences (estimated from examination of MZ twins reared together) into respective components of genetic and shared environmental influence. Without the information from MZ twins (which establishes constraining estimates for both total familiality and non-shared environmental influence) it is impossible to interpret concordance between DZ twins or siblings.

Thus, we conducted this first-reported study of mental representations of attachment in MZ twins reared together, in order to confirm the magnitude of familial influence on mental representations of attachment, and to resolve the extent to which non-shared environmental factors exert influences on AAI classifications. It is important to emphasize that non-shared environmental influences render members of an MZ twin pair *distinct* from one another, they include environmental factors that are uniquely experienced by one twin (and not the other), as well as measurement error (an important component that is sometimes overlooked in interpretations of the results of twin studies). Estimation of non-shared environmental influence and the possible contribution of measurement error (the upper limit of which is indicated by the level of MZ twin *discordance*) are critical for validating the AAI, the current theoretical assumptions regarding the intergenerational transmission of attachment, and the potential mediating role of mental representations of attachments in the development of abnormalities in social behavior.

Methods

Sample

Monozygotic (MZ) female–female twin pairs, age 13–26 were randomly ascertained from the pool of participants in the Missouri Adolescent Female Twin Study [16]. Participants in this study had previously been characterized (3–5 years prior to the current study) using the Diagnostic Interview for Children and Adolescents Revised (DICA-R-by parent report). In order to acquire an equal representation of females with and without deviant patterns of social behavior, we separately (and randomly) ascertained (a) a group in which one or both twins had 2 or more concurrent DSM-IIIR Conduct Disorder symptoms and (b) a group in which neither twin had 2 or more Conduct Disorder symptoms. Because of the relative infrequency of a full diagnosis of Conduct Disorder in females, we relaxed the symptom count criteria from 3 Conduct Disorder symptoms to 2 in designating a socially deviant group. Females with 2 Conduct Disorder symptoms are as prevalent in the general population as males with 3 Conduct Disorder symptoms and experience a similar degree of adverse life outcome [17]. Thirty-two twins (from 19 families) had 2 or more DSM-IIIR Conduct Disorder symptoms (18 of these twins met full diagnostic criteria for Conduct Disorder with 3 or more symptoms); the remaining 34 twins had less than 2 DSM-IIIR Conduct Disorder symptoms at the time of ascertainment.

The demographic characteristics of the sample were representative of the State of Missouri in being predominantly Caucasian, with no significant differences between groups with respect to age, self-reported ethnicity, race, rural/urban residency, or median household income (as judged by census tract data).

Measures

The Adult Attachment Interview

For each participating family, the MZ twins (and any available close-aged adolescent non-twin female siblings of the twins, $n = 7$) were simultaneously and independently (using separate examiners) interviewed using the protocol for the AAI (the interviews were conducted over the period from 2002 to 2004). The psychometric properties have been described extensively elsewhere [10]. We note that there was no significant association between age of subject and AAI classification in this sample.

Descriptions of the characteristics of each of the 4 categorical adult attachment classifications are elaborated in the AAI manual [18]. Briefly, an individual classified as ''*secure-autonomous*'' (F) on the AAI tends to value previous attachment relationships, and regards them as influential in his/her development; global impressions of relationships are congruent with retrievable memories, which substantiate those impressions. In addition, the linguistic properties of the subject's narrative are consistent throughout the interview, and negative life experiences can be objectively and coherently described. Individuals in the three *insecure* categories (Ds: insecure-dismissing, E: insecure-preoccupied/mentally entangled, U: insecure disorganized) violate these criteria in characteristic ways [10, 18].

Coding of the AAI transcripts was conducted in accordance with the manual for scoring the AAI [18] in batches of six or more transcripts, in which no two transcripts came from members of the same family. Scoring was completed by coders (authors JNC or UGW) who were blind to family affiliation of individual subjects, and who were certified in the coding of the AAI by establishing reliability with Mary Main, Ph.D [19]. The coders established reliability with one another in both a previous study involving young adult providers of day care [20] and in the present study. Reliability coding of 20 AAI transcripts from the present sample (in which both coders independently coded the 20 transcripts) resulted in complete 4-category inter-rater agreement for 19 of the cases (95% agreement) and 2-category inter-rater agreement for all 20 cases (100%). For the case in which there was disagreement regarding 4-category classification, the transcript was reviewed until the coders reached a consensus classification.

For the remaining 53 transcripts (46 twins, 7 non-twin sibs), the AAI was coded by a single coder (UGW or JNC), and the transcripts and scoring sheets were subsequently reviewed by the second coder (while remaining blind to family membership and co-twin attachment classification) as an accuracy check. We observed no statistically significant associations between AAI classifications and the demographic characteristics described in the sample section.

The Achenbach System of Empirically Based Assessment (ASEBA)

The Child Behavior Checklist (CBCL), 4–18 year-old and adult versions, are widely used ASEBA assessments [21], which were utilized in this attachment study to provide a dimensional measure of concurrent level of aggressive behavior. The CBCL items comprising the aggression sub scale were administered to a parent or guardian of the twins at the time of their AAI interview. CBCL syndrome scores for aggressive behavior are highly stable over time, and their genetic structure—as well as associations with clinical syndromes—have been elucidated in large population-based studies in the U.S. and in the

Netherlands [22, 23]. Such studies have supported a role for both genetic and shared environmental influences on the development (and stability) of aggression.

Data Analysis

Associations between attachment classification and: (a) presence or absence of 2 or more DSM-IIIR Conduct Disorder symptoms, by prior history; and (b) concurrent aggression, as measured by the CBCL; were tested using, respectively, chi-square and comparison of means (Student's *t* test). Since raw scores for aggression on the CBCL (in contrast to T-scores) most closely approximate normality assumptions for the *t*-test, and since there are minimal within-gender age effects on CBCL aggression scores within the age range of the subjects in the study, raw scores (rather than T-scores) were used for comparison of means.

Familiality of AAI classifications was explored by examining MZ twin–twin concordance for attachment classification, separately considering 4-category AAI classifications (F, Ds, E, U) and 2-category AAI classifications (*secure*: F, versus *insecure*: Ds, E, or U) in separate runs of the analyses. Cohen's kappa was computed for each of these analyses. Chi-square was utilized as a separate determination of strength of trait concordance between MZ twins. The number of non-twin siblings (7) was too low to incorporate the data meaningfully into a structural equation-modeling paradigm for mathematically differentiating the relative contributions of genetic and shared environmental influences to familiality of mental representations of attachment, however we did examine the extent to which non-twin siblings' AAI classifications matched those of their respective twin siblings by calculating proportions of concordance.

Results

With respect to the association between attachment classification and history of conduct disorder symptoms, there was no difference in the proportion of secure versus insecure attachment classification among subjects with versus without a history of 2 or more concurrent conduct disorder symptoms. However, for this sample, there were statistically significant associations between AAI classifications and *current* level of aggressive behavior, ascertained by parent report on the Child Behavior Checklist at the time the AAI was completed. The mean T-score on the aggression sub scale of the CBCL for subjects with insecure attachment classification was 58, and that for subjects with secure attachment classification was 51 (comparison of means for raw aggression sub scale scores: $t = 2.55$; df = 66; $P = 0.01$). Subjects whose parents (at the time of AAI completion) reported CBCL aggression scores >90th percentile for the general population ($n = 7$) all scored insecure on the AAI (Fisher's exact $P = 0.04$).

Twenty-two of the 33 MZ twin pairs were concordant for 4-category attachment classification on the AAI, as depicted in Table 1 ($\chi^2 = 35.9$; df = 9; $P < 0.0001$; Cohen's kappa = 0.51, SE = 0.12). Considering 2-category AAI classification (secure-insecure split), 26 of the 33 pairs were concordant (Cohen's kappa = 0.57; SE 0.14; $P < 0.0001$), corresponding to an odds ratio of 13.75. This degree of MZ twin concordance indicates a high degree of familiality of mental representations of attachment, and that the combined influence of non-shared environmental factors and measurement error is relatively low in magnitude (on the order of 0.30 or less), when measured by the AAI.

Table 1 MZ twin-twin concordance for 4-category attachment classification

		Twin B AAI classification				Total
		F Secure	Ds Insecure	E Insecure	U Insecure	
Twin A AAI Classification	F	11	2	0	1	14
	Ds	4	5	0	0	9
	E	0	1	2	1	4
	U	0	2	0	4	6
Total		15	10	2	6	33

$\chi^2 = 35.9$; df = 9; $P < 0.0001$; Cohen's Kappa = 0.51($\pm$0.12)

F: Secure, Autonomous

Ds: Insecure, Dismissing

E: Insecure, Mentally Entangled/Preoccupied

U: Insecure, Unresolved

Attachment classifications were also concordant for 13 of the 14 pairings of MZ twins and their non-twin siblings. This finding, that the concordance in attachment classification between twins and their non-twin sibs (who share, an average, 50% of their genetic material) was as strong as that observed for MZ twins (who share 100% of their genes) indicates that there is no deterioration in concordance as a function of genetic dissimilarity. This provides preliminary evidence that familiality in AAI classification occurs predominantly on the basis of *shared* environmental influences (not genetic influences).

Discussion

The long tradition of attachment research initiated by the work of John Bowlby, Mary Ainsworth and others has led to key questions regarding developmental competencies related to social attachment. One such question is whether internal mental representations of attachment, as currently conceptualized and measured, are influenced by non-shared environmental factors.

In this first report of mental representations of attachment in twins, categorical classifications on the Adult Attachment Interview (AAI) exhibited a high degree of familiality (the sum of genetic and shared environmental influences), and relatively low degrees of non-shared environmental influence and measurement error. The study also provided preliminary evidence (from examination of concordance between MZ twins and their non-twin siblings) that a significant proportion of those familial influences are a function of shared environmental factors. Furthermore, we found that insecure mental representations of attachment were associated with current level of aggressivity but not necessarily with past history of Conduct Disorder symptoms in females.

An obvious limitation of the study is that it was restricted to the examination of identical (monozygotic) twins (and their close-aged non-twin siblings) reared together, and did not include examination of non-identical (dizygotic) twins. A primary reason for this involves the expense of the AAI procedure, and the importance (given limited resources) of establishing estimates of identical twin concordance in order to determine sample sizes required to resolve the relative contributions of genes and rearing on familial influences (as is possible when DZ twin data is subsequently incorporated into the analyses). Given the degree of MZ concordance observed in this study (consistent with familial influences on

the order of 0.7 or greater), and our preliminary observations of strong concordance between twins and their non-twin siblings, subsequent studies involving DZ twins or sib pairs are fully warranted.

Summary

Mental representations of attachment, as measured by the AAI, represent a compelling candidate for mediating the effects of social experience on social behavior throughout life. Future studies guided by the findings of this research can help resolve the relative contributions of genetic and shared environmental influences on mental representations of attachment. The AAI offers a reliable method for characterizing this unique domain of human development for both the prediction of important life outcomes (including personality disorders) and associations with critical parameters of brain and behavioral development, including aggression.

This study revealed a striking degree of concordance—for both 2-category and 4-category attachment classification—in identical twins (at the level of inter-rater reliability for the instrument itself) thus confirming substantial familiality and relative lack of either measurement error or non-shared environmental influences on mental representations of attachment as measured by the AAI. Furthermore, a similarly high level of concordance in AAI classification observed between a sub sample of twins and their non-twin siblings suggests strongly that the primary contributor to familial influences on mental representations of attachment are shared environmental influences, rather than genetic influences. This finding is in keeping with prevailing (but yet unproven) theories regarding the intergenerational transmission of attachment behavior [6, 9].

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