

German Observational Study of Adult Twins (GOSAT): A Multimodal Investigation of Personality, Temperament and Cognitive Ability

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The German Observational Study of Adult Twins (GOSAT) is the largest population-based observational twin study in Germany to date. Embedded in the Bielefeld Longitudinal Study of Adult Twins (BiLSAT), it addresses the etiology of personality, temperament and cognitive ability in a sample of 300 monozygotic (MZ) and dizygotic (DZ) adult twin pairs between 18 and 70 years of age. A major aim of the GOSAT lies in the utilization of different modes of measurement, (i.e., peer reports and observational data), in addition to self-reports which have been used predominantly in past behavioral genetic research on personality and temperament in adults. Participants completed a full day assessment at the University of Bielefeld including videotaped social interactions and presentations, psychometric intelligence tests and computerized elementary cognitive tasks as well as objective measures and unobtrusive behavior counts. The research design of the GOSAT was devised to reduce the potential impact of systematic rater bias on estimates of genetic and environmental influences to a minimum. In combination with extensive self- and peer report data on key personality and personality related dimensions available from the BiLSAT, the GOSAT provides a rich dataset, which currently includes DNA samples from 80% of its participants.

Major Research Focus and Study Rationale

The German Observational Study of Adult Twins (GOSAT) focuses on the investigation of genetic and environmental influences on adult personality and cognitive abilities in the normal range. Participants were recruited from the larger Bielefeld Longitudinal Study of Adult Twins (BiLSAT) which was initiated in 1993 as a joint research project with funding from the Max Planck Research Prize awarded to Alois Angleitner (Bielefeld, Germany) and Jan Strelau (Warsaw, Poland). As part of the BiLSAT, a register of more than 1100 monozygotic (MZ) and same as well as opposite-sex dizygotic (DZ) twin pairs was set up because no twin-register was available in Germany at the time. An early objective of the BiLSAT involved the assessment of personality and temperament by peer reports in addition to self-reports. The prevalence of self-reports in behavioral genetic research of adult personality has been criticized as

self-reports may be subject to methodologically specific sources of variance (Brody, 1993). The inclusion of peer reports provides a way of overcoming these drawbacks. Despite this advantage, the BiLSAT is one of only two peer report studies on adult personality (Heath et al., 1992; Riemann et al., 1997). One problem affecting both self-reports and peer reports is that they are susceptible to rater bias such as contrast effects (Simonoff et al., 1998). Conceptualized as a form of rater bias, contrast effects emerge when raters compare twins to their co-twins rather than to the population mean, inflating differences within pairs and reducing differences between pairs. There is some indication that contrast effects may affect ratings of DZ twins to a greater extent than ratings of MZ twins (Neale & Stevenson, 1989; Spinath & Angleitner, 1998), which can be problematic as it increases heritability estimates and decreases shared environmental estimates.

Observational studies can be designed in such a way that rater bias of this kind is precluded or reduced to a minimum. Supported by a grant from the German Research Foundation (Deutsche Forschungsgemeinschaft) the GOSAT was initiated in 1995. We devised a one-day assessment aimed at eliciting behaviors in both social and nonsocial situations that were informative of their personality. These situations (see below) were videotaped and later rated on measures of the Big Five model of personality (Goldberg, 1990; McCrae & Costa, 1987) by judges who did not know the twins prior to the study. A total of 300 MZ and same-sex DZ pairs participated in the GOSAT over the course of a two-year assessment period. To avoid mutual influences within pairs and to preclude systematic rater bias, the twins were separated for most of the assessment day, tested by different experimenters, interacted with separate confederates in situations involving social interactions, and were rated by different sets of judges on the basis of the videotapes. In addition to these behavior recordings,

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psychometric intelligence tests and computerized elementary cognitive tasks were administered over the course of the assessment day and several objective measures such as physical activity or behavioral counts (e.g., number of questions asked during certain tasks) were collected. Because most of the twins in GOSAT are also participating in the ongoing BiLSAT, the final dataset from the GOSAT sample consists of personality ratings based on actual behavior as well as self- and peer reports assessed longitudinally, thus offering unique possibilities for multivariate quantitative genetic analyses. The additional availability of data on cognitive abilities along with DNA from almost the full sample will allow molecular genetic analyses in a very well assessed sample once genes for personality or intelligence are found.

Specifics of Recruitment, Sample Descriptions and Procedure

BiLSAT

Starting with a press conference in Frankfurt (Germany) in 1993, twins were recruited through newspaper and media announcements as well as twin clubs. A telephone hotline was installed and twins who expressed their interest in the BiLSAT were informed about the aims of the study and the approximate time required to complete the questionnaires. Names, addresses, date of birth and self-reported zygosity of twin pairs who decided to participate were entered into the database. Participants were offered a personality profile for their participation and asked to name two peers who preferably knew only one twin sibling well enough to provide a peer rating. Within 6 months, approximately 1500 twin pairs were enrolled in the BiLSAT and sent two sets of self- and peer report questionnaires, approximately one year apart. A total of 1118 twin pairs (74.5%) returned complete questionnaire sets from the first mailing and 798 twin pairs completed the second set. A list of the inventories used complete with detailed references is available upon request from the first author. The twins' age varied between 14 and 80 years ($M = 31.9$, $SD = 12.7$) and the sample was heterogeneous with regard to education and employment status. As it is typically observed with voluntary twin samples, females participated more frequently than males and MZ twins participated more frequently than DZ twins. Peers were mostly friends (46.2%), relatives (15.5%), spouses (10.8%) or colleagues (9.2%), who knew the participants for 11.2 years on average ($SD = 10.5$). The majority of peers was female (62.6%). Zygosity was determined using a self-report questionnaire on physical similarity (Oniszczenko et al., 1993) which also assessed brief information about the twins' medical history. A separate questionnaire addressed the twins home and rearing environment (e.g., whether the twins shared the same room at home, went to the same class, etc.).

Due to the substantial amount of calls we received from parents of twins who were interested in participating in a study of twin children, we have conducted a separate twin study on child temperament in a sample of 354 twin pairs between 2 and 14 years of age ($M = 6.6$, $SD = 3.7$) which is reported elsewhere (Spinath & Angleitner, 1998).

We are currently in the process of mailing the third set of questionnaires to those twins who have indicated that they are interested in participating in another assessment, five years after they completed the first questionnaire set.

We chose a longer time interval between assessments and administered two personality inventories for the assessment of the Five Factor Model (NEO-PI-R, Costa & McCrae, 1992; BIPOLE, Ostendorf, 1990) a second time to extend our analyses on genetic and environmental influences on stability and change in personality. In addition, we included short scales on interests, goals and values along with an inventory for the assessment of life events. So far, we have collected data from 293 twin pairs and will begin first longitudinal analyses in 2002.

GOSAT

In 1995 we started to contact twins from the BiLSAT who had responded to a previous mailing and had agreed to participate in a psychological testing at the University of Bielefeld. We invited one pair a day and within the time frame of the project it was possible to test 168 MZ and 132 same-sex DZ pairs. Participants were recruited from all over Germany and were reimbursed for their travel expenses as well as accommodation if it was necessary to arrive on the day before the testing. Females (234 pairs) participated more frequently than males (66 pairs) but gender was not significantly associated with zygosity, $\chi^2(1, 300) = 2.0$, $p = .16$. The twins' age ranged from 18 to 70 years ($M = 34.3$, $SD = 13.0$).

For 283 pairs, zygosity was determined by means of semiautomated genome mapping on 5 to 10 polymorphic dinucleotide marker loci, using either blood or saliva samples. The remaining 17 pairs were classified by questionnaire measures or physical similarity data. The total proportion of correct zygosity classification in GOSAT approaches 99%. Currently, additional DNA from 478 individual GOSAT participants (79.7%) is stored for a collaborative study with Robert Plomin's research team at the Social, Genetic and Developmental Psychiatry Research Centre, Institute of Psychiatry (London).

A detailed description of the procedure, measures and a typical assessment schedule within GOSAT has been published elsewhere (Spinath et al., 1999). An average assessment day lasted between 6 and 8 hours. Over the course of this day, we assessed four different types of personality related data: a) *Actual behavior*, videotaped in 15 different situations varying in duration between 1 and 12 minutes and including social interaction as well as performance tasks. Approximately 60 minutes of video material are available for each participant; b) *Unobtrusive behavioral counts*, registered during selected tasks and including number of questions, comments or utterances; c) *Objective temperament measures*, such as activity registration measured by means of motion recorders and; d) *Cognitive ability*, assessed with two psychometric intelligence tests and two widely used computerized elementary cognitive tasks (Posner & Sternberg tasks). In addition, we carried out two twin interviews (one joint, one separate) in order to gather relevant person information concerning specific events and twin experiences relevant to testing the equal environments assumption.

Video-based personality ratings were obtained on the basis of the behavior recordings from the assessment day. Each twin was observed and rated by four independent judges in each situation, and members of a twin pair were always rated by different observers who had no information

on the twins apart from the video segment. Thus, a total of 120 judges were employed (15 different settings x 4 independent judges x 2 co-twins) who provided ratings for 300 target persons each. The judges provided their ratings on adjective rating scales covering the Big Five factors (i.e., Extraversion, Agreeableness, Conscientiousness, Emotional Stability, and Intellect), Openness to Experience (McCrae & Costa, 1987), and physical attractiveness.

Experimenters and confederates also provided repeated personality ratings of the twins, using short adjective scales as well as peer rating versions of the NEO-FFI (Costa & McCrae, 1992). Female confederates interacted with the twins for an overall duration of approximately one hour. One experimenter accompanied one twin throughout the whole assessment day. Whereas the experimenter saw both co-twins of a pair, the confederate met only one twin sibling.

Major Achievements

BiLSAT

The first major report from the BiLSAT provided evidence for substantial genetic influence on peer reported personality on the NEO-FFI scales, validating previous findings based on self-report data alone (Riemann et al., 1997). Heritability (h^2) estimates based on averaged peer report data alone were above .40. Multivariate behavioral genetic analyses of combined self- and peer-report data indicated even higher additive genetic influences which accounted for the major proportion of the phenotypic personality trait variance. The remaining variance was explained by nonshared environmental influences. A recent analysis of self- and peer-reports on the scales of the German Eysenck Personality Questionnaire-RS (EPQ-RS; Ruch, 1999) showed a similar etiological pattern (Wolf et al., 2002). Both studies found evidence for high genetic correlations which indicated that approximately 80% of the correlations between self- and peer-reported personality ($= .55$ for the NEO-FFI and $= .68$ for the EPQ-RS) was explained by genetic factors.

In a joint analyses of data from the BiLSAT and a Canadian twin sample, Jang et al. (1999) examined the heritability of residual specific variance in facet-level traits from the Revised NEO Personality Inventory and found support for a hierarchical conceptualisation of personality. A second analysis investigated genetic, environmental, and artifactual influences on the covariation of the NEO-PI-R personality traits and found a five factor structure in both the phenotypic and genetic/familial covariances (McCrae et al., 2001).

Parts of the BiLSAT sample have been used in two selected extremes study exploring the possible role of genes involved in the dopaminergic neurotransmitter system on neuroticism (Eley et al., 1998). An earlier study had investigated the proposed association between polymorphisms in the serotonin transporter gene (5HTT) and neuroticism (Ball et al., 1997).

Model-fitting analyses of the video-based trait ratings also suggested substantial genetic influences on personality of about 40% (Borkenau et al., 2001). Interestingly, we found some indication for shared environmental influence of $\chi^2 = .25$ on observer rated personality traits which was consistent for all traits under study, except for Extraversion. A similar trend was found in the analysis of confederate and

experimenter data. Personality ratings by confederates who were unable to contrast the twins in the GOSAT design suggested a small but consistent pattern of shared environmental influences of $\chi^2 = .18$ across personality dimensions whereas ratings by experimenters who had met both twin siblings over the course of the assessment day yielded an average estimate of $\chi^2 = .04$, much closer to zero (Spinath, 2000). Even though these findings require replication as 300 twin pairs do not provide sufficient power to carry out reasonable significance testing, it underlines the necessity of multi-method approaches in behavioral genetic studies as our results are in agreement with the hypotheses that self- and peer-rating studies might be subject to rater bias working against the detection of shared environmental influences.

Analyses of our cognitive data revealed a significant negative phenotypic correlation ($r = -.36$, $p < .05$) between general cognitive ability (g) and an aggregate of reaction time measures from elementary cognitive tasks (Neubauer et al., 2000). Both measures showed substantial genetic influences which were somewhat higher for g ($h^2 = .64$) than for the equally reliable mental speed aggregate ($h^2 = .39$). Shared environmental estimates were small and of similar magnitude ($\chi^2 = .16$ and $.12$, respectively), albeit not significant. Bivariate analyses revealed that most of the phenotypic variance between g and mental speed was due to genetic factors, suggesting not only that elementary cognitive tasks are genetically linked to psychometric (g) but also that genetic g pervades these tasks (Plomin & Spinath, 2002).

Additional findings published from the GOSAT include moderate genetic ($h^2 = .40$) and no shared environmental influences on objectively assessed activity (Spinath et al., 2002), a study of genetic and environmental sources of consistency and variability in positive and negative mood across the assessment day indicating that variability of mood states is mainly due to nonshared environmental influences and only marginally attributed to genetic or nonshared environmental effects (Riemann et al., 1998), a study of similarity of childhood experiences and personality resemblance corroborating the validity of the equal environments assumption (Borkenau et al., 2002), a behavioral genetic analysis of the overlap between personality and parenting indicating that the moderate phenotypic covariation between personality and parenting is attributed largely to non-genetic factors (Spinath & O'Connor, 2002), and a multivariate analysis of behavioral counts yielding results consistent with the hypothesis that genes tend to affect observed behavior to a greater extent at a global level whereas environmental influences are the only source of variation at a more specific level (Borkenau et al., 2000).

Future Plans

In the course of 2002, longitudinal analyses using data from the third mailing will begin. Multivariate genetic analyses of multi-method as well as combined international datasets will continue to be conducted including joint analyses of psychometric (g), mental speed and intelligence ratings (Spinath et al., 2002). Specific behavioral genetic analyses focusing on values, interests and goals in relation to personality and life events as a potential source of non-shared environmental influences are also planned.

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