A Web-Based Study of Personality, Psychopathology and Substance Use in Twin, Other Relative and Relationship Pairs

Kenneth S. Kendler,[1,2,3] John Myers,[1,2] Jeff Potter,[4] and Jill Opalesky[1,2]

[1] *Virginia Institute of Psychiatric and Behavioral Genetics, Virginia Commonwealth University School of Medicine, Richmond, United States of America*

[2] *Department of Psychiatry, Virginia Commonwealth University School of Medicine, Richmond, United States of America*

[3] *Department of Human and Molecular Genetics, Virginia Commonwealth University School of Medicine, Richmond, United States of America*

[4] *Atof Inc, Cambridge, United States of America*

Web-based studies have become increasingly common in the social sciences, but have been rare in genetic epidemiology in general and twin studies in particular. We here review the methods, validity checks and preliminary correlational data from an on-line questionnaire collected from 2005–2008. During this time period, 44,112 individuals completed the questionnaire. This sample was 65.3% female, 85.4% 18 years or older, 72.0% Caucasian and had a mean educational level of 12.2 years. The sample included 609 twin, 333 sibling and 201 parent-offspring pairs as well as 342 dating partners, 313 'significant other' pairs, 327 spouses and 2,316 friend pairs. A range of checks suggested low levels of invalid data. Correlations for personality, substance use and misuse, lifetime major depression, social attitudes, educational status, and height and weight were broadly similar to those obtained previously using conventional assessment methods. Web-based studies are a relatively easy and inexpensive way to ascertain large numbers of individuals, although obtaining twin pairs is more difficult, and female and monozygotic pairs are overrepresented. The sample is diverse and pair resemblance is generally similar to that obtained using interviews or mailed questionnaires.

Keywords: Twins, World Wide Web, personality, drug use

Traditionally, twin studies of psychiatric and/or psychological traits have been conducted using face-to-face or telephone interviews and/or mailed questionnaires. In recent years, the World Wide Web has been increasingly used as a data collection tool in the social sciences. Especially in psychology, recent research supports the validity and generalizability of on-line samples (Gosling et al., 2004).

In this report, we summarize results obtained over the last 3 years from a web-based ascertainment system for twins and other relative and relationship pairs that we established. We describe our methods and validity checks and then provide summary correlational data from the main variables studied in the twin, family and other paired data that we obtained.

Methods

Participants in this study were part of the 'Twins: An Interactive Personality Test' that collected data from 2005 to 2008. This survey was designed as an interactive assessment tool for measures of personality, psychopathology and substance use and dependence. The web site permits any two people, regardless if they are twins, to compare their personalities and behaviors. Participants could take the survey as individuals or share with others of their choice. All participants were volunteers and were recruited and assessed over the World Wide Web. Potential respondents found out about the site via Internet search engines, direct access to its address (http://www.outofservice.com/twins/), or through links from other sites. For portions of this time period, we also advertised this site on GOOGLE.

Data collection was done with automated computerized administration, data entry and scoring. All participants received individualized feedback for the purpose of self insight or entertainment after completing the survey. The data presented in this article was collected using a noncommercial, advertisement free web site (www.outofservice.com) that contains personality measures as well as several games, quizzes, and questionnaires for entertainment purposes. Participants did not provide any personally identifying information and complete anonymity was assured. This research obtained exempt ethics approval at Virginia Commonwealth University.

Received 6 December, 2008; accepted 2 February, 2009.

Address for correspondence: Kenneth Kendler, MD, Virginia Institute for Psychiatric and Behavioral Genetics, Virginia Commonwealth University Medical School, Box 980126, 800 E. Leigh Street, Room 1–123, Richmond, VA 23298-012, United States of America. E-mail: kendler@vcu.edu

In twin pairs, we also examined similarity of reported year of birth and found only a moderate number of normally distributed disagreements with no evidence for an excess of widely divergent birthdates. As a further quality control approach we examined the distribution of the personality variables to see if we had an excess of individuals who had extreme scores as might arise if a significant proportion of individuals set out to subvert this project by 'faking' data. We found no evidence for an excess of very low or very high personality scores.

The questionnaire contained an item that asked 'Have you ever personally filled out this particular questionnaire on this site?' This 'taken before' variable was endorsed by 1.7% of individuals in the sample (but only 0.7% of twin pairs with both members in the sample). For ethical reasons, we had no identifying information in the sample so could not definitively determine what proportion of these 1.7% responded in error to this item versus had two records in the sample. However, for those who responded that they had filled out the questionnaire previously, we identified possible matches in the data-set using exact height, year of birth, mother and father's year of birth, race and sex and weight (± one category which ranged from 4 to 10 pounds) and schooling (± one category which ranged from 1 to 4 years). We found one or more matches in only 17.5% of these subjects. These results suggest that the majority of these individuals responded to this item in error and on this basis, they were included in the data for analysis.

In same-sex twin pairs, zygosity was determined from responses from both twin pairs to three questions commonly used in the literature: strangers telling twins apart as children, alike as 'two peas in a pod' and twins own belief about zygosity. When results were ambiguous and/or twins substantially disagreed (which occurred in 1.6% of pairs), they were excluded from analyses.

The following major variables were included in the web-based questionnaire: the Big Five Inventory (BFI) which assesses Openness, Conscientiousness, Extraversion, Agreeableness and Neuroticism (John et al., 1991); four dimensions of personality pathology from the Dimensional Assessment for Personality Pathology (DAPP) — Affective Instability, Cognitive Distortion, Identity Problems, and Insecure Attachment; (Livesley, 1990); a self-report lifetime measure of DSM-IV (American Psychiatric Association, 1994) major depression used previously and validated in the Swedish Twin Registry (Kendler et al., 1993); nicotine dependence as assessed by the Fagerstrom Test for Nicotine Dependence (Heatherton et al., 1991); measures of caffeine toxicity and dependence as used previously in the Virginia Adult Twin Study of Psychiatric and Substance Use Disorders (Kendler & Prescott, 1999); and symptoms of pathological gambling obtained from two standard questionnaires (Christenson et al., 1994; Stinchfield, 2003). The questions about gambling were added on July 24, 2005, and therefore are missing on a proportion of the sample. While we had no specific measures of social attitudes in this questionnaire, the BFI contained two items ('is very religious' and 'is politically liberal') that were not part of the five personality scales that we examined for this purpose.

To reduce the chances of respondents learning to say 'no' to the stem items because it would allow them to skip over sections of the questionnaire, we asked all the stem questions at the beginning of the questionnaire (e.g., about lifetime use of alcohol and nicotine, gambling and symptoms of depression).

Results

Description of the Sample

Data for this report was downloaded from the web site for the period from July 1, 2005 to May 1, 2008. These data contained 44,112 completed questionnaires with unique user codes. This sample was 65.3% female, 85.4% 18 years or older and 72.0% Caucasian. The remaining ethnic breakdown was 6.6% Other, 5.7% Black, 3.5% Latino, 3.0% Indian/Pakistani, 2.8% Chinese and the remaining others were 1.5% or less (Chicano, Filipino, Japanese, Korean, Native American, Other Asian, Pacific Islander, and Puerto Rican).

In the 609 twin pairs where zygosity could be determined, there were 364 female-female monozygotic (MZ) twins, 80 female–female dizygotic (DZ) twins, 77 male–male MZ twins, 21 male–male DZ twins and 67 opposite sex DZ twins. Of the members of these twin pairs, 84.6% were 18 years or older, and 85.1% were White/Caucasian.

We provide a few descriptive statistics from the entire sample. These subjects reported a monthly median and mean alcohol intake of 9 and 18.5 drinks (SD = 34.2), respectively. Parallel figures for cups per day of caffeinated beverages were 1.5 and 2.6 (7.1). 27% were regular smokers and had a median and mean FTND score of 3 and 3.5 (2.6), respectively. 32% reported a lifetime history of major depression. Median and mean years of education were 12 and 12.2 (3.3).

Pattern of Correlations in Twin, Relative and Other-Relationship Pairs

In addition to the 609 twin pairs, the sample contained 333 non-twin sibling pairs, and 201 parent–offspring pairs. Three kinds of romantic pairs with increasing levels of commitment were also represented: 342 dating pairs, 313 pairs of 'significant other,' and 327 spouses. Finally, the sample contained 2,316 pairs of friends.

Correlations for most of the variables assessed in the questionnaire are depicted for the twin, relative and other-relationship pairs in Table 1. We divide the variables into five groups: substance-related, personality, psychopathology, attitudes and anthropometric/demographic.

Psychoactive Substance Use and Misuse

With the exception of symptoms of caffeine dependence and alcohol intake, correlations for other drug

https://doi.org/10.1375/twin.12.2.137 Published online by Cambridge University Press

Table 1

Web Based Twin Study Correlations for Non-Twin Relationships

Variable	MZ twins $n = 441$	DZ twins $n = 168$	Non-twin siblings $n = 333$	Parent and child pairs $n = 201$	Partners ('We're dating') $n = 342$	Partners ('Significant Others') $n = 313$	Spouses $n = 327$	Friends $n = 2316$
Alcohol(drinks/week)*	0.59[d]	0.57[d]	0.36[d]	0.09	0.23[d]	0.27[d]	0.18[b]	0.26[d]
Caffeine (cups/day)*	0.30[d]	0.24[b]	0.34[d]	0.02	0.14[b]	0.18[d]	0.30[d]	0.17[d]
Caffeine toxicity**	0.57[d]	0.18	0.02	0.15	0.18	0.23[a]	–0.01	0.18[d]
Caffeine dependence**	0.38[d]	0.44[d]	0.21[b]	–0.07	0.18[a]	0.15[a]	0.12	0.15[d]
Smoking* (# cigs/day)	0.70[d]	0.27[c]	0.49[d]	0.11	0.52[d]	0.38[d]	0.35[d]	0.35[d]
Regular smoker**	0.91[d]	0.41[b]	0.76[d]	0.05	0.54[d]	0.57[d]	0.56[d]	0.54[d]
FTND*	0.75[d]	0.28[c]	0.46[d]	0.22[b]	0.48[d]	0.37[d]	0.36[d]	0.31[d]
Agreeableness*	0.42[d]	0.03	0.19[c]	0.24[c]	0.11[a]	0.22[d]	0.04	0.15[d]
Conscientiousness*	0.39[d]	0.16[a]	0.16[b]	–0.04	0.20[d]	0.15[b]	0.14[b]	0.25[d]
Extroversion*	0.43[d]	–0.01	0.01	0.14[a]	0.12[a]	0.03	–0.20[c]	0.14[d]
Neuroticism*	0.41[d]	0.12	0.00	0.07	–0.04	–0.01	–0.06	0.12[d]
Openness*	0.57[d]	0.13	0.24[d]	0.25[c]	0.16[b]	0.16[b]	0.05	0.23[d]
Affect instability*	0.41[d]	0.14	0.20[c]	0.09	–0.10	–0.04	–0.04	0.13[d]
Cognitive distortion*	0.43[d]	0.34[d]	0.39[d]	0.12	0.24[d]	0.24[d]	0.30[d]	0.28[d]
Identity problems*	0.43[d]	0.37[d]	0.21[d]	0.24[c]	0.21[d]	0.22[d]	0.22[d]	0.21[d]
Insecure attachment*	0.52[d]	0.09	0.16[b]	0.18[b]	0.17[b]	0.04	0.17[b]	0.15[d]
Major depression**	0.60[d]	0.29[a]	0.30[c]	0.29[a]	0.07	0.16	0.11	0.25[d]
Gambling*	0.42[d]	–0.03	0.32[c]	0.33[b]	0.16	0.35[b]	0.27[b]	0.22[d]
Very religious**	0.78[d]	0.66[d]	0.63[d]	0.51[d]	0.56[d]	0.46[d]	0.55[d]	0.35[d]
Politically liberal**	0.62[d]	0.32[d]	0.52[d]	0.25[c]	0.45[d]	0.44[d]	0.58[d]	0.38[d]
Height*	0.90[d]	0.51[d]	0.39[d]	0.38[d]	–0.38[d]	–0.31[d]	–0.34[d]	0.20[d]
Weight*	0.87[d]	0.47[d]	0.46[d]	0.33[d]	–0.01	0.06	0.07	0.28[d]
Years of education*	0.89[d]	0.86[d]	0.41[d]	–0.20[b]	0.48[d]	0.53[d]	0.44[d]	0.71[d]

Note: * Pearson correlation, ** Tetrachoric correlation [a] $p <= .05$, [b] $p <= .01$, [c] $p <= .001$, [d] $p <= .0001$.

related variables were greater and often substantially so in MZ than in DZ twins. Correlations in non-twin siblings (n = 333 pairs) tended to be higher than those seen in DZ pairs for smoking related variables and lower for caffeine-related variables. Correlations for all the drug use variables were generally lower in the parent-offspring pairs (n = 201) than in the DZ or sibling pairs. All the smoking related variables were substantially and similarly correlated in the three kinds of romantic pairs, while correlations in these groups for alcohol and caffeine related variables were generally lower and more variable. A broadly similar pattern was seen in the friend-pairs (n = 2,316), that is, higher correlations for smoking-related than for caffeine- or alcohol-related traits.

Personality

Correlations for the BFI measures ranged from .39 to .57 in the MZ and –.01 to .16 among the DZ pairs. The correlations in the sibling and parent-offspring pairs were somewhat more variable but roughly comparable to that seen in the DZ twins. Correlations for these personality measures were low in all three of our groups of romantic partners. By contrast, correlations in personality among the friend pairs (ranging from .12 to .25) were similar if slightly greater than those seen in siblings and DZ pairs.

For the four dimensions of personality pathology from the DAPP, correlations between MZ twin pairs were in the narrow range of .41 to .52 and lower and somewhat more variable among DZ pairs. Sib pair correlations roughly resembled the pattern seen in DZ pairs while correlations in parent–offspring pairs were somewhat lower. Of interest, two of these measures (cognitive distortion and identity problems) were moderately and significantly correlated to a similar degree among all three groups of romantic partners. As with the normal dimensions of personality, the four measures of abnormal personality were moderately correlated in pairs of friends.

Psychopathology

The tetrachoric correlations for lifetime major depression were .60 in MZ twins and ranged from only .29 to .30 in DZ, sibling and parent–offspring pairs. Correlations were low and nonsignificant among romantic partners but quite moderate (.25) among friends.

Symptoms of pathological gambling were correlated .42 in MZ pairs with correlations ranging from –.03 to .33 among DZ, siblings and parent–offspring pairs. Interestingly, correlations for gambling problems

https://doi.org/10.1375/twin.12.2.137 Published online by Cambridge University Press

were lower among the least committed romantic pairs (dating .16) than among those who saw each other as 'significant others' or were married (.27 to .35).

Social Attitudes

Our one-item measure of religiosity was highly correlated among all pairs assessed, although correlations were slightly higher in MZ twins (.78) than in other relative pairs (.51 to .66) which in turn were quite similar to those seen in romantic partners and lowest in friends (.35). The pattern of correlations for our item about political orientation was similar except that the correlations in DZ, sibling and parent-offspring pairs were lower. Interestingly, spouses were somewhat more highly correlated for this item than the other two types of romantic partners.

Anthropometric/Demographic

Height and weight were correlated around .90 in MZ twins, approximately .50 in DZ twins and .45 in siblings and a bit lower in parent–offspring pairs and pairs of friends. Weight is uncorrelated in romantic partners but, surprisingly, height is consistently negatively correlated. Friends are moderately correlated for both measures.

Correlations for years of education are in the range of .80–.90 in MZ and DZ pairs, only slightly lower in friendship pairs (.71), .41 to .53 in sibling and romantic pairs and surprisingly correlated in parent–offspring pairs.

Discussion

The goal of this report was to describe the methods and present preliminary results from our web-based study of twin, relative and other-relationship pairs. From these results, we would suggest the following tentative conclusions.

First, consistent with web-based studies of psychological traits (Gosling et al., 2004), it has been relatively easy and inexpensive to ascertain large numbers of individuals. By contrast, ascertaining twin pairs has been a slow process, as we have accumulated only 609 complete pairs in 34 months. Despite our emphasis on twins in the name of the study and in our advertisements with Google (which we stopped because they did not impact substantially on enrollment), we in fact ascertained larger number of other kinds of pairs than of twin pairs.

Second, we were concerned about the representativeness of the sample. The entire sample was largely white, and females were over-represented. As has been noted previously in volunteer twin samples (Lykken et al., 1978), both MZ and female twin pairs were substantially in excess in the twins ascertained from our web site. However, this sample was not highly biased with respect to education (with the median years of education of 12) or levels of smoking, although lifetime rates of major depression are higher than those reported in most prior large epidemiological studies (e.g., Hasin et al., 2005; Kessler et al., 1994). On virtually all the traits we examined, the sample was quite diverse — contrary to the concern that Internet samples would be restricted to highly educated, 'nerdish' individuals.

Third, we wondered about the representativeness of the twin pairs that we had ascertained. Would the pattern of resemblance for the traits we have measured in our twin pairs be consistent with prior literature? Here our results were reassuring. The correlations we observed for the BFI were well within the range commonly found for personality in prior general population studies (e.g., Bouchard, Jr., 1993; Riemann et al., 1997; Tellegen et al., 1988). Although there were some anomalies that were not unexpected given our moderate sample sizes, the pattern of correlations observed for the drug use variables were broadly consistent with expectation. Other features of our data were consistent with prior literature in finding, among romantic partners, low levels of personality resemblance, intermediate correlations for drug use and psychopathology, and high correlations for religious and political attitudes (Caspi et al., 1992; Eaves et al., 1999; Maes et al., 1998; Vandenberg, 1972).

Especially supportive of the validity of our ascertainment method were the twin correlations for weight and height, which are quite similar to results obtained from other studies (Preece, 1996) and, as an example, nearly identical to those reported from a recent epidemiological study of over 3,300 Swedish twin pairs: height MZ .93, DZ .53; weight MZ .87, DZ .44 (Silventoinen et al., 2008). From these data, as well as efforts we outlined above to confirm the twin status of these pairs, we conclude that the proportion of 'faux' twin pairs in our sample is quite small. These and other results obtained suggest that the data we have obtained is unlikely to contain many subjects who have faked data or otherwise tried to subvert the research process.

Fourth, we had not anticipated the large number of other relationship pairs. In particular, we were pleased at our ability to ascertain a very large number of friend-pairs as well as romantic partners, reflecting three levels of commitment. These samples would be of use in clarifying the mechanisms underlying assortative mating and friendship formation (Eaves, 1979; Eiser et al., 1991; Kandel, 1979).

In summary, we conclude that our web-based ascertainment has succeeded in gathering quality research data. While the sample is not fully representative of any particular population, it is diverse and produces patterns of findings broadly consistent with those obtained by more conventional measures.

Acknowledgments

Carol David PhD provided statistical assistance.

References

American Psychiatric Association. (1994). *Diagnostic and statistical manual of mental disorders* (4th ed.). Washington, DC: American Psychiatric Association.

Bouchard, T. J., Jr. (1993). Genetic and environmental influences on adult personality: Evaluating the evidence. In J. Hettema & I. J. Deary (Eds.), *Foundations of personality* (pp. 15–44). Netherlands: Kluwer Academic Publishers.

Caspi, A., Herbener, E. S., & Ozer, D. J. (1992). Shared experiences and the similarity of personalities: A longitudinal study of married couples. *Journal of Personality and Social Psychology, 62,* 281–291.

Christenson, G. A., Faber, R. J., Dezwaan, M., Raymond, N. C., Specker, S. M., Ekern, M. D. et al. (1994). Compulsive buying: Descriptive characteristics and psychiatric comorbidity. *Journal of Clinical Psychiatry, 55,* 5–11.

Eaves, L. (1979). The use of twins in the analysis of assortative mating. *Heredity, 43,* 399–409.

Eaves, L., Heath, A., Martin, N., Maes, H., Neale, M., Kendler, K., Kirk, K., & Corey, L. (1999). Comparing the biological and cultural inheritance of personality and social attitudes in the Virginia 30,000 study of twins and their relatives. *Twin Research, 2,* 62–80.

Eiser, J. R., Morgan, M., Gammage, P., Brooks, N., & Kirby, R. (1991). Adolescent health behaviour and similarity-attraction: friends share smoking habits (really), but much else besides. *British Journal of Social and Clinical Psychology, 30,* 339–348.

Gosling, S. D., Vazire, S., Srivastava, S., & John, O. P. (2004). Should we trust web-based studies? A comparative analysis of six preconceptions about Internet questionnaires. *American Psychologist, 59,* 93–104.

Hasin, D. S., Goodwin, R. D., Stinson, F. S., & Grant, B. F. (2005). Epidemiology of major depressive disorder: Results from the National Epidemiologic Survey on Alcoholism and Related Conditions. *Archives of General Psychiatry, 62,* 1097–1106.

Heatherton, T. F., Kozlowski, L. T., Frecker, R. C., & Fagerstrom, K. O. (1991). The Fagerstrom Test for Nicotine Dependence: A revision of the Fagerstrom Tolerance Questionnaire. *British Journal of Addiction, 86,* 1119–1127.

John, O. P., Donahue, E. M., & Kentle, R. L. (1991). *The Big Five Inventory: Versions 4a and 54*. Berkeley, CA: University of California Berkeley, Institute of Personality and Social Research.

Kandel, D. (1979). Homophily, selection and socialization in adolescent friendships. *American Journal of Sociology, 84,* 427–436.

Kendler, K. S., Pedersen, N., Johnson, L., Neale, M. C., & Mathe, A. A. (1993). A pilot Swedish twin study of affective illness, including hospital- and population-ascertained subsamples. *Archives of General Psychiatry, 50,* 699–700.

Kendler, K. S. & Prescott, C. A. (1999). Caffeine intake, tolerance, and withdrawal in women: A population-based twin study. *American Journal of Psychiatry, 156,* 223–228.

Kessler, R. C., McGonagle, K. A., Zhao, S., Nelson, C. B., Hughes, M., Eshleman, S., Wittchen, H. U., & Kendler, K. S. (1994). Lifetime and 12-month prevalence of DSM-III-R psychiatric disorders in the United States. Results from the National Comorbidity Survey. *Archives of General Psychiatry, 51,* 8–19.

Livesley, W. J. (1990). *Dimensional assessment for personality pathology: Basic questionnaire (DAPP)*. Unpublished work, University of British Columbia, Canada.

Lykken, D. T., Tellegen, A., & DeRubeis, R. (1978). Volunteer bias in twin research: The rule of two-thirds. *Social Biology, 25,* 1–9.

Maes, H. H., Neale, M. C., Kendler, K. S., Hewitt, J. K., Silberg, J. L., Foley, D. L., Meyer, J. M., Rutter, M., Simonoff, E., Pickles, A., & Eaves, L. J. (1998). Assortative mating for major psychiatric diagnoses in two population-based samples. *Psychological Medicine, 28,* 1389–1401.

Preece, M. A. (1996). The genetic contribution to stature. *Hormone Research, 45,* 56–58.

Riemann, R., Angleitner, A., & Strelau, J. (1997). Genetic and environmental influences on personality: A study of twins reared together using the self- and peer report NEO-FFI scales. *Journal of Personality, 65,* 449–475.

Silventoinen, K., Magnusson, P. K. E., Tynelius, P., Kaprio, J., & Rasmussen, F. (2008). Heritability of body size and muscle strength in young adulthood: A study of one million Swedish men. *Genetic Epidemiology, 32,* 341–349.

Stinchfield, R. (2003). Reliability, validity, and classification accuracy of a measure of DSM-IV diagnostic criteria for pathological gambling. *American Journal of Psychiatry, 160,* 180–182.

Tellegen, A., Lykken, D. T., Bouchard, T. J., Jr., Wilcox, K. J., Segal, N. L., & Rich, S. (1988). Personality similarity in twins reared apart and together. *Journal of Personality and Social Psychology, 54,* 1031–1039.

Vandenberg, S. G. (1972). Assortative mating, of who marries whom? *Behavior Genetics, 2,* 127–157.

https://doi.org/10.1375/twin.12.2.137 Published online by Cambridge University Press