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Psychiatrists' views of the genetic bases of mental disorders and behavioral traits and their utilization of genetic tests

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Abstract

We examined how 372 psychiatrists view genetic aspects of mental disorders and behaviors, and use genetic tests (GTs). Most thought the genetic contribution was moderate/high for several disorders (e.g. bipolar, schizophrenia, depression, Alzheimer's, intelligence, creativity, anxiety, suicidality). In the past 6 months, 14.1% ordered GTs, 18.3% discussed prenatal testing with patients, 36.0% initiated discussions about other GTs, 41.6% had patients ask about GTs, and 5.3% excluded GT results from patient records. Many thought that GTs were available for schizophrenia (24.3%) and major depression (19.6%). Women were more likely to report that patients asked about GTs; and were less certain about the degree of genetic contribution to several disorders. Psychiatrists perceive strong genetic bases for numerous disorders and traits; and many have discussed and ordered tests for GTs; but have relatively little knowledge about available tests. These data suggest possible gender differences in psychiatrist's beliefs about genetic contributions to disorders; and have implications for future research, education, policy, and care.

Keywords

Genomics; epigenetics; genetic testing; decision making; etiology

Introduction

Numerous studies continue to probe possible genetic contributions to a wide range of mental disorders and behavioral traits, but many questions remain concerning how psychiatrists themselves view these issues. With the identification of genetic markers associated with

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Conflicts of Interest

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diagnoses and responses to treatment, and decreasing costs of whole genome and exome sequencing, psychiatrists may well be called upon increasingly to incorporate genetic information into clinical practice (Laegsgaard and Mors, 2008; Hoge and Appelbaum, 2012). Hence, the views and approaches of these providers towards genetic testing can potentially shape future diagnosis, treatment, and disease prevention (Farmer et al., 2007; Hoop et al., 2008; Mitchell et al., 2010).

To date, susceptibility genes have been associated to varying degrees with several neuropsychiatric disorders including Huntington's disease (HD), Alzheimer's disease (AD) (Selkoe, 1996; Selkoe and Podlisny, 2002) and epilepsy (Ottman et al., 2010). Emerging evidence suggests that copy number variants and single gene mutations may be found in relatively small proportions of patients with other psychiatric disorders including schizophrenia (Walsh et al. 2008, Tam et al., 2009; Shi et al., 2009), ADHD (Thapar et al. 1999; Stergiakouli and Thapar, 2010), major depression (Caspi et al., 2003; Wilhelm et al., 2009), and autism (Glessner et al., 2009). In 2012, researchers claimed to have developed a genetic test with clinical utility for autism spectrum disorders (Skafidas et al.), but that claim has since been refuted (Robinson et al., 2013). Many of the genes are shared among these disorders, providing evidence for similar genetic risks to a wide range of diagnoses with varying severity (Sullivan et al., 2012).

Clinically significant behavioral traits, such as aggression and antisocial behavior, have been associated with a variant of the *MAOA* gene, in combination with a history of abuse (Caspi et al., 2002). Clearly, tests vary in penetrance and predictiveness. While HD is a Mendelian dominant disorder, and the mutation is fully penetrant and predictive, other genetic markers mentioned above vary widely in the degrees to which they contribute to disease in various patients. Psychiatrists could also use other genetic tests for medical conditions that can cause psychiatric symptoms, such as mitochondrial disorders, porphyria and other monogenic disorders (Dimauro and Schon, 2008; Simon and Herkes 2011). Genetic markers associated with psychiatric pharmacogenomics are also being sought, identified, and employed. Indeed, there may be wider understanding and use of pharmacogenomics among psychiatrists than tests for markers directly associated with diseases (Mrazek, 2010). How widely pharmacogenomics will be used is uncertain, but they may potentially improve treatment of depression and anxiety, and identification of past inappropriate prescription of medication (Winner et al., 2013).

Direct-to-consumer marketing (DTC) of genetic tests, which often includes variants associated with psychiatric disorders, has also been increasing, though recently questioned by the FDA (Klitzman, 2013). Yet many internists have been found to have significant deficits in understanding genetic tests (Klitzman et al., 2013), and there is reason to be concerned that this may be true of many psychiatrists as well.

Only a few studies have examined psychiatrists' attitudes and practices concerning genetic tests. Most psychiatrists believe that they are the most appropriate mental health professionals to counsel patients about the possible impact of genetics on patients' diagnoses (Hoop et al., 2008) and see discussing genetic information as clinically relevant and part of psychiatrists' role (Hoop et al., 2008; Finn et al., 2005). In 2006, A large majority of 45 U.S.

psychiatrists thought genetic testing would have high utility for determining a patient's optimal dose of medication (73%), and risk of serious side effects from psychiatric medication (82%), for predicting severity of mental illness (85%), and assessing risk of an asymptomatic person developing mental illness (84%) (Hoop et al., 2008). Of 64 researchers and clinicians who worked with patients with schizophrenia, 72% indicated that they would test all patients with initial diagnoses of schizophrenia, even if a test with only limited diagnostic power were available (DeLisi and Bertisch, 2006). Of 352 psychiatrists surveyed in 2005, 45% said they would use genetic tests for schizophrenia, if available, to test asymptomatic adults with a family history (Finn et al., 2005). In 2006, 9 of 41 (20.9%) psychiatrists surveyed had ordered a genetic test in the previous five years (Hoop et al., 2008). Yet, in another study, only 23% of psychiatrists felt competent to talk with patients about genetic information, 15% felt adequately trained to do so, and only 1% could answer ten genetics questions correctly (Finn et al., 2005). Psychiatrists would welcome additional education in genetics (Lawrence and Appelbaum, 2011).

As genetic research continues to advance rapidly, it is important to understand whether these views and practices may have changed over time, and what variables may affect them (e.g., age and gender of the provider, understandings of genetic contributions to psychiatric disorders, knowledge of the availability of genetic tests). Indeed, prior research by one of us (RK) found that among psychiatrists, women were more likely than men to have psychotherapeutic rather than biological orientations toward treatment of psychiatric disorders (Bodkin, Klitzman, Pope, 1995), which may also impact their attitudes toward and use of genetic tests. To address these issues, we thus examined the views of genetic influences and use of genetic tests among a large sample of psychiatrists.

Methods

In conjunction with the American Medical Association (AMA), we sent e-mails describing the study and inviting participation from psychiatrists on the AMA Master Lists who had provided e-mail addresses and had agreed to receive survey invitations. We contacted 5,316 psychiatrists in September and October 2011. We did not follow-up through direct mail or phone calls, nor compensate respondents. We received 372 responses (response rate: 7.0%). The New York State Psychiatric Institute IRB approved the study. The survey instrument was developed on the basis of our prior, related study of internists (Klitzman et al., 2013), a literature review, drawing on items reflecting attitudes and behaviors in two prior studies of psychiatrists by other investigators (Hoop and Finn) and our clinical experience, and used the Survey Monkey online survey system (www.surveymonkey.com). Domains probed included: 1) demographics of respondents and their patients; 2) respondents' self-reported knowledge of genetics and genetics testing; 3) practices regarding genetic testing and privacy of genetic information; 4) barriers and facilitators to use of genetic tests; 4) attitudes toward tests and diagnoses; and 5) perceived needs for education. The survey included an information sheet that described the study, and indicated that participants' consent would be presumed by their completing survey questions. Before distribution, the survey was piloted with three psychiatrists, who provided feedback, and was revised accordingly.

Statistical analyses included chi-squared tests for examination of categorical variables, simple binary logistic regressions, and a multiple logistic regression to explore independent variables associated with differences in respondents' characteristics and beliefs by age and gender. We first assessed associations with age (<49 *vs.* >49 or older) and gender separately, and then entered both age and gender into a multiple logistic regression model. As this was an initial, exploratory study of these rapidly emerging areas, we did not test the internal validity of the scale; however, the items here appear to have a certain face validity.

Results

Sociodemographic characteristics of participants are shown in Table 1. As shown on Table 2, in the past six months 14.1% of psychiatrists had ordered a genetic test, 18.3% had discussed with patients prenatal genetic testing for non-psychiatric conditions, 51.9% had discussed genetic testing with patients (36.0% had initiated discussions with patients about genetic testing, and 41.6% had patients ask about genetic testing) and 5.6% had excluded genetic information from patient records.

As shown on Table 3, of respondents, 61.7% knew that a genetic test was available for Alzheimer's disease risk, yet many also mistakenly thought that comparable tests were available for major depression (19.6%), obsessive-compulsive disorder (9.9%), suicidality (6.6%), intelligence (7.6%), and social anxiety disorder (4.7%).

Most psychiatrists thought that the extent of genetic contribution (Table 4) was moderate or high for bipolar disorder (88.7%), schizophrenia (85.2%), major depression (81.7%), Alzheimer's (79.3%), intelligence (76.6%), panic disorder (67.6%), creativity (60.9%), social anxiety disorder (57.3%), dysthymia, (55.2%), and suicidality (52.9%). Most also believed there was low or no genetic contribution for anorexia (50.7%), homosexuality (50.9%), and pedophilia (64.1%).

Younger respondents were more likely to be women (44.0% *vs.* 28.4%, p<.010), and as a trend, were less likely to believe there is a genetic test for intelligence (OR: 0.29, p<0.054). When controlling for gender younger respondents were, as trends, less likely to be uncertain about the genetic contribution to bipolar (AOR: 0.14, CI: 0.02–1.16, p<0.07), or to believe a genetic test existed for intelligence (AOR: 0.30, CI: 0.08–1.04, p<0.059).

We then explored gender, controlling for age, and found that women were more likely than men to have a patient ask about genetic tests (51.0% *vs.* 37.7%, AOR=1.719, CI: 1.03–2.86, p<0.038), and be unsure about the degree of genetic contribution to many psychiatric disorders and behavioral traits (Table 4). Women were less likely to think that genetic tests would have a role in diagnosing schizophrenia.

Discussion

These data suggest that most psychiatrists are discussing genetic tests with patients, either on their own initiative or in response to patients' inquiries. However, only 14.1% had ordered a genetic test in the preceding 6 months. Most perceived strong genetic bases for certain psychiatric disorders and behavioral traits, but a sizable minority appeared

misinformed about the availability of genetic tests for several disorders (e.g., 38.3% did not know that genetic testing is currently available for AD). In addition, gender differences may exist in some of these views. A small but notable percentage of psychiatrists (5.2%) reported having excluded genetic information from medical records in response to concerns about patients' genetic privacy. Whether patients or providers initiate this practice is unclear. Our past research suggests that patient groups, particularly those confronting HD, may request such exclusions,. We found a similar rate among internists (4.5%) (Klitzman et al., 2013). Clearly the practice deserves further study, to understand when and why it occurs and with what possible implications.

As suggested in Tables 4 and 5, over time, psychiatrists' perceptions of genetic contributions to various disorders and behavioral traits appear to have increased. The two prior studies conducted by other researchers (Finn et al. 2005; Hoop et al. 2008) used different metrics, which makes direct comparisons difficult, though overall trends emerge. Specifically, Finn et al. reported the means of respondents' estimates of the percent risk of developing each condition due to genetic factors (ascertained by filling in a blank); while Hoop reported the proportion of respondents who chose each of the 4 forced choices of qualitative descriptions of the influence of genetics (scaled 1= none, 2 = weak, 3 = moderate, 4 = strong). Nonetheless, comparisons suggest possible patterns.

In 2005, Finn et al. reported that a sample of psychiatrists thought the extent of genetic contribution was relatively low. The percent risks were estimated as follows (as shown in parentheses): schizophrenia (30%), autism (10%), Alzheimer's disease (20%), ADHD (25%), alcoholism (30%), panic disorder (25%), and antisocial personality disorder (20%). In 2008, Hoop et al. found that a different group of psychiatrists reported beliefs that the influence of genetics was moderate to strong for bipolar disorder (3.53), schizophrenia (3.37), Alzheimer's disease (3.30), ADHD (3.28), major depression (3.24), panic disorder (2.86), autism (2.86), and antisocial personality disorder (2.62). Since these studies were conducted, genetic research has continued to grow enormously, examining a wide range of psychiatric, neurologic, and other disorders, and clarifying their genetic contributions including copy number variation (Malhotra and Sebat, 2012) and the role of de novo genetic events in the absence of a family history of the disorder (Kong et al., 2012). Still, additional research using larger experimental sample sizes is needed (Visscher et al., 2012).

Our data suggest that psychiatrists now perceive more genetic contribution to certain psychiatric disorders, reflecting growing research and new findings over time on the genetic bases of mental health disorders. Yet, many psychiatrists remain unsure of the genetic contribution to various disorders, even for conditions where the degree of heritability has been clearly established.

Compared with available scientific data on heritability of various traits and psychiatric conditions, our respondents were relatively accurate, but with some important exceptions. As shown on Table 5, most psychiatrists correctly thought that the genetic contribution was moderate or high for several disorders and characteristics for which the heritability (shown in Table 5 and in parentheses below) is above 0.5: autism (0.70–0.90) (Geschwind, 2009), bipolar disorder (0.71) (Edvardsen et al., 2008), intelligence (0.50–0.90) (Devlin et al.,

1997), schizophrenia (0.41–0.87) (Cannon et al., 1998), and Alzheimer's disease (0.58–0.79) (Gatz et al., 2006). However, for several disorders, most respondents overestimated the genetic contribution, thinking that it was high when it is estimated to be less than 0.5: social anxiety disorder (0.30–0.50) (Kendler et al., 1999), major depression (0.40 for women, 0.30 for men) (Kendler et al., 2006), and obsessive compulsive disorder (0.27–0.47) (Van Grootheest et al., 2005). For anorexia, most respondents underestimated the genetic contribution, thinking it was low, though scientists estimate heritability to be 56% to 84% (Klump et al., 2001). The fact that psychiatrists overestimate the genetic contribution for major depression, obsessive-compulsive disorder, and social anxiety disorder, and underestimate it for anorexia is noteworthy, as these beliefs may reflect patterns of diagnosis for these disorders. These data highlight important needs for enhanced education of psychiatrists through both training programs and CME.

Although Hoop reported in 2008 that 20.9% of psychiatrists had ordered genetic tests in the prior 5 years, we found that 14.1% of respondents had done so in the previous six months, suggesting a higher rate per year now than in the past. No previous studies have examined whether and how often psychiatrists or patients initiate discussions about genetic tests. Of note, a sizable proportion of our respondents (41.6%) reported that patients had asked about genetic tests, slightly more than the percentage of respondents who had themselves initiated these discussions (35%). DTC testing may contribute to patients' questions, highlighting the importance of psychiatrists being aware of such services, and able to address issues that they may raise for patients.

These data also suggest possible gender differences with respect to how psychiatrists view genetics. More women than men reported that they were uncertain about genetic contributions to several psychiatric disorders, which may reflect either greater uncertainty or more willingness to admit uncertainty. Uncertainty about particular issues may not reflect knowledge deficits, but rather unwillingness to endorse categorical statements, given that many disorders result from a complex interplay of genetic and environmental influences. Interestingly tolerance for ambiguity has been found to be higher among female than male medical students, especially among those who identify with a more "humanistic" approach to treatment methods (Geller et al., 1990), though other studies show more mixed results (Geller et al., 1993). The fact that women were less likely than men to think that in the future genetic tests will have a role in diagnosing schizophrenia and, as trends, bipolar disorder and major depression, suggests that women may be warier of emphasizing genetics in understanding psychiatric etiology. This finding is in line with prior research that indicated that among psychiatrists, women were less likely than men to have a biological orientation in treatment of psychiatric disorders (Bodkin et al., 1995). Of note, women psychiatrists' reduced certainty about genetic contributions to psychiatric disorders and unlikelihood to think genetic tests will have a future role in diagnosing schizophrenia, bipolar disorder and major depression also reflect, anecdotally, the views of many psychiatric geneticists, as suggested by the range of heritability estimates in Table 5. Clearly, additional research is needed to explore these gender differences more fully.

Compared to the results of our prior survey of internists concerning genetic testing, we found psychiatrists were less likely to have ordered tests (14.1% vs. 44.0%) but only slightly

less likely to have patients ask about tests (41.6% vs. 50.6%). Both groups only rarely did not include test results in patients' medical records (5.2% vs. 4.5%). These differences not only suggest that internists have more experience ordering genetic tests, but that patients seen by both sets of doctors have relatively high levels of interest in genetic testing. Additional research is also needed to assess the differences between physicians in these and other specialties (e.g. pediatrics, obstetricians/gynecologists, etc.)

These data may have important implications for professional education. Psychiatrists' knowledge of genetics and of the roles of genetic testing are clearly imperfect. Genetics and genomics have been playing increasing roles in the medical school curriculum, suggesting that recent medical school graduates may be more knowledgeable about genetics (Korf, 2002). However, only 47% of U.S. and Canadian medical schools report incorporating genetics into the third and fourth years (Thurston et al., 2007). More genetics may be entering the curriculum (Dhar et al., 2012), yet the absence of an age effect in our data indicates a general need for more education of psychiatrists across all stages of their careers, regarding the genetic bases of disorders and the uses of genetic testing. To handle growing amounts of genetics research on psychiatric disorders, the incorporation of additional genetics training during psychiatric residency appears to be critical to prepare future psychiatrists. In a 2010 survey, 39% of psychiatric residency program educators and 55% of trainees reported little or no genetics instruction in their curricula. Only 20% and 16% respectively reported moderate or a great deal of emphasis. Almost half of educators indicated they had few or no faculty with sufficient expertise in instructing trainees about genetics (Hoop et al., 2010). CME activities should also emphasize understanding of genetic associations that are being discovered, and their limitations. On-going research over time is also needed to assess knowledge of genetics and needs for education among these groups.

This study has several limitations. We had a relatively low response rate from those invited to participate; however, we did not follow-up via direct mail or phone calls, and did not compensate respondents – all of which might have increased the response rate. Nonetheless, this sample is the largest to date of psychiatrists concerning their views and behaviors in relation to genetics, and the first to examine several critical issues. Moreover, our sample did not differ significantly from a national sample of psychiatrists (based on data obtained from the American Psychiatric Association) in gender, race (white *vs.* non-white), or proportion in solo practice. Furthermore, in recent years response rates in studies generally have been declining steeply (Huber et al., 2011), especially among physicians (Galea et al., 2007; Cull et al., 2005)**,** yet research has suggested that low response rates do not necessarily result in non-response bias (Galea et al., 2007). Such bias in any case may be less of a concern in surveys of doctors, compared with surveys of the general public (Asch et al., 2000; Kellerman and Herold, 2001; Guadagnoli and Cunningham, 1989; Hovland et al., 1980), since there is more consistency in knowledge, training and behavior among physicians than within the population at large. We also relied on self-reports, with the usual uncertain effects on validity of responses. Although there is no reason to suspect that the effects of social desirability played a role in the answers of our respondents, recall of events may vary in accuracy. Finally, due to the exploratory nature of this study, we did not adjust our statistical analyses for multiple comparisons.

Conclusions

In sum, these data, the first to explore several key aspects of how psychiatrists view and respond to genetic information, reflect growing levels of genetic knowledge, possible gender differences in perceptions of these issues, and needs for further research into these issues and for enhanced professional education. The extent of inaccurate information about the availability of certain genetic tests is of concern, and highlights needs for educational outreach and distribution of educational materials. More referrals of psychiatric patients to genetic counselors or other knowledgeable professionals may also be appropriate. Especially given advances in genetic research, use of DTC testing, and rapidly decreasing costs of genome sequencing, these issues are of increasing importance.

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Table 1

Socio-demographic Characteristics of Respondents

Total	**% (N*) 100% (372)**
Gender	
Male	61.8% (162)
Female	38.2% (100)
Age	
<49 years	65.6% (172)
>49 years	34.4% (90)
Race	
White	70.4% (183)
Asian	13.8% (36)
Prefer not to answer	9.6% (25)
Other	4.6% (12)
Black or African American	1.2% (3)
Native Hawaiian/Pacific Islander	0.4% (1)
Religion	
Protestant	19.1% (50)
Jewish	17.2% (45)
Prefer not to answer	13.7% (36)
Catholic	12.6% (33)
Other	37.4% (98)
Primary Practice Setting	
Private Practice	57.3% (150)
Other	42.7% (112)
Approximately, what % of patient population is:	
White	
<75%	64.5% (160)
>75%	35.5% (88)
Covered by No Insurance	
<25%	60.1% (134)
>25%	39.9% (89)

Table 2

Behavior of Respondents with respect to Genetic Tests

	Total	Gender		Binary Logistic (Controlling for Age)		
	% (N)	Male	Female	AOR[1]	p value [2]	CI [3]
Total	**100% (372)**					
Have you discussed prenatal GT for non-psychiatric condition?						
Yes	18.3% (48)	74.4% (32)	75.0% (30)			
No	81.7% (214)	25.6% (11)	25.0% (10)			
In past 6 months, have patients asked about GT?				1.72	0.038	1.03–2.86
Yes	41.6% (129)	37.7% (61)	51.0% (51)			
No	58.4% (181)	62.3% (101)	49.0% (49)			
In past 6 months, have you ordered a GT?						
Yes	14.1% (37)	14.2% (23)	14.0% (14)			
No	85.9% (225)	85.8% (139)	86.0% (86)			
Have you ever excluded genetic information from the patient record?						
Yes	5.3% (14)	5.6% (9)	5.0% (5)			
No	94.7% (248)	94.4% (153)	95.0% (95)			

[1] Adjusted Odds Ratio

[2] P value shown if <0.1

[3] Confidence Interval

Table 3

Respondent's Knowledge and Attitudes about Genetic Tests

	Total	Gender		Binary Logistic (Controlling for Age)		
	% (N)	Male	Female	AOR [a]	p value [b]	CI [c]
Total	**100% (372)**					
To best of your understanding, is there a GT available for:						
Alzheimer's						
Yes [d]	61.7% (171)	60.0% (96)	65.7% (65)			
No	38.3% (106)	40.0% (64)	34.3% (34)			
Autism						
Yes	19.6% (54)	18.1% (29)	21.2% (21)			
No [e]	80.4% (221)	81.9% (131)	78.8% (78)			
Borderline Personality Disorder				0.14	0.068	0.02–1.16
Yes	4.0% (11)	6.3% (10)	1.0% (1)			
No [f]	96.0% (264)	93.7% (149)	99.0% (98)			
Intelligence						
Yes	7.6% (21)	8.8% (14)	7.1% (7)			
No[f]	92.4% (254)	91.2% (145)	92.9% (92)			
Major Depression						
Yes	19.6% (54)	18.2% (29)	22.0% (22)			
No[f]	80.4% (222)	81.8% (130)	78.0% (78)			
Obsessive Compulsive Disorder						
Yes	9.9% (27)	11.4% (18)	8.1% (8)			
No[f]	90.1% (247)	88.6% (140)	91.9% (91)			
Schizophrenia				0.61	0.088	0.34–1.07
Yes	25.0% (65)	21.2% (34)	31.0% (31)			

	Total	Gender		Binary Logistic (Controlling for Age)		
	% (N)	Male	Female	AOR [a]	p value [b]	CI [c]
Total	**100% (372)**					
No [g]	75.0% (195)	78.8% (126)	69.0% (69)			
Social Anxiety Disorder				0.13	0.049	0.02–0.99
Yes	4.7% (13)	7.5% (12)	1.0% (1)			
No[f]	95.3% (261)	92.5% (147)	99.0% (97)			
Suicidality						
Yes	6.6% (18)	8.2% (13)	4.1% (4)			
No[f]	93.4% (255)	91.8% (145)	95.9% (94)			
In the future, will GT have a role in diagnosing:						
Alzheimer's						
Yes	94.2% (243)	94.3% (150)	93.9% (93)			
No	5.8%(15)	5.7% (9)	6.1% (6)			
Autism						
Yes	83.7% (216)	83.0% (132)	84.8% (84)			
No	16.3% (42)	17.0% (27)	15.2% (15)			
Bipolar Disorder				0.56	0.06	0.30–1.02
Yes	79.2% (205)	83% (132)	73% (73)			
No	20.8% (54)	17% (27)	27% (27)			
Major Depression				0.63	0.094	0.37–1.08
Yes	68.3% (177)	72.3% (115)	62% (62)			
No	31.7% (82)	27.7% (44)	38% (38)			
Schizophrenia				0.49	0.03	0.26–0.93
Yes	81.2% (211)	85% (136)	75% (75)			
No	18.8% (49)	15% (24)	25% (25)			

[a] Adjusted Odds Ratio

[b] P value shown if <0.1

[c] Confidence Interval

[d] A genetic test exists and is used clinically, though not widely.

[e] At time of survey, recent studies had indicated a viable test had been developed. This has since been refuted.

[f] No clinically useful genetic test exists.

[g] Genetic markers have been identified for a subset of patients, though a clinically useful test does not exist.

Table 4

Respondents' Understanding of Genetic Contribution to Psychiatric Disorders

	Total	Gender		Binary Logistic(Controlling for Age)		
	% (N)	Male	Female	AOR [a]	p value [b]	CI [c]
Total	**100% (372)**					
Extent of genetic contribution to:						
Alzheimer's						
Unsure	8.3% (24)	4.4% (7)	12.0% (12)	3.12	0.023	1.07–8.33
Moderate/High	79.3% (230)	81.1% (130)	78.0% (78)			
None/Very Low/Low	12.4% (36)	13.8% (22)	10.0% (10)			
Anorexia						
Unsure	12.8% (37)	6.3% (10)	21.2% (21)	4.17	0.001	1.84–9.43
Moderate/High	36.6% (106)	43.8% (70)	29.3% (29)			
None/Very Low/Low	50.7% (147)	50.0% (80)	49.5% (49)			
Antisocial Personality Disorder						
Unsure	13.4% (39)	7.5% (12)	21.0% (21)	3.75	0.001	1.71–8.13
Moderate/High	45.4% (132)	48.8% (78)	43.0% (43)			
None/Very Low/Low	41.2% (120)	43.8% (70)	36.0% (36)			
Autism						
Unsure	10.8% (31)	6.3% (10)	16.2% (16)	2.84	0.016	1.22–6.62
Moderate/High	56.6% (163)	58.9% (93)	55.6% (55)			
None/Very Low/Low	32.6% (94)	34.8% (55)	28.3% (28)			
Bipolar Disorder						
Unsure	5.2% (15)	2.5% (4)	7.0% (7)	3.68	0.045	1.03–13.16
Moderate/High	88.7% (258)	91.9% (147)	88.0% (88)			
None/Very Low/Low	6.2% (16)	5.6% (9)	5.0% (5)			
Borderline Personality Disorder						

	Total	Gender		Binary Logistic(Controlling for Age)		
	% (N)	Male	Female	AOR [a]	p value [b]	CI [c]
Total	**100% (372)**					
Unsure	11.3% (33)	5.0% (8)	19.0% (19)	4.70	0.001	1.94–11.36
Moderate/High	39.9% (116)	43.8% (70)	35.0% (35)			
None/Very Low/Low	48.8% (142)	51.3% (82)	36.0% (46)			
Creativity						
Unsure	12.5% (36)	7.5% (12)	17.0% (17)	2.65	0.017	1.19–5.88
Moderate/High	60.9% (176)	59.7% (95)	63.0% (63)	1.88	0.046	1.01–3.50
None/Very Low/Low	26.6% (77)	32.7% (52)	20.0% (20)			
Dysthymia						
Unsure	9.0% (26)	5.0% (8)	11.0% (11)	2.66	0.047	1.01–6.99
Moderate/High	55.2% (160)	56.0% (89)	59.0% (59)			
None/Very Low/Low	35.9% (104)	39.0% (62)	30.0% (30)			
Homosexuality						
Unsure	14.8% (43)	10.6% (17)	21.0% (21)	2.19	0.029	1.08–4.42
Moderate/High	34.4% (100)	35.0% (56)	31.0% (31)			
None/Very Low/Low	50.9% (148)	54.4% (87)	48.0% (48)			
Major Depression						
Unsure	5.5% (16)	1.9% (3)	8.1% (8)	5.44	0.015	1.38–21.3
Moderate/High	81.7% (237)	85.0% (136)	81.8% (81)			
None/Very Low/Low	12.8% (37)	13.1% (21)	10.1% (10)			
Panic Disorder						
Unsure	8.3% (24)	4.4% (7)	12.0% (12)	3.12	0.023	1.17–8.33
Moderate/High	67.6% (196)	69.8% (111)	67.0% (67)			
None/Very Low/Low	24.1% (70)	25.8% (41)	21.0% (21)			
Pathological Gambling						
Unsure	15.3% (44)	8.2% (13)	27.3% (27)	4.27	0.001	2.06–8.85

	Total	Gender		Binary Logistic(Controlling for Age)		
	% (N)	Male	Female	AOR [a]	p value [b]	CI [c]
Total	**100% (372)**					
Moderate/High	36.8% (106)	40.3% (64)	36.4% (36)			
None/Very Low/Low	47.9% (138)	51.6% (82)	36.4% (36)			
Pedophilia						
Unsure	23.8% (69)	16.4% (26)	35.0% (35)	2.79	0.001	1.54–5.05
Moderate/High	12.1% (35)	13.2% (21)	9.0% (9)			
None/Very Low/Low	64.1% (186)	70.4% (112)	56.0% (56)			
Schizophrenia						
Unsure	4.8% (14)	1.9% (3)	6.0% (6)	3.77	0.068	0.91–15.6
Moderate/High	85.2% (248)	86.9% (139)	86.0% (86)			
None/Very Low/Low	10.0% (29)	11.3% (18)	8.0% (8)			
Social Anxiety Disorder						
Unsure	10.4% (30)	7.5% (12)	13.1% (13)			
Moderate/High	57.3% (165)	54.1% (86)	60.6% (60)	1.67	0.083	0.94–2.97
None/Very Low/Low	32.3% (93)	38.4% (61)	26.3% (26)			
Suicidality						
Unsure	11.7% (34)	6.9% (11)	17.0% (17)	2.74	0.015	1.21–6.21
Moderate/High	52.9% (154)	56.3% (90)	50.0% (50)			
None/Very Low/Low	35.4% (103)	36.9% (59)	33.0% (33)			

[a] Adjusted Odds Ratio

[b] P value shown if <0.1

[c] Confidence Interval

Table 5

Views and Extents of Heritability of Psychiatric Disorders and Behavioral Conditions

Condition	Finn et al. (2005) Median % perceived risk of developing condition due to heritable genetic factors	Hoop et al. (2008) % of psychiatrists who thought the extent of genetic contribution in developing condition is moderate/high	Klitzman et al. (2013) % of psychiatrists who thought the extent of genetic contribution in developing condition is moderate/high	Actual Extent of Contribution
Alzheimer's	20%	94%	79.3%	0.58–0.79 (Gatz et al., 2006)
Anorexia			36.6%	56%–84% (Klump et al., 2001)
Antisocial Personality Disorder	20% (in males)	52%	45.4%	.65 (aggressive rule breaking) .48 (non-aggressive rule breaking) (Burt, 2009)
Autism	10%	63%	56.6%	0.70–0.90 (Geschwind, 2009)
Bipolar Disorder	40%	95%	88.7%	0.71 (Edvardsen et al., 2009)
Borderline Personality Disorder			39.9%	.51 (Distel et al., 2010)
Creativity		78%	60.9%	N/A
Dysthymia			55.2%	.29 (Savitz et al., 2008)
Homosexuality			34.4%	.34–.39 (Langstrom et al., 2008)
Intelligence			76.6%	0.50–0.90 (Devlin et al., 1997)
Major Depression	30%	89%	81.7%	0.40 (females) 0.30 (males) (Kendler et al., 2006)
Obsessive Compulsive Disorder			78.3%	0.27 (Van Grootheest et al., 2005)
Panic Disorder	25%	78%	67.6%	.40–.50 (Spatola et al., 2010)
Pathological Gambling			36.8%	.27–.61 (Slutske et al., 2010)
Pedophilia			12.1%	14.6% (Alanko et al., 2013)
Schizophrenia	30%	93%	85.2%	0.41–0.87 (Cannon et al., 1998)
Social Anxiety Disorder			57.3%	0.30–0.50 (Kendler et al., 1999)
Suicidality			52.9%	43% (McGuffin et al, 2001)