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The blunt-edged sword: genetic explanations of misbehavior neither mitigate nor aggravate punishment

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ABSTRACT

Links between genetic variants and negatively valenced behaviors have stimulated intense commentary about the implications for responsibility and punishment. Previous research has suggested that behavioral genetic evidence of a predisposition to negative behaviors has modest to no impact on mitigation of punishment, at least for serious crimes. Data are presented on the effect of such evidence in a representative sample of the general population ($n = 640$) asked to consider three vignettes describing lesser offenses, dealt with in less formal adjudicatory settings and in everyday life. Genetic explanations of behavior had no effect on the severity of the punishment selected in any case, in contrast to the egregiousness of the behavior and respondents' beliefs in free-will. Public views of genetic influences on behavior may be less deterministic and more nuanced than is often thought, or genetic explanations may simply not have the salience for decision makers that is frequently attributed to them.

KEYWORDS: behavioral genetics, neuroscience, evidence, responsibility, punishment

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INTRODUCTION

Studies suggesting genetic predispositions for negatively valenced behaviors—ranging from crime[1] to marital infidelity[2] to excessive credit card debt[3] —appear regularly in scientific journals and attract attention in the popular media.[4] Implied in many of these discussions is that people with specific alleles are less able to avoid engaging in undesirable behaviors than other people, and thus bear less responsibility for their actions. An oft-stated corollary of this assumption is that such people are less deserving of punishment and in greater need of treatment than people who behave similarly for other reasons.[5] On the other hand, they may also be perceived as more likely to commit legally and socially proscribed acts again in the future, which may lead to more severe punishment—the so-called double-edged sword.[6] How these competing considerations are balanced will play an important role in shaping formal and informal responses to socially deviant behavior.

The most frequently discussed relationship between a genetic trait and socially disapproved behaviors involves the monoamine oxidase A (MAOA) gene and antisocial behavior. A foundational study reported that the presence of a low-activity allele of MAOA in males markedly increased rates of antisocial behavior, but only when combined with a history of childhood maltreatment.[7] Many studies attempting to confirm these findings followed, usually but not always successful; these studies were often based on secondary analyses of data collected for other purposes, using a variety of definitions of maltreatment and antisocial behavior. One recent meta-analysis, which included 20 studies involving over 5800 male participants—supported the association between MAOA and antisocial behavior by maltreated boys.[8] However, another meta-analysis, which included an overlapping, but not identical set of studies, demonstrated a main effect of the low-activity allele, but no interaction with maltreatment.[9] It seems clear that the exact nature of the relationship remains to be definitively determined.

Even as the precise relationship between MAOA and criminal behavior is being elucidated, evidence of genetic predispositions to impulsive, antisocial behavior has been appearing increasingly in the criminal justice system, generally as part of an argument

1 Jari Tiihonen et al., *Genetic Background of Extreme Violent Behavior*, 20 Mol. Psychiat. 786 (2015).

2 Brendan P. Zietsch et al., *Genetic Analysis of Human Extrapair Mating: Heritability, Between-sex Correlation, and Receptor Genes for Vasopressin and Oxytocin*, 36 Evol. Hum. Behav. 130 (2015).

3 Jan-Emanuel DeNeve & James H. Fowler, *Credit Card Borrowing and the Monoamine Oxidase A (MAOA) Gene,* 107 J. Econ. Behav Organ 428 (2014).

4 Melissa Hogenboom, *Two Genes Linked with Violent Crime*. BBC News, Oct. 28, 2014, available at, http://www.bbc.com/news/science-environment-29760212 (accessed June 15, 2015); Richard A. Friedman, *Infidelity Lurks in Your Genes,* New York Times, May 24, 2015, at p. SR-1; Sharon Begley, *OMG, There's a Credit Card Gene*. Newsweek, Nov. 10, 2009, available at, http://www.newsweek.com/omg-theres-credit-card-gene-76925 (accessed June 15, 2015).

5 Joshua Greene & Jonathan Cohen, *For the Law, Neuroscience Changes Nothing and Everything*, 359 Philo Trans r. Soc. Lond. B Biol. Sci. 1451 (2004); Mathew Jones, *Overcoming the Myth of Free Will in Criminal Law: The True Impact of the Genetic Revolution*, 52 Duke Lj 1031 (2003).

6 Lisa G. Aspinwall et al., *The Double-edged Sword: Does Biomechanism Increase or Decrease Judges' Sentencing of Psychopaths?*, 337 Science 846 (2012).

7 Avshalom Caspi et al., *Role of Genotype in the Cycle of Violence in Maltreated Children*, 297 Science 851 (2002).

8 Amy L. Byrd & Stephen B. Manuck, *MAOA, Childhood Maltreatment, and Antisocial Behavior: Meta-Analysis of a Gene–Environment Interaction*, 75 Biol. Psychiat 9 (2014).

9 Courtney A. Ficks & Irwin D. Waldman, *Candidate Genes for Aggression and Antisocial Behavior: A Meta-analysis of Association Studies of the 5HTTLPR and MAOA-uVNTR,* 44 BEH. GENET. 427 (2014).

for mitigation in sentencing.[10] Such claims may be based on genetic tests demonstrating the presence of an MAOA low-activity allele or another genetic variant that has been associated with criminal behavior [e.g., a variant of the serotonin transporter gene (SLC6A4)],[11] or on a family history of antisocial behavior.[12] Whether such evidence *should be* mitigating has been the subject of debate from scientific, legal, and ethical perspectives,[13] and its effect on sentencing outcomes has been difficult to determine.[14] But a small number of reports from the USA and Italy have demonstrated judges' willingness to reduce sentences in light of such genetic predisposition evidence.[15] In addition, a study of USA state court judges who were asked to assign a sentence to a hypothetical defendant showed that testimony indicating the presence of a genetic predisposition to psychopathy resulted in a modest but statistically significant decrement in length of sentence.[16] Attorneys thus have been encouraged by legal scholars to consider the use of behavioral genetic evidence for purposes of mitigation, especially in combination with evidence about maltreatment and brain dysfunction.[17]

A series of studies we have undertaken on the impact of genetic explanations of behavior on perceptions of responsibility and appropriate punishment, however, has yielded very different results from those anticipated by legal advocates. The introduction of genetic explanations for criminal behavior did not affect perceptions of culpability or sentences imposed by large, representative samples of the USA population presented with vignettes describing defendants who had committed serious offenses.[18] Similar findings regarding the impact of genetic evidence were described by

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[10] Deborah W. Denno, *Courts' Increasing Consideration of Behavioral Genetics Evidence in Criminal Cases: Results of a Longitudinal Study*, 64 MICH. ST. L REV 967 (2011); Paul S. Appelbaum, *The Double Helix Takes the Witness Stand: Behavioral and Neuropsychiatric Genetics in Court*, 82 NEURON 946 (2014); C.H. de Kogel & E.J.M.C. Westgeest, *Neuroscientific and Behavioral Genetic Information in Criminal Cases in the Netherlands,* J. L. & BIOSCI., DOI:10.1093/jlb/lsv024.

[11] William Bernet et al., *Bad Nature, Bad Nurture, and Testimony Regarding MAOA and SLC6A4 Genotyping at Murder Trials*, 52 J FORENSIC SCI. 1362 (2007); Roberto Tatarelli et al., *Behavioral Genetics and Criminal Responsibility at the Courtroom*, 237 FORENSIC SCI. INTL. FORENSIC SCI. INTL 40 (2014).

[12] Appelbaum, *supra* note 10, at 947.

[13] Joshua W. Buckholtz & Andreas Meyer-Lindenberg, *MAOA and the Bioprediction of Antisocial Behavior: Science Fact and Science Fiction* in BIOPREDICTION, BIOMARKERS, AND BAD BEHAVIOR: SCIENTIFIC, LEGAL, AND ETHICAL CHALLENGES 131–52 (Singh I, Sinnott-Armstrong WP, Savulescu J, eds, Oxford University Press) (2014); Stephen J. Morse, *Genetics and Criminal Responsibility,* 15 TRENDS COG. SCI. 378 (2011); Mathew L. Baum, *The Monoamine Oxidase A (MAOA) Genetic Predisposition to Impulsive Violence: Is it Relevant to Criminal Trials?*, 6 NEUROETHICS 287 (2013).

[14] Denno, *supra* note 10, at 1027.

[15] Brett Walker, *When the Facts and the Law Are Against You, Argue the Genes? A Pragmatic Analysis of Genotyping Mitigation Defenses for Psychopathic Defendants in Death Penalty Cases*, 90 WASH. U. L. REV. 1779 (2013); Emiliano Feresin, *Lighter Sentence for Murder with 'Bad Genes'.* NATURE NEWS, Oct. 30, 2009, available at http://dx.doi.org/10.1038/news.2009.1050 (accessed June 15, 2015); Hank Greely, *Another 'Brain Mitigation' Criminal Sentence from Italy.* Sept. 3, available at http://blogs.law.stanford.edu/lawandbiosciences/2011/09/03/another-brain-mitigation-criminal-sentence-from-italy/ (accessed June 15, 2015).

[16] Aspinwall et al., *supra* note 6, at 847.

[17] Deborah W. Denno, *What Real-world Criminal Cases Tell Us About Genetics Evidence,* 64 HASTINGS L. J. 1591 (2013); Walker, *supra* note 15, at 1810.

[18] Paul S. Appelbaum & Nicholas Scurich, *Impact of Behavioral Genetic Evidence on the Adjudication of Criminal Behavior*, 42 J AM. ACAD. PSYCHIAT & L 91 (2014); Paul S. Appelbaum et al., *Effects of Behavioral Genetic Evidence on Perceptions of Criminal Responsibility and Appropriate Punishment*, 21 PSYCHOL. PUB. POL'Y & L. 357 134 (2015).

Cheung and Heine in a set of studies using a vignette involving a homicide.[19] Moreover, a recent attempt by a German team, surveying 372 judges in that country, to replicate the findings noted above that evidence of a genetic predisposition to psychopathy led USA judges to select reduced sentences[20] was unsuccessful: using the same hypothetical vignette, the German researchers found that genetic evidence had no effect on the average length of the sentences selected.[21] Using somewhat different methods, Dar-Nimrod and colleagues found that evolutionary explanations of behavior related to sex (which are intrinsically genetic in nature) failed to impact subsequent decisions about bail and punishment for sex-related offenses in a set of hypothetical scenarios.[22] A literature on the effect of neuroimaging evidence on mock jurors is somewhat more equivocal in its findings, with two studies of mock jurors making decisions about *mens rea* (culpable mental states) and sentencing showing no incremental effect of brain images beyond the impact of verbal testimony regarding neuropsychological impairment.[23] However, a more recent study with similar methods in a capital sentencing context found that neuroimages reduced perceived responsibility and death sentences for defendants diagnosed with psychopathy but increased perceived responsibility in defendants with schizophrenia.[24]

We undertook the study reported below to further clarify the likely impact of genetic explanations of behavior on perceptions of responsibility and appropriate punishment. Our earlier findings showing no impact of such explanations could have been due to the seriousness of the offenses described (all involved homicides), which may have overshadowed the potential effect of genetic evidence—a conclusion supported by the strong and consistent correlations in our data between the heinousness of the offenses and the resulting sentences. Thus, although genetic explanations have most often been introduced for purposes of mitigation in capital cases, we wanted to test the hypothesis that the impact of genetic explanations may be greater in less egregious cases of wrongdoing, characterized by offenses of lesser severity, younger perpetrators, and informal adjudicatory settings, including everyday judgments of behavior. The importance of exploring these issues is underscored by the growing availability of genetic information,[25] which seems increasingly likely to make its way into a variety of situations in which

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19 Although Cheung and Heine found extensive effects on participants' perceptions of various defense claims, of the perpetrator's mental state, and of the causal basis for the criminal behavior, genetic explanations had no impact on the verdicts or punishments selected. Benjamin Y. Cheung & Steven J. Heine, *The Double-Edged Sword of Genetic Accounts of Criminality: Causal Attributions from Genetic Ascriptions Affect Legal Decision-Making*, 41 PERSONALITY & SOC. PSYCHOL. BULL. 1723 (2015).

20 Aspinwall et al., *supra* note 6, at 847.

21 Johannes Fuss et al., *Neurogenetic Evidence in the Courtroom: A Randomised Controlled Trial with German Judges*, J. MED. GENET., DOI:10.1136/jmedgenet-2015-103284. Genetic predisposition evidence, however, did result in judges rating the defendant as less criminally responsible, and being much more likely to say that they would order involuntary psychiatric commitment.

22 Ilan Dar-Nimrod et al., *Do Scientific Theories Affect Men's Evaluations of Sex Crimes?* 37 AGGRESSIVE BEHAV. 440 (2011).

23 Edith Greene & Brian S. Cahill, *Effects of Neuroimaging Evidence on Mock Juror Decision Making*, 30 BEHAV. SCI. & L. 280 (2012); Nicholas J Schweitzer et al., *Neuroimages as Evidence In a Mens Rea Defense: No Impact*, 17 PSYCHOL., PUB. POL'Y & L. 357 (2011).

24 Michael J. Saks et al., *The Impact of Neuroimages in the Sentencing Phase of Capital Trials*, 11 J. EMP. L. STUDIES 105 (2014).

25 Jeanne De Sa et al., *Growth of Molecular Diagnostics and Genetic Testing in the USA, 2008-2011: Analysis and Implications*, 10 PERSONALIZED MED. 785 (2013).

culpability and punishment must be determined.[26] In the study reported here, we explore these possibilities.

METHODS

Participants

Participants were 640 members of the USA adult population recruited by YouGov, a survey research company that maintains a web-based panel of respondents,[27] to participate in an anonymous online survey. YouGov constructed a sample representative of the adult USA population with a two-stage sampling design. First, a sampling frame was constructed from the American Community Study,[28] with additional data from the Current Population voter supplement[29] and the Pew Religious Life Study.[30] A stratified random sample was drawn similar in size to the desired study sample. At the second stage, the sampling algorithm behind the proprietary sampling system searched the opt-in panel (i.e., respondents to a generic invitation to participate in a survey) for participants who most closely matched the individuals in the randomly drawn target sample. The algorithm invites 2–3 matches for every respondent in the target frame. The matching criteria include age, race, gender, and education. The final sample ($n = 640$) has the characteristics of the adult U.S. population.

Sample size was determined by an *a priori* power analysis.[31] Assuming a medium effect size of Delta = 0.75 [32] and Type I error rate of 0.05, each experimental condition (or cell) required more than 30 participants per cell to obtain power greater than 0.80. Since the most complex case had a total of 16 cells, a total of 480 participants was the minimum required sample size. However, given the previous null findings (suggesting that the potential effect size is less than medium[33]), we elected to have 40 participants per cell, for a total of 640 participants. The demographic characteristics of the final sample appear in Table 1.

General Procedures

In this online study, participants were presented with descriptions of three different vignettes and asked to render a decision. One case asked participants to determine the length of incarceration for a defendant convicted of assault with a deadly weapon (Case 1); a second case asked participants to determine the appropriate punishment for a 21-year-old college student who broke a window at a party (Case 2); and a third case inquired about the appropriate punishment for a fourth grader who intentionally engaged in misbehavior and caused damage at home (Case 3). The approximate length of the stimulus for each case was 650 words. The cases were presented to participants in random order.

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26 Denno, *supra* note 10.

27 YouGov, https://today.yougov.com/about/about-the-yougov-panel (accessed June 15, 2015).

28 US Census Bureau, *Current Population Survey, November 2008 Voting And Registration Supplement File,* http://www.census.gov/prod/techdoc/cps/cpsnov08.pdf (accessed June 15, 2015).

29 US Census Bureau, *American Community Survey: 2010 Data Release,* http://www.census.gov/acs/www/data_documentation/2010_release/ (accessed June 15, 2015).

30 Pew Research, *Religious Landscape Survey,* http://religions.pewforum.org/reports (accessed June 15, 2015).

31 Jacob Cohen, Statistical Power Analyses for the Behavioral Sciences (2nd ed. 1988, Erlbaum).

32 *Ibid.*

33 See generally Appelbaum et al., *supra* note 18.

Table 1. Characteristics of participants ($n = 640$).

Characteristic	*N*	*%*
Sex		
Male	301	47.0%
Female	339	53.0%
Race		
White	486	75.9%
Black	61	9.5%
Hispanic	48	7.7%
Asian	7	1.1%
Native American	7	1.1%
Mixed	15	2.3%
Other	16	2.4%
Education		
<High school graduate	39	6.1%
High school graduate	196	30.6%
Some college	157	24.5%
Two-year college degree	60	9.4%
Four-year college degree	120	18.8%
Postcollege education	68	10.6%
Marital status		
Married	339	53.0%
Domestic partnership	23	3.6%
Separated	10	1.6%
Divorced	75	11.7%
Widowed	25	3.9%
Single	168	26.3%
Employment status		
Full-time	227	35.5%
Part-time	67	10.5%

Table 1 *Continued.*

Characteristic	*N*	*%*
Unemployed	58	9.1%
Retired	123	19.2%
Permanently disabled	58	9.1%
Homemaker	49	7.7%
Student	41	6.4%
Other	11	1.7%
Political orientation		
Very liberal or liberal	174	26.9%
Moderate	192	30.0%
Very conservative or conservative	220	34.4%
Not sure	54	8.7%

Respondents were randomized to receive information about an explanation for the person's behavior, which might include genetic, neuroscience, or psychosocial evidence. Whenever a genetic or neuroscientific explanation was proffered, it was accompanied by a graphic image to enhance the likelihood that participants would attend to the key manipulations. After rendering a decision about appropriate punishment in each case, participants answered 12 questions about their reactions to the defendant (hereafter 'reaction questions'). For example, participants were asked, 'How fearful of [the defendant] are you?', 'How much control did [the defendant] have over his actions?', and 'How harshly should [the defendant] be punished for his actions?' All ratings were made on a 9-point Likert scale. After completing these questions for each case, participants were given a comprehension check question to ensure that they had attended to the materials. Participants who did not correctly answer these questions were removed from all analyses and replaced by another matched participant. Finally, in addition to providing demographic information, participants were asked to indicate their beliefs about freewill by responding to the freewill subscale of the FAD-Plus[34] (Cronbach's $\alpha = .861$); and to complete a four-item parenting style scale (the Control subscale of the Parent Opinion Survey [35]; Cronbach's $\alpha = .839$), and an 18-item questionnaire testing knowledge of basic genetics (median percentage correct 83.0%; InterQuartile Range (IQR) = 11%). (See supplementary information for case vignettes, including images, and questions.)

34 Delory L. Paulhus & Jasmine M. Carey, *The FAD-Plus: Measuring Lay Beliefs Regarding Free Will and Related Constructs*, 93 J. Person. Ass. 96 (2011).

35 Jonathan R.H. Tudge et al., *Parents' Child-rearing Values and Beliefs in the United States and Russia: The Impact of Culture and Social Class*, 9 Inf. Child Dev. 105 (2000).

Statistical Analyses

As the dependent variable in Case 1 was continuous (i.e., length of incarceration), a three-way analysis of variance (ANOVA) was utilized to analyze the data. ANOVA is appropriate when the dependent variable is continuous, and there are categorical independent variables.[36] In contrast, the dependent variables in Cases 2 and 3 were categorical (i.e., four possible punishments); hence, a multinomial logistic regression was used to analyze these data. Both the ANOVA and the multinomial logistic regressions included all possible interactions of the independent variables, which is appropriate given the fully crossed factorial design. Responses to the twelve reaction questions were factor analyzed to determine the dimensionality of the latent construct that the questions were tapping.

CASE 1

Design

This vignette described the aftermath of a confrontation on the street, in which a young man badly beat the victim, another young man, with a baseball bat. The defendant was tried in criminal court and convicted of assault with a deadly weapon. Participants were tasked with determining the appropriate prison sentence (0–25 years). There were three experimental manipulations, with 16 possible combinations: Whether the defendant was a juvenile or adult (15 or 23 years old); the heinousness of the assault (victim suffered pervasive bruising, or in addition to bruising victim suffered a brain injury); and the explanation proffered by the defendant's attorney for the assaultive behavior (simple impulsivity; a genetic variant predisposing to impulsivity; an abusive upbringing predisposing to impulsivity; or a genetic variant and an abusive upbringing, both predisposing to impulsivity). Both conditions presenting evidence of a genetic variant included images of genetic test results described as demonstrating the abnormality.

Results

The median prison sentence selected by participants was 5 years (IQR = 8). A three-way ANOVA with prison sentence as the dependent variable (and the experimental manipulations as the independent variables) found no main effect of proffered explanation of the behavior, nor were any of the interactions significant (all *p*s > .05). However, main effects were detected for juvenile status [$F(1, 640) = 5.74, p < .05, h_p^2 = .009$] and for heinousness [$F(1, 640) = 6.31, p < .005, h_p^2 = .010$]: the 23-year-old defendant was given a longer sentence (mean = 7.41) than the 15-year-old (mean = 6.27), and the more heinous assault resulted in a longer sentence (mean = 7.44) than the less heinous assault (mean = 6.25).

A one-way ANOVA was conducted to determine whether the length of incarceration varied as a function of freewill beliefs or genetic knowledge, after controlling for the explanation of the defendant's behavior. The explanation of behavior had no effect on length of incarceration [($F(1, 640) < 1$], however both freewill beliefs and genetic knowledge did [$F(1, 640) = 29.77, p < .001, h_p^2 = .045$, $F(1, 640) = 4.37, p < .05, h_p^2 = .001$, respectively]; greater belief in freewill and less genetic knowledge were each associated with longer sentences (see Fig. 1).

[36] Barbara G. Tabachnick & Linda S. Fidell, Using Multivariate Statistics (6th ed. Pearson 2013).

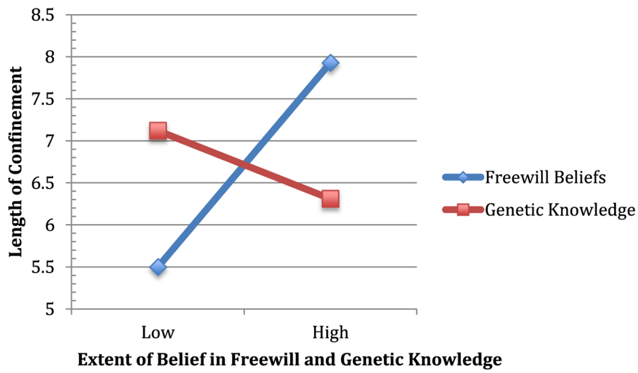

Figure 1. Impact of participants' ($n = 640$) freewill beliefs and genetic knowledge on length of confinement.

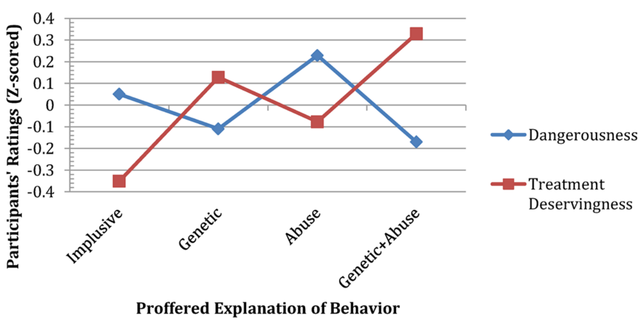

Figure 2. Perceived dangerousness and treatment deservingness as a function of the proffered explanation of perpetrator's assaultive behavior.

When a principal components analysis with varimax rotation was performed on the reaction questions, they loaded onto two distinct factors (eigenvalues = 4.56, 2.39, respectively; all others less than 1), which we refer to as dangerousness (alpha = 0.85, $n = 8$) and treatment deservingness (alpha = 0.70, $n = 4$). The scores were standardized by z-score transformation. A 2-way ANOVA with dangerousness as the dependent variable detected a significant main effect for proffered explanation [$F(3, 640) = 4.93$, $p < .01$, $h_p^2 = .023$]. None of the other effects was significant. A 2-way ANOVA with treatment deservingness as the dependent variable detected a significant main effect for heinousness [$F(1, 640) = 5.03$, $p < .05$, $h_p^2 = .008$] and proffered explanation [$F(3, 640) = 13.90$, $p < .001$, $h_p^2 = .063$]. The two significant main effects for proffered explanation are depicted in Fig. 2.

As is apparent in the figure, dangerousness and treatment deservingness were negatively correlated ($r = -.238$, $p < .001$, $n = 640$), indicating that higher dangerousness is associated with less treatment deservingness (and vice versa). Respondents considering genetic explanations were less likely to perceive the defendant as dangerous and more likely to perceive him as deserving treatment.

DISCUSSION

Consistent with the findings in our previous studies with vignettes illustrating more serious criminal behaviors,[37] none of the explanatory variables had an impact on the sentence assigned to the defendant. Specifically, a genetic explanation neither decreased nor increased the sentence. However, jurors were responsive to several of the other manipulated variables, rendering longer sentences for older defendants, an effect that has been demonstrated in other studies,[38] and in light of a more heinous crime (i.e., resulting in brain injury). Stronger beliefs in freewill and less knowledge of genetics also correlated with longer sentences, controlling for the explanation of the defendant's behavior. Despite the lack of impact on sentencing, however, we did detect an effect of genetic explanation on respondents' perceptions of the defendant: when the defendant's behavior was said to have a genetic basis, he was seen as less dangerous and more deserving of treatment. Thus, genetic explanations at least partially 'medicalized' the problem with his behavior.

One limitation of this study concerns the ecological validity of the lay public determining prison sentences. In the majority of jurisdictions, including all but a handful of USA states,[39] members of the general population do not get to make decisions about sentences in non-capital cases, a function reserved for judges. Nonetheless, insofar as public views about appropriate punishment are likely to shape the ultimate posture of the judiciary with regard to mitigating and aggravating circumstances, the reactions of a representative sample of the population are of considerable interest. To extend our investigation to a situation in which non-judicial decision makers necessarily are involved, the next case compares the impact of genetic explanations in a university administrative hearing compared with a more traditional criminal court setting.

CASE 2

Design

In the second case, a 21-year-old university student threw a chair through a window after being asked to leave a party. Although no one was seriously injured, the partygoers were doused in punch and the building sustained more than $5,000 damage. He now faced adjudication and punishment for his behavior. There were three experimental manipulations yielding 16 possible combinations: the adjudicative setting (university administrative hearing or criminal court); prior record of disruptive behavior (yes/no); and the explanation proffered by the defendant's attorney for the behavior (none; a genetic variant that predisposes to impulsivity; a neurological abnormality that predisposes to impulsivity; both genetic and neurological explanations for his impulsivity). The genetic and neurological explanations included images of genetic test results and an fMRI scan, respectively, described as demonstrating the abnormalities. Following the vignette, participants were asked to select a punishment, and to respond to the reaction questions.

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37 Appelbaum et al., *supra* note 18, at 138; Appelbaum & Scurich, *supra* note 18, at 95.

38 Charity M. Walker & William D. Woody, *Juror Decision Making for Juveniles Tried as Adults: The Effects of Defendant Age, Crime Type, and Crime Outcome*, 17 Psychol. Crime & Law 659 (2011).

39 Morris B. Hoffman, *The Case for Jury Sentencing*, 52 Duke L. J. 951 (2003).

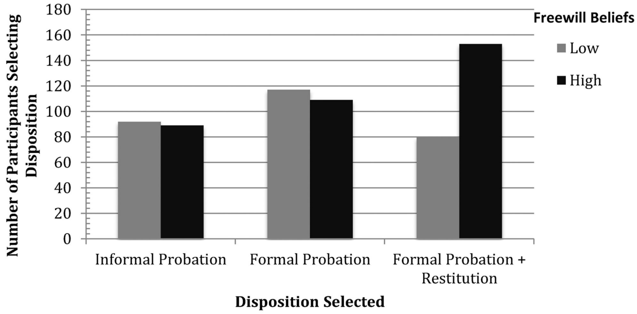

Figure 3. Severity of punishment as a function of respondents' beliefs in freewill.

Results

When asked to choose a punishment, respondents indicated that the student should be: (a) given a warning (selected by 1.7%, $n = 11$); (b) placed on informal probation (26.6%, $n = 170$); (c) placed on formal probation (35.3%, $n = 226$); (d) placed on probation with community service (36.4%, $n = 233$). Given that the 'warning' disposition was endorsed by so few participants, it was combined with the informal probation category, and a multinomial logistic regression conducted to examine whether the experimental manipulations could predict the selected dispositions ($\chi^2 = 61.23$, df $= 30$, $p < .001$). Neither the adjudicative setting (university disciplinary hearing or criminal court) nor the proffered explanation of the behavior affected participants' choices. The only significant effect was for prior record: a student with a prior record was 5.6 times more likely (95% CI [1.52, 20.45], wald = 6.71, $p < .01$) to receive formal probation and 8.1 times more likely (95% CI [2.30, 28.81], wald = 10.58, $p < .001$) to receive formal probation with community service (the two more severe punishments) than to receive informal probation or a warning (the least severe). None of the interactions were significant (all *p*s >.05).

A multi-nominal logistic regression was conducted to determine whether the disposition that participants selected was affected by the proffered explanation of behavior, freewill beliefs, or genetic knowledge. The model was significant ($\chi^2 = 33.040$, df $= 10$, $p < .001$), detecting an effect for freewill beliefs ($\chi^2 = 27.79$, df $= 2$, $p < .001$), but not genetic knowledge ($p = .44$) or explanation of behavior ($p = .71$). For each point increment in freewill beliefs, participants were twice as likely (Exp(B) = 2.02, 95%CI[1.52, 2.69], wald = 23.44, $p < .001$) to select formal probation with restitution—the most punitive option—than informal probation (see Fig. 3).

The twelve reaction questions were subject to a principal components analysis with varimax rotation, which again revealed that these questions loaded onto two factors (eigenvalues = 4.52, 2.50, respectively; all others less than 1), referred to as dangerousness (alpha = 0.87, $n = 8$) and treatment deservingness (alpha = 0.75, $n = 4$);[40] they were then normalized via *z*-score transformation. A 2-way ANOVA with dangerousness as the dependent variable detected a significant main effect for prior record of disruptive behavior [$F(1, 640) = 33.73$, $p < .001$, $h_p^2 = .051$] (one prior being more

[40] The same items loaded onto the factors for dangerousness and treatment deservingness in both Cases 1 and 2.

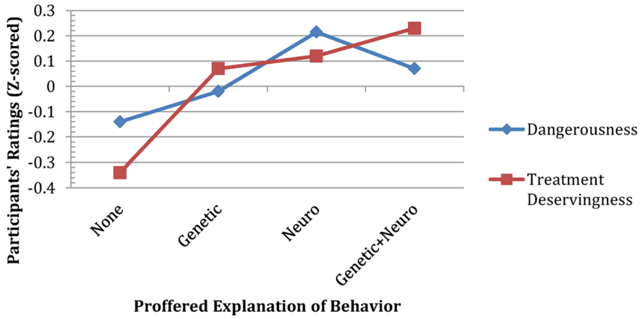

Figure 4. Perceived dangerousness and treatment deservingness of misbehaving student as a function of the proffered explanation of his behavior.

dangerous than no priors, means = 5.61 and 4.92, respectively) and proffered explanation [$F(3, 640) = 3.75, p < .01, h_p^2 = .018$]. A 2-way ANOVA with treatment deservingness as the dependent variable detected a significant main effect for prior record of disruptive behavior [$F(1, 640) = 19.75, p < .001, h_p^2 = .031$]–a student with no prior record of disruptive behavior was seen as less deserving of treatment (mean = 5.01) than a student with a prior record (mean = 5.60)–and a main effect for proffered explanation [$F(3, 640) = 10.39, p < .001, h_p^2 = .048$]. The two main effects for proffered explanation are depicted in Fig. 4. Both genetic and neurologic explanations increased perceptions of dangerousness and of deserving treatment. Dangerousness and treatment deservingness were positively correlated ($r = .351, p < .001, n = 640$).

DISCUSSION

Once again, genetic explanations did not have an impact on punishment, regardless of whether adjudication was described as taking place in an administrative hearing or in a formal courtroom setting. This was true even though the negative behavior did not involve physical injury, and hence there might have been wider scope for the influence of mitigating evidence. Nor did we find a mitigating effect for evidence based on neuroimaging data that suggested a neurologic basis for the student's impulsive behavior. A prior record of misconduct did result in the imposition of more serious sanctions, which is also consistent with our findings in previous studies.[41] Respondents with stronger beliefs in freewill were again more likely to select a harsher punishment, but in this instance the extent of participants' genetic knowledge did not affect the punishment selected.

As in Case 1, a genetic explanation increased the degree to which the student was seen as deserving of treatment, but contrary to the findings in Case 1, it also led to his being seen as more dangerous. Although our data cannot speak definitively to the reasons for the reversal of the relationship between genetic explanations and dangerousness, taken together the two cases suggest that the relationship is unstable and perhaps susceptible to baseline effects. Thus, respondents may have had a baseline tendency to view the streetwise defendant with an explosive temper in Case 1 as more dangerous;

41 Appelbaum et al., *supra* note 18, at 140.

a genetic explanation, insofar as it medicalized his behavior, may have made him seem less so. In contrast, the university student in Case 2 may have been perceived as less dangerous at baseline merely by virtue of having gotten wild and destructive at a party; once respondents were told that he had a genetic predisposition to behavior of this sort; however, his perceived dangerousness may have been exacerbated.[42]

CASE 3

Design

In the third case, the question of the impact of genetic information was examined in a family setting. The vignette described a fourth grader, Sammy, who engaged in misbehavior when left home alone. There were three experimental manipulations, with 12 possible conditions: mild misbehavior (inappropriately taking a cookie and accidentally breaking a ceramic cookie jar) or severe misbehavior (intentionally closing a sink stopper with the faucet running, leading to $7000 in water damage); a history of misbehavior or not; and a chromosomal deletion detected *in utero* that may have increased the likelihood of having a learning disability and difficulty controlling behavior (effect: none, possible, or probable). After reading the vignette, participants were asked to choose a punishment. In addition to the reaction questions used in Cases 1 and 2, respondents were asked to indicate on a 0–100 scale the extent to which Sammy 'should be held responsible for his misbehavior'. On a similar scale, they were asked to rate the extent to which they believed that Sammy's mother 'is responsible for what happened because she left Sammy home alone'.

Results

Respondents selected the following punishments for Sammy: no TV for a week (selected by 31.6%, $n = 202$); cannot visit best friend's house for a week (6.7%, $n = 43$); no TV or visits to best friend's house for a week (19.7%, $n = 126$); no TV or visits plus after-dinner cleanup for a week (42%, $n = 269$). A multinomial logistic regression was conducted to determine the effect of the independent variables on the punishment selected. The model was significant ($\chi^2 = 100.16$, df = 12, $p < .001$), detecting a main effect for degree of misbehavior ($\chi^2 = 82.64$, df = 3, $p < .001$) and history of misbehavior ($\chi^2 = 9.14$, df = 3, $p < .05$), but no effect of genetic influences on misbehavior ($p = .15$). However, a multinominal logistic regression conducted to examine if punishment varied as a function of freewill beliefs, genetic knowledge, or parenting style, after controlling for the likelihood of the child's misbehaving based on genetic influences found no significant effects (all *ps* > .05).

Overall, participants believed Sammy was quite responsible for his misbehavior (median = 75, IQR = 47), as was Sammy's mother for leaving him home alone (median = 67, IQR = 44). The evaluations of Sammy's responsibility and his mother's

42 The plausibility of this explanation is supported by an examination of the mean scores on the items that loaded onto the dangerousness factor in the baseline condition in each case. In case 1, the mean for dangerousness in the 'impulsive' condition (i.e., no biological explanation) was 6.665 (95% CI = 6.446, 6.885), and in case 2 the mean for dangerousness in the 'no biological explanation' condition was 4.913 (95% CI = 4.677, 5.149). Since the confidence intervals do not overlap, that would suggest they are statistically different. However, since the conditions being compared in the two cases were not identical, the evidence can only be considered to be suggestive.

responsibility were negatively correlated ($r = -.239$, $p < .001$, $n = 640$), indicating that the more responsible his mother is for the misbehavior, the less responsible Sammy is, and vice versa. A three-way analysis of variance (ANOVA) with Sammy's responsibility as the dependent variable and the experimental manipulations as the independent variables detected only one significant effect, a main effect for degree of misbehavior [$F(1, 640) = 19.57$, $p < .001$, $h_p^2 = .03$]. Somewhat contrary to what might have been expected, Sammy was deemed less responsible (mean = 61.53) for the severe misbehavior (flooding the house) than the mild misbehavior (breaking the cookie jar) (mean = 71.87). A three-way analysis of variance (ANOVA) with Sammy's mother's responsibility as the dependent variable and the experimental manipulations as the independent variables detected only one significant effect for degree of misbehavior [$F(1, 640) = 30.02$, $p < .001$, $h_p^2 = .046$]. In this case, Sammy's mother was deemed more responsible when the misbehavior was severe (mean = 68.64) than when the misbehavior was mild (mean = 56.00).

The twelve reaction questions were aggregated into a single composite variable (alpha = .804), reflecting both Sammy's dangerousness and his need for treatment, and will be referred to as 'apprehension of Sammy'.[43] A three-way analysis of variance (ANOVA) with apprehension of Sammy as the dependent variable and the experimental manipulations as the independent variables detected main effects for the likelihood that the genetic condition would affect his behavior [$F(1, 640) = 13.00$, $p < .001$, $h_p^2 = .040$], degree of misbehavior [$F(1, 640) = 29.45$, $p < .001$, $h_p^2 = .045$], and history of misbehavior ($F(1, 640) = 27.59$, $p < .001$, $h_p^2 = .042$). None of the interactions were statistically significant (all ps > .05). Apprehension of Sammy was higher when Sammy had a history of frequent misbehavior (mean = 3.95) compared to no history (mean = 3.47), and when the degree of misbehavior was severe (mean = 3.96) compared to mild (mean = 3.47). The main effect for likelihood that his genetic condition would lead to misbehavior is plotted in Fig. 5. As that likelihood increased, so did the apprehension of Sammy (i.e., the perception that he was dangerous and needed treatment).

DISCUSSION

As in the previous cases, evidence of a genetic predisposition to impulsive behavior did not impact respondents' choices of punishment for Sammy. Nor were participants' perceptions of the degree to which either the child or his mother should be held responsible for his behavior affected by the presence of a genetic condition that might explain it. But we did detect an effect of the genetic condition on apprehension of Sammy: as an impact of his chromosomal abnormality became more likely, apprehension increased.

43 Similar to Cases 1 and 2, the 12 reaction questions were subjected to a principal components analysis with varimax rotation, which revealed that the questions loaded onto three factors (eigenvalues = 5.32, 1.90, 1.14; all others less than 1). Six items loaded onto factor 1, three items loaded onto factor 2, and two items loaded onto factor 3, yielding alphas of .911, .361, .354, respectively, and one item did not load on any factor. Alphas in the range of .3–.4 are highly unreliable. In other words, the items cannot reliably measure the subfactors of the latent construct suggested by the factor analysis. Because of this, and for theoretical and interpretative reasons, we decided for Case 3 to combine all of the items into a single, global measure. Doing so yielded an alpha of .804, as reported in the text. Note that the results reported in the text do not change whether one uses this global measure or the factor 1 subscale, which encompassed the items that in the previous cases loaded on to the dangerousness factor.

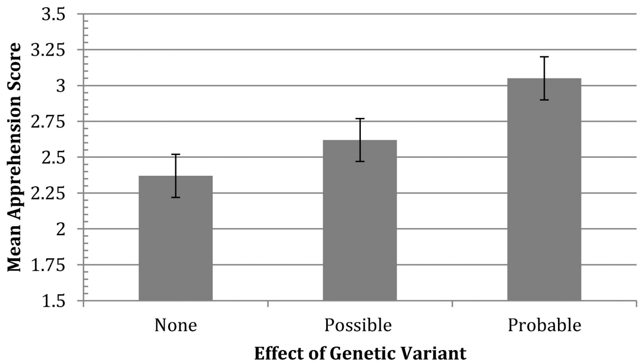

Figure 5. Respondents' apprehension as a function of the likelihood that a chromosomal deletion will result in a learning disability and difficulty controlling behavior.

This is similar to what was seen with a two-factor model for the reaction questions in Case 2, where genetic evidence was associated with perceptions of greater dangerousness and increased need for treatment. As might be expected, apprehension was also related to the presence of a previous history of misbehavior and the severity of the current episode.

The finding that Sammy was seen as less responsible for behavior that resulted in more severe damage may seem anomalous on its face, but could have a number of explanations. Respondents may have believed that a fourth grader could not have anticipated the consequences of leaving a faucet running in a stopped-up sink, but should have anticipated the risk of breaking a jar. Alternatively, the finding may reflect an oddity in the way the two versions of the vignette were written. The cookie jar vignette specified that Sammy 'knew the cookie jar was off limits'. So by taking a cookie, he was clearly doing something he had been told not to do, and respondents may have believed that he deserved to be held responsible for the consequences. However, the bathroom sink vignette said that his father had told him that the water would go thru the overflow hole if the water were left running, and he decided to see if his father was right. In this case, he's testing a hypothesis, which he was not explicitly told not to do, and indeed his father appears to have suggested that nothing bad would happen. That may be why he, but not his mother, is seen as less responsible for what happened with the sink than with the cookie jar. If that explanation is correct, it is unlikely that any generalizable conclusion can be drawn from this particular finding.

As access grows for parents to children's genetic information, scenarios such as the one in this vignette may become more likely. Techniques for prenatal testing to identify copy number variants and other genetic anomalies are improving,[44] stimulating its increased use. Were suggestions to be followed that all newborns have their genomes sequenced at birth;[45] access to such information could become almost universal. Some

44 Ronald J. Wapner et al., *Chromosomal Microarray versus Karyotyping for Prenatal Diagnosis*, 367 New Eng. J. Med. 2175 (2015).

45 Aaron J. Goldenberg & Richard R. Sharp, *The Ethical Hazards and Programmatic Challenges of Genomic Newborn Screening*, 307 J. Am. Med. Assoc. 461 (2012).

people may be reassured that a representative sample like this one is not inclined to alter their child-rearing practices based on a child's genetic endowment, especially in light of the uncertainties about the actual impact of Sammy's copy number variant. On the other hand, as the effects of particular genetic findings become easier to specify, parents may be more inclined to take them into account in their decision making, and undoubtedly justifications for doing so will be offered.

DISCUSSION

In finding no effect of genetic explanations for wrongful behavior on decisions regarding punishment of a juvenile offender, a university student and a misbehaving child, our findings call into question the commonly expressed view that such data would—and should—be seen as mitigating.[46] Unlike in our previously reported research,[47] this result cannot be attributed to the severity of the offenses, and seems to hold true even for judgments of non-criminal, rule-breaking behavior (i.e., in campus and family settings). It is also consistent with a growing body of research suggesting that other kinds of scientific evidence—specifically neuroimaging—generally fail to show significant impacts on perceptions of culpability and punishment.[48]

What could account for the absence of the predicted mitigating effect of genetic predispositions? Whereas concerns have long been expressed that lay people see genetic influences on behavior from a deterministic perspective,[49] i.e., as the controlling factor in shaping behavior, members of the general public may actually have more sophisticated views of the matter. Evidence from other studies suggests that ordinary people recognize genetic predispositions as only one influence on behavior, including violent behavior, and not necessarily the prime determinant in a particular context;[50] indeed, the public appears to view the influence of genetic factors as strongest with regard to appearance, moderate with regard to health, and least in terms of impact on behavior.[51] In general, most people tend to resist the notion that behavior is absolutely determined by biological or other factors, preferring to see a role for human choice; this remains true even when they are asked to assume conditions that imply a completely causal and predictable universe.[52] Hence, the genetic (and neurologic) evidence of predispositions to impulsive, negative behaviors to which our respondents were exposed may not have seemed particularly salient as mitigating factors, since people tend to discount scientific explanations that conflict with their preexisting beliefs.[53]

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46 Denno, *supra* note 10, at 979; Jones, *supra* note 5, at 1031; Walker, *supra* note 15, at 1791.

47 Appelbaum & Scurich, *supra* note 18, at 95; Appelbaum et al., *supra* note 18, at 240.

48 Tannieka Minott, *Born This Way: How Neuroimaging Will Impact Jury Deliberations*, 12 Duke L. Technol. Rev. 219 (2014).

49 IIan Dar-Nimrod & Stephen J. Heine, *Genetic Essentialism: On the Deceptive Determinism of DNA*, 137 Psychol. Bull. 800 (2011).

50 Celeste M. Condit, *When Do People Deploy Genetic Determinism? A Review Pointing to the Need for Multi-factorial Theories of Public Utilization of Scientific Discourses*, 5 Soc. Compass 618 (2011); Mairi Levitt, *Perceptions of Nature, Nurture and Behavior*, 9 Life Sci. Soc. Pol'y 13 (2013).

51 Condit, *supra note* 50, at 625.

52 Joshua Knobe, *Free Will and the Scientific Vision*. Current Controversies in Experimental Philosophy, eds. Machery E., O'Neill E. (New York: Routledge) (in press); Eddy Nahmias et al., *It's OK If 'My Brain Made Me Do It': People's Intuitions About Free Will and Neuroscientific Prediction.* 133 Cognition 502 (2014).

53 Nicholas Scurich & Adam Shniderman, *The Selective Allure of Neuroscientific Explanations*, 9 Plos One e107529 (2014).

It is also possible that genetic explanations induce countervailing beliefs—i.e., that a person with a genetic predisposition to act badly is less responsible for his or her behavior but also more likely to commit such acts again—that negate any impact on punishment decisions.[54] Although our study did not test this proposition directly, it is consistent with the data from Cases 2 and 3, indicating greater perceptions of dangerousness for the university student and the fourth grader when genetic predispositions to impulsive behavior were present. Perceptions that persons with genetic predispositions are likely to behave similarly in the future may also be related to the belief that they are more in need of treatment, an effect that was present in all three of our cases and was also found in the study by Fuss and colleagues of judges in Germany.[55] Finally, biological explanations for the symptoms associated with mental disorders have been shown to reduce clinicians' empathy for these patients, an effect that could also negate any tendency toward mitigation.[56]

A final possibility for our failure to find an impact of genetic evidence, either mitigating or aggravating, is that members of the general public may see scientific data as something beyond their comprehension,[57] and hence may simply discount it in reaching judgments about dispositions. Since we found that increased genetic knowledge was associated with a greater impact of genetic explanations on choice of punishment in only one of our three cases, our data are not strongly supportive of this explanation. However, we measured genetic knowledge with a simple test of basic genetic concepts, which may have failed to separate out those participants with a sophisticated enough view of behavioral genetics for them to seriously consider the implications of genetic explanations for misbehavior.

In contrast to the negative findings regarding the impact of genetic explanations, severity of punishment was increased by a previous history of misbehavior and the seriousness of the behavior, consistent with our results in previous studies.[58] Recidivism and seriousness of an offense may be seen as predictors of a greater likelihood of recurrence and thus a need for more severe sanctions to deter future, unwanted behaviors. Belief in freewill was also positively associated with severity of punishment in two of our three cases, again replicating our earlier findings with vignettes portraying more severe offenses.[59] The strong association between freewill beliefs and outcome suggests that our respondents took a generally retributive view of punishment, i.e., believing that the severity of punishment should be proportionate to the extent to which the negative behavior was freely chosen.[60]

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54 Erland P. Kvaale et al., *Biogenetic Explanation and Stigma: A Meta-analytic Review of Associations Among Laypeople*, 96 Soc. Sci. Med. 95 (2013); Cheung & Heine, *supra* note 19, at 1723.

55 Fuss et al., *supra* note 21, at 6.

56 Matthew S. Lebowitz & Woo-kyoung Ahn, *Effects of Biological Explanations for Mental Disorders on Clinicians' Empathy*, 111 Proc. Nat. Acad. Sci. 17786 (2014).

57 Cliodhna O'Connor & Helene Joffe, *Social Representations of Brain Research: Exploring Public (Dis)engagement with Contemporary Neuroscience*, 36 Sci. Comm. 617 (2014).

58 Appelbaum et al., *supra* note 18, at 140.

59 *Ibid*, at 138.

60 These findings contrast somewhat with those of Krueger and colleagues, who found that the effect of freewill beliefs on punishment decisions was limited to crimes evoking low affective responses. [Frank Krueger et al., *An fMRI Investigation of the Effects of Belief in Free Will on Third-Party Punishment.* 9 Soc. Cogn. & Affect. Neurosci. 1143 (2014)]. Although we did not measure affective responses directly, it is plausible to assume

This study has the limitations of any vignette-based research, including uncertainty as to whether participants' judgments would be different if placed in real-life decision-making situations. Brief, written vignettes responded to online may evoke different responses than extended presentations of evidence in a courtroom, hearing room, or family setting. It is also impossible to know if participants' responses might have been different with slight changes to the descriptions of the cases. In addition, since we did not measure respondents' views about the purposes of punishment, it is possible that the lack of an overall effect of genetic evidence on selection of punishment could be explained by taking into account contrasting attitudes of respondents with primarily retributive or rehabilitative views of punishment. Even assuming our data accurately reflect current perceptions of genetic explanations of behavior, reactions may change as the general public gains genetic knowledge or as genetic findings become more predictive of future behavior.

Notwithstanding their limitations, these findings provide suggestive evidence that the double-edged sword of genetic explanation of negatively valenced behavior is blunter than anticipated: growing availability of genetic information about oneself and others—including criminal defendants, college students, and children—may not profoundly alter views of responsibility for behavior and the allocation of appropriate punishment.

SUPPLEMENTARY DATA

The supplemental material is available online at http://jlb.oxfordjournals.org/lookup/suppl/doi:10.1093/jlb/lsv053/-/DC1.

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that Case 1—a largely unprovoked beating of a stranger with a baseball bat—would evoke stronger affective responses than Cases 2 or 3. Yet, freewill beliefs were significantly and strongly associated with punishment in Cases 1 and 2, as well as in our previous study, where the cases all involved homicides, but not in Case 3—which involved misbehavior by a child. (Appelbaum et al., *supra* note 18).