

The Social Life of Scientific Theories: A Case Study from Behavioral Sciences

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Received: 18 November 2011 / Accepted: 20 June 2012
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Abstract This article reports on the third phase of a comparative epistemological, ontological, and social analysis of a variety of approaches to investigating human behavior. In focusing on the fate of scientific ideas once they leave the context in which they were developed, I hope not only to show that their communication for a broader audience imposes a shape on their interrelations different than they seem to have in the research context, but also to suggest that a study comparing different approaches to the same phenomenon is more illuminating than one that focuses on a single approach.

Keywords Aggression research · Behavioral science · Implicit theory · Public understanding of science · Sexual orientation research · Social dimensions of science

The sciences of behavior, especially human behavior, attract an inordinate amount of attention. Newspapers frequently report on findings about novelty seeking, aggression, prosociality, depression, addiction, etc. Prompted by controversy over a proposed conference on Genetics and Criminal Violence in the 1990s, I undertook a comparative epistemological, ontological, and social analysis of a variety of approaches to investigating behavior. This paper reports on aspects of the third, social, phase of the analysis. Most social response to research on human behavior is

reactive rather than analytical, and tends to focus on one among a range of research approaches. The comparative analysis performed in the larger study facilitates a more nuanced understanding of its social implications. By focusing on the fate of scientific ideas once they leave the context in which they were developed, I hope not only to show that their communication for a broader audience imposes a shape on their interrelations different than they seem to have in the research context, but also to demonstrate that a comparative study is more illuminating than one that focuses on a single approach. This focus also sheds light on an important function of what I call “approaches,” and their associated implicit theories.

Theory and Approach

By “approach” I mean a set of questions, experimental and observational strategies for answering those questions, patterns of argument, and a specification of the phenomena about which the questions are asked and the strategies applied. By “theory” we usually mean a set of laws or principles, often expressed mathematically, that are taken to describe the fundamental forces at work in the production of a given phenomenon, as the principles of random variation, inheritance, and selection are taken to describe the fundamental processes in the evolution of species, or Newton’s three laws of motion are taken to describe the fundamental principles of motion of medium-sized bodies traveling at less than the speed of light.

An approach is not a theory in this sense, as it does not require a set of laws or principles. Nevertheless, approaches carry an implicit model/theory of the processes investigated. An approach that measures the correlation between a disease state and a genetic configuration is either

This essay draws from Chapter 10 of my book *Studying Human Behavior*, forthcoming from University of Chicago Press.

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provisionally or implicitly committed to a view that genes play a role in the disease state in question. That the view need not be articulated in order to pursue the empirical research shields investigators from having to defend a theory of the genetic basis of disease processes or of the particular disease in question. The role of the implicit theory is to guide investigation and to provide an implicit conceptual framework that can inform many similarly conceived empirical studies. It also entitles researchers to think of a group of empirical studies as having some internal cohesion and common conceptual commitments. The implicit theory of an approach informs empirical research, but development of theory is not the main concern. It is thus an example of Pigliucci's *n*th kind of theory (2012, this issue).

The approaches reviewed for this investigation included quantitative behavior genetics, molecular behavior genetics, neurophysiological behavioral research, social-environmental behavioral research, integrative approaches (developmental systems theory, genes \times environment \times neurosystem [Caspi and Moffitt], and multifactorial path analysis [Kendler]), and population/social ecological approaches.

These programs seek what Ernst Mayr termed proximate explanations, in contrast to the ultimate explanations sought and offered in evolutionary theorizing. The studies exemplifying these approaches have been empirical studies on aggression and on sexual orientation. In previous articles (Longino 2001a, b, 2006) and in a book (Longino in press), I have argued for a pluralist thesis regarding the interrelations among approaches. In particular, I've argued that

- (1) They are not, in spite of the polemics of the nature-nurture debates, empirical competitors.
- (2) The methods they employ discriminate alternative hypotheses within approaches, but not between or among approaches.
- (3) They cannot be integrated without loss of content.
- (4) Each approach offers partial knowledge.

These are claims based on the epistemological analysis of the structure of evidence and argument in the approaches. Thinking ontologically, in analyzing how these approaches conceptualize their superficially common explanandum, behavior, I have argued that at least three different kinds of object of study can be discerned. Behavior can be studied as a (dispositional) property of individuals, as an interaction among two or more individuals, or as a property of populations. In the latter case, the object of interest would be the frequency and distribution of behaviors in populations. The ways in which particular behaviors are operationalized for empirical study not only specifies particular phenomena for measurement but, through the choice of operationalizations, also implicitly

valences the behavioral construct. In particular, aggression was operationalized for study as conviction of criminal violence, as achieving a certain score in a personality questionnaire, as observed to pick on schoolmates, and so on. Aggression was not understood as a means of maintaining social peace, for example, in the way de Waal sometimes treats it in his bonobo studies (for example in de Waal 1992), but valenced negatively and as disorder (see Longino 2001a, b and in press for details and discussion). The epistemological and ontological analyses inform the social analysis that follows.

The Circulation of Research

To understand the social impact of research it is useful not only to think through what might be the case were the conclusions of a given program to be accepted as true and a basis for action, but also to see how the program is taken up in the larger research and public context. After all, a program to which no one pays attention would not have much social impact, if any. To study the uptake of the approaches, I worked with a series of research assistants to analyze various kinds of literature. We performed citation analyses both of compilations of articles by authors adopting one or another approach and of single articles. In addition to the attention in the professional literature, we sought to find out how the work was presented in mass and middle-brow media both in book reviews and in magazine and newspaper articles.¹ In order to get a reliable sense of how any of this work is taken up and presented to the general public, it is necessary to comb through a very large amount of material. Citations to a 2003 article on the interaction of one of the genes associated with serotonin metabolism and social experience (Caspi et al. 2003) numbered 1,319 in 2009, the year in which we conducted our citation analyses, and over 3,000 in July 2011. This is work that requires extensive sociological and statistical analysis to be comprehensive. Our studies, therefore, skim the surface, but even so reveal trends that support some generalizations and hypotheses.

With the assistance of Whitney Sundby, I sought to analyze patterns of citations of several articles or collections of articles representing the different approaches.² The point of this analysis was to see how the material in those articles was taken up. We used both the ISI citation index and the citation record available on Google Scholar.

¹ Several scholars have investigated the representation of genetic research in general media. See Nelkin and Lindee (1995) and Carver et al. 2008. But these studies have stayed focused on genetic approaches, not on the array of approaches to human behavior.

² Preliminary work was performed by Kris Houten, Cale Basaraba, and Mario Silva.

Although both books and journals are included in citation information, the following analyses are restricted to journals. After review of several sets of citations and the mastheads of journals included in those sets, we came up with eight categories of journal: research, clinical, clinical/research, policy, policy/research, policy/clinical, policy/clinical/research, general interest, and miscellaneous.³ Abstracts and articles themselves inform about the content; the journal category informs about the intended audience for the content. In many cases, articles published in journals focused on clinical or policy matters seem little different in content from those published in research journals. The difference is in the expected readership and the implied expectation that the content is relevant to a readership interested in clinical or policy applications of the research. Finally, number of citations tells us something about the relative impact of the article or set of articles.

The research approach outlined by Caspi and Moffitt (Caspi et al. 2002, 2003; Caspi and Moffitt 2006) has generated a great deal of interest. Having found that groups of individuals characterized by both a genetic risk factor and an environmental stressor show a higher frequency of a given psychological disorder than groups characterized by possession of only one or the other, they propose an interactive model for psychiatric and behavioral disorders. Neither genetic factors nor environmental ones are sufficient to bring about a condition. Instead, genetic factors predispose the brain to respond to environmental trauma

with psychiatric or behavioral syndromes. While it is probably the case that others were proceeding along similar lines, Caspi and Moffitt were successful in attracting attention both within their local research context and among downstream users, as well as in popularizing media such as *Scientific American* and among philosophers. A study of articles citing their work reveals significant uptake in research, clinical, and policy contexts even before their publication (Caspi and Moffitt 2006) of an informal model of gene, brain, and environment involvement in the induction of behavioral disorders. Using citations to a representative group of four articles, we found that 35 % of citations occurred in journals devoted to research and another 35 % in journals classified as clinical/research. 14 % of citations occurred in clinical journals and about 6 % in mixed policy, clinical, and research journals. The citations to some of their central publications number in the hundreds, with some amounting to over a thousand.⁴ While a few of the almost 500 articles citing their articulation of the gene (G)—environment (E)—neurosystem (N) nexus (Caspi and Moffitt 2006) are reporting negative results on gene-behavior associations, most are either reporting particular studies within the interactive framework, proposing methodological refinements, or promoting the $G \times E$ or $G \times E \times N$ approach and/or informing new constituencies of its relevance to their concerns.

The behaviors and conditions to which the interactive approach is applied include depression, anxiety, post-traumatic stress disorder, phobias, self-injury and suicide, delinquency, attention deficit hyperactivity disorder (ADHD), substance (including illicit drugs, alcohol, and nicotine) abuse, eating disorders, bipolar disorder, schizophrenia, antisocial behavior, and aggression. The model is also proposed as useful in addressing a variety of stress-related somatic conditions such as chronic fatigue syndrome, fibro-myalgia, and irritable bowel syndrome. In animal models it is used to study premature aging, stress coping, mania, and immune system function. A certain amount of research is going into identifying intermediate conditions (endophenotypes) in the pathway from genes to behavior such as impulsivity and behavioral inhibition, but also proteins and particular brain and nervous system conditions. Multiple genes are studied, as are multiple environmental factors. Methodological refinements include computational models to overcome problems of small sample sizes, definitional and classification refinements, the addition of gender and race as factors, neural models for the action of specific molecular/genetic configurations, and methods of taking advantage of so-called “natural

³ *Research*: any journal whose primary focus is research; this includes basic/experimental research, and research to inform theory.

Clinical: any journal dedicated primarily to the discussion of, assessment, diagnosis, or treatment of patients. This includes medical journals and journals specifically targeted to practitioners in medical fields. Often, research is a part of these journals, since most clinically oriented journals are at least partially based on research.

Clinical/Research: journals that fall under this category include those that publish both clinical papers and research papers that are equally relevant to some larger topic (e.g., *Journal of Personality Disorders*; *Journal of Epilepsy*); journals that give equal weight to basic and clinical research; and journals where the primary content is research, but the explicit primary purpose of that research is to inform clinical practice.

Policy: any journals that focus on policy, law, or justice.

Policy/Clinical/Research: these journals are usually dedicated to a broad topic that represents an intersection of research, clinical practice, and policy—where each of these categories seem to be equally relevant. Journals dedicated to social work and services, aggression/maltreatment/abuse/trauma, substance abuse and addiction, public health and preventive medicine, etc., often fall under this category.

Policy/Clinical: same sort of idea as above, but where research is a less emphasized focus of the journals.

Policy/Research: same sort of idea as above, but where clinical practice is a less emphasized focus of the journal.

General Interest

Miscellaneous: this category includes journals that focus on theory, philosophy, research in totally unrelated fields, etc.

⁴ The articles include Caspi et al. (2002) with 777 citations, Caspi et al. (2003) with 1,319 citations, Caspi et al. (2005) with 202 citations.

experiments.” Reviews of the research are published in journals of public health and health policy and in journals specializing in relations between behavioral science and the law.⁵ And the Office of Behavioral and Social Science Research at the National Institutes of Health some years ago announced a plan to support interdisciplinary and integrative research into behavioral problems (Mabry et al. 2008). While Caspi and Moffitt’s 2006 article in *Nature Reviews Neuroscience* does offer a general model, it is proposed as an articulation of the $G \times E \times N$ approach and how it might be applied, rather than as a general theory of behavioral and psychological phenomena. And the more highly cited of their articles are research reports on the $G \times E$ connection rather than the 2006 $G \times E \times N$. The cumulative effect of so many research reports claiming kinship with the Caspi and Moffitt approach is the appearance of a consensus on a theory, a theory about gene by environment interaction, that is nowhere articulated but exists implicitly.

Widom’s (1989) work on the effect of abuse of children on their later offending showed yet a different pattern of citations. Less than 20 % of citations were in journals dedicated only to research, and another 20 % in journals that published research related to clinical practice or research related to policy. The highest percentage (39.7 %) was in journals that included work on policy, clinical application, and relevant basic research. Among these combined policy categories, journals were divided among law and criminology, public health, and social work journals.

Work on serotonin metabolism in the brain and aggression by Emil Coccaro and colleagues (Coccaro et al. 1992; Lee and Coccaro 2001; Best et al. 2002) shows a pattern similar to distribution of the citations to the Caspi and Moffitt work. Of 139 journal citations to three articles, 34.5 % are in research journals, 12 % in clinical journals, and 43 % in clinical/research journals. Nine percent are in one or another policy category, five (or 45 %) of those in law or criminology journals.

By contrast the articles citing work by developmental systems theorist Gilbert Gottlieb and collaborators are concentrated in research journals (73 %) and show a four to one ratio of theoretical to empirical content.⁶ Developmental Systems Theory (DST) holds that all factors interact within and across levels of organization in the course of development. Of the approaches considered, this is the one

that comes closest to constituting a theory, properly speaking. The theoretical articles citing Gottlieb’s work include a variety of proposals for understanding the interaction of genetic, physiological, and environmental factors in development, calls to incorporate developmental research into evolutionary research and into evolutionary psychology. Empirical articles included several on endocrine secretion and behavioral development, maternal metabolism during gestation and offspring intelligence, imitative learning in chimps, the timing of walking in humans, the reinforcing effect of experience in neonates. Only 9 % of citations fell into the clinical/research category and <4 % in the purely clinical category. The plurality of citations (112 of 384) in the research category occurred in the journal *Behavioral and Brain Sciences*, for five target articles and their commentaries. DST does purport to be or offer a general theory of organismic development, including the development of behavioral propensities. Where Caspi and Moffitt’s $G \times E$ approach, with its plethora of empirical reports, is taken up in clinical, public health, and policy journals, uptake of the DST approach does not extend much beyond the theoretical arena.

These results suggest that research from the different approaches gets taken up differently. The $G \times E$ approach and the neurophysiological approach attract primarily researchers seeking to align themselves with the approach and to a lesser degree researchers focused on clinical applications. The social environment approach reverses this pattern with greater uptake in policy and clinical contexts, and a lower, but non-negligible, rate of citations in purely research journals. The Developmental Systems approach remains largely confined to research journals and is discussed as theory rather than being developed empirically or clinically. Of course, these are just particular representatives of the approaches; a more complete study would follow several representatives of each approach.

Looking at single articles rather than compilations reveals further patterns among citations of behavioral research. A 1994 article by Goldsmith and Gottesman making a case for the behavior genetic perspective on antisocial behavior received just under 60 % of its citations in research journals. Of these the majority were empirical studies bearing out the authors’ suggestions either on effects of common rearing versus genetics/heritability on anti-social behavior or on other particular behavioral traits. Of the articles classifiable as theoretical, most were focused on methodological issues of measurement or classification, rather than proposing alternative models or refinements thereof. There were a number of citations in clinically oriented journals. Interestingly, these tended to discuss familial (biological) correlations without distinguishing between genetic and environmental contribution.

⁵ *Criminal Science and the Law, Forensic Psychology, Psychology, Public Policy and the Law, Psychological Science in the Public Interest, Social Policy and Society, The American Journal of Public Health*, and other epidemiology and public health journals.

⁶ The articles whose patterns we reviewed include Gottlieb (1991, 1997) and Gottlieb et al. (2006).

A more recent behavior genetic article, a 2002 meta-analysis of behavior genetic research on aggression by Soo Yun Rhee and Irwin Waldman, makes somewhat similar but updated points supportive of the behavior genetic approach. It has received a much greater number of citations, distributed somewhat differently than those for Goldsmith and Gottesman (G&G). Citations in research journals account for just under 40 %, and there are almost as many citations in journals classifiable as jointly research and clinical. While the policy and clinical uptake of G&G is negligible, at least 12 % of the Rhee and Waldman citations are in policy-related journals, and over 36 % in clinical/research journals (compared to just under 15 % for G&G). In addition, at least 7 % of citations are in explicitly criminology-focused journals. This is partly accounted for by the fact that Rhee and Waldman presented a version of their paper at a criminology conference (although the publication venue for the cited article was a major research journal in psychology). Both the citations and the conference presentation are evidence of a shift in interest towards genetic analyses in the criminology literature. As a meta-analysis, this article gestures toward generality, but no general theory of the etiology of behavior is actually articulated. Instead, the focus remains on a particular behavior—aggressive or anti-social behavior. The uptake in research journals likewise does not articulate a general theory, but the cumulative effect of so many research reports making comparable claims about the particular behaviors studied suggests an implicit (informal) theory of the genetic basis of human behavior.

For further contrast consider the citations to population level/social ecology researchers Alfred Blumstein and Jeffrey Fagan and his collaborators. Blumstein's (1997a, b) article on the puzzling relationship between rising incarceration rates and stable crime rates receives only 18 citations in journals. Most of these are in policy or policy and research journals, with only 11 % in research journals. The topics of citing articles include incarceration policy, crime rates (including both homicide and drug offenses, among others), and domestic violence. One or two of the journals are general sociology or public health journals, but most are dedicated to criminology, law, or violence. While the distribution of citations is reversed, given Rhee and Waldman's 186 total, their 7 % in criminology journals means a total of 13 in that category, and their 12 % in policy journals overall means a total of 21 in that category, more than the overall total for Blumstein. Fagan and collaborators receive two and five respectively for their 2004 and 2003 articles on the relationship between crime rates, arrest rates, and neighborhood characteristics (Fagan et al. 2003; Fagan and Davies 2004). This population-based, ecological approach receives far less uptake overall than the individually focused etiological studies, whether these

concern genetic, environmental, physiological, or integrated etiology.

Adam's (1985) work on sexual orientation and population-level factors receives a number of citations (23 in journals) comparable to Blumstein's. As it was published more than 10 years earlier, however, this does not indicate comparable uptake. Over 70 % of the citations are in research journals, just under 20 % in policy/research journals, and just under 9 % in miscellaneous. All but two citations occur in journals concerned with gender and/or sexual orientation. A similarly themed article by Mildred Dickemann received nine citations, mostly in articles on sexual behavior among various North American Indian cultures (Dickemann 1993). Just for comparison, according to Google Scholar, Bailey and Pillard's (1991) genetic study of male homosexuality received 406 citations.⁷ The first study on the possible involvement in male homosexuality of the XQ28 genetic locus published by Dean Hamer and his colleagues received 550.⁸ Citations to Bailey and Pillard occur primarily in articles on sexual orientation, but a few also on determinants of behavior or personality generally. Most of the citations to Hamer et al. (1993) are likewise concentrated in articles about sexual behavior or sexual orientation, with a few on molecular genetic methodology and a few on genetic influence on behavior more generally.

Several general trends can be identified here. Research on sexual orientation is taken up primarily by others researching sexual orientation, in contrast to research on aggression which is taken as relevant to research on other behaviors or behavioral families and to general approaches to the study of behavior. This gives reason to think that research on human sexual behavior will remain isolated from research on other aspects of human behavior, getting cited elsewhere for the most part for purposes of adding evidence for a particular theoretical approach.⁹ Research focused on the etiology of behavior conceptualized as an individual phenomenon both predominates in the behavior literature, and receives much more attention, in so far as attention can be measured by citations. This is the case no matter which theoretical perspective is adopted, among those focused on behavior as an individual phenomenon, and holds for academic as well as non-academic media. Research on sexual orientation receives somewhat more attention than does research on aggression in non-academic media, mostly in books or journals concerned with sexual

⁷ <http://scholar.google.com/scholar?start=0&hl=en&cites=17785363071856309846>, accessed 19 August 2009.

⁸ <http://scholar.google.com/scholar?start=50&hl=en&cites=6377697433952791366>, accessed 19 August 2009.

⁹ This represents a different pattern than that found in the literature on animal research, especially ethological, field research, which tends to integrate sexual behavior with other behaviors of the population under study.

behavior or sexual orientation, or gay culture and politics. Individually focused research receives much more attention in these venues than does the population approach associated with Barry Adam. The resulting impression is that the real issues about the incidence of aggressive or violent behavior or about sexual orientation concern how individuals become disposed one way or the other, and the research debates concern what factors are most influential in the development of individual dispositions. Population-level questions, e.g., about variation across differently situated populations, do not figure very prominently in the professional or lay discussion of these matters.

As with analysis of the compilations, approaches are largely isolated from one another; citations are within the broad framework of the approach or in contexts of application and uptake extends or presents complementary research. There is little real effort at replication and even when attempted replications fail to produce the same (or same enough) results, research is rarely treated as conclusively refuted and certainly not withdrawn. There are some interactions among approaches, usually around target articles or as replies. These are manufactured by journal editors or conference organizers. It is not clear what difference they make in either the long or short term. As long as the uptake is positive, there is little incentive to modify one's claims or change direction.

Uptake in the General Press

One way to see how the general public understands and takes up the research is to investigate the ways in which it is represented in the mass or lay press. There are three principal sources: articles in science sections of news weeklies or daily papers and in science periodicals such as *Scientific American*, books by researchers intended for popular rather than professional audiences, and reviews of those books.¹⁰ My assistants and I searched for accounts of research on aggression and violence and on sexual behavior as well as for accounts of the theoretical underpinnings of behavioral research. Here I restrict the report primarily to reporting about aggression research.

General Interest Magazines

From 1990 to 2005, *Time*, *Newsweek*, and *US News and World Report* each published 26 articles reporting on research on aggression, crime and violence. The aggression

research and debate most reported in these newsweeklies concerned the effects of media violence, especially video games and television, on young people.

For example, *Newsweek* in this period featured nine articles on media violence, all but one of which focused on effects on young children. Four articles discussed the effects of drugs or addiction on violence. One featured the neuro-scientific study of brain regions implicated in aggression. Three reported on other research on etiological factors implicated in childhood violence (one on daycare, one on excessive self-esteem, the other on loss and mourning). The rest were about crime statistics or recent episodes "in the news."

Time also published nine articles on the relationship between media violence and youth violence. Of the remaining 17, two focused on the possibility of a relationship between availability of guns and rates of youth violence, while one reported on the same daycare study as reported in *Newsweek*, and one focused on approaching the psychiatric category of antisocial personality disorder as a neurological phenomenon. None focused on drugs. Matt Ridley's (2003) *Nature via Nurture* was the subject of a cover story, and a report of Caspi and Moffitt's studies on the gene promoter for the enzyme, MAOA, was headlined "Search for a Murder Gene."

US News and World Report featured eleven articles on youth aggression, crime, and violence, only five of which focused on its relation to media violence. Others reported on efforts to direct young people away from violence or on statistics (interestingly these were statistics indicating decreases in some forms of youth violence throughout the 1990s). Two articles reviewed the state of research in one or another approach to the study of human aggression. In 1990, evolutionary studies were reviewed with emphasis on the role of aggression in group violence and social control, and the role of genetics and neurotransmitters in the etiology of individual aggression. In 1997, a cover story on "The Politics of Biology" covered claims made on behalf of molecular behavior genetics, but noted the lack of replication of most such studies and difficulties in defining behavioral phenotypes such as alcoholism. The claim of relevance of some of the research to gay rights is covered and a fuzzy interactionism is described in the piece's conclusion. This magazine also published a report on Moffitt's MAOA study in New Zealand, but, unlike *Time*'s, the header, "Genes + Abuse = Trouble," incorporated the interaction message of the study. *US News and World Report* also featured a profile of Steven Pinker, as did *Time*, during the marketing period for his (2002) *The Blank Slate*.

If one could characterize the overall representation of research on violence and aggression in these mass circulation media, research on genetics has pride of place. The profiles of Pinker and Ridley emphasize the genetic point

¹⁰ In this work I was ably assisted by a number of research assistants: Kristen Houlton, Yeonbo Jeong, and Cale Basaraba. (While I selected journals, set keywords, and reviewed results, they performed searches in tables of contents, databases, periodical indexes, and so on.)

of view as the front line of research. Criticism is presented as but a tempering of claims, rather than as representing an alternative framework for research. The interactive model offered by Caspi and Moffitt is treated as an insight into how a specific gene works rather than as an avatar for an entirely different approach to thinking about behavior. While research on exposure of children and others to media violence was more frequently reported, the issues at stake often had to do with the effectiveness or desirability of one or another kind of control (parental, state regulation of publication and broadcasting, the V-chip, and others).

Different approaches to etiology make different sense of what correlational research there is. Where the overall framing of reports of research on behavioral genetics is that future research will provide more knowledge, whether of environmental interactions, gene regulation, or single gene disorders, the framing of reports on exposure to media violence leaves an impression of terminal inconclusiveness. The difference is subtle, but the implication is that genetic research will produce results, while environmental research, at least on media exposure, will not. Furthermore, most reports about research are phrased in terms of direct effects on individuals of factors under study rather than of population level effects. And even when population-level effects are reported, they are treated as clues to effects on individuals. The overall effect is to preserve an understanding of behavior as an individual phenomenon and behavior patterns in a population as an aggregation of individual behaviors, rather than as properties related to population-level ecological factors.

US Special Interest Periodicals 1990–2005

The Economist included 17 articles related to aggression, of which one was an obituary for sociologist Robert K. Merton. Five of the 17 concerned crime statistics. Of the remaining 11, two (in the same issue in August 1993) concerned children's exposure to media violence and two, about 10 years apart, concerned genetics research. In 1992, the magazine carried a generally favorable report on increased research in molecular behavior genetics incorporating a caveat on environmental interactions. In 2003, the magazine featured an article on Moffitt and Caspi's New Zealand studies of depression, which, like their work on MAOA, pointed to specific gene–environment interactions. One article reported on brain research, one on alcohol and aggression. The remainder concerned specific incidents in the news.

New Scientist, with 27 articles dealing in some way with aggression and violence, featured seven on media violence. Three articles reported on non-human animal research, both field research and laboratory work. The 27 also included a profile of Adrian Raine and his physiological research and a

report on the Caspi and Moffitt study, as well as the work on bullying and self-esteem and on daycare and aggression in children. Several concerned drugs and violence, both the enhancing and the dampening effects.

As in the mass circulation magazines, the focus in these media is on individual expressions of violence, and aggression is represented negatively, as synonymous with violence and as a phenomenon to reduce or control.

Books and Book Reviews

Researchers attached to each of the covered approaches have also written books for non-specialist audiences in addition to their scientific work. These are received in the general press as entrants into the nature-nurture debate and assessed for their effectiveness in shoring up their side. Both the relative number and tenor of reviews convey a general representation of the research field. Reviews in the scholarly press, even when short, are more likely to be critical, to review flaws in argumentation, incomplete or one-sided presentations of evidence, and failures to address relevant issues. These are rarely picked up by reviews in the general press, where authors' own representations of the dialectical status quo tend to pass into reviewers' representations of the background against which to assess a book's significance.¹¹

Using the EBSCO search tool, we searched for reviews of seven recently published entrants up to 2005. Pinker's *The Blank Slate* (2002) received the most attention, with 42 reviews in media ranging from anthropological and general science journals to middlebrow publications like *The New Yorker*, *Times Literary Supplement*, and *New York Review of Books*, to *Time* and other mass-circulation media. Matt Ridley's *Nature via Nurture* (2003) received 23, and Richard Lewontin's *The Triple Helix* received 20 in a similar range of publications. Four other books, Hamer and Copeland's *Living with Our Genes* (1998), Fausto-Sterling's *Sexing the Body* (2000), Jonathan Pincus's *Base Instincts* (2001), and the second edition of Susan Oyama's *Ontogeny of Information* (2000), received fewer than ten reviews each. Each set also included reviews in trade publications, such as *Publishers' Weekly*, which give short summary reviews with recommendations in lieu of critical evaluation.

Here, again, numbers tell a story. Pinker's genetic and evolutionary psychology manifesto received twice the attention of Ridley's volume, in which the effects of genes are presented as tempered by environmental factors ("via

¹¹ One exception to this pattern is philosopher Simon Blackburn's (2002a) review of Pinker's *The Blank Slate* in *the New Republic*, a review that stressed conceptual and argumentative shortcomings. Blackburn (2002b) also published a review in *New Scientist*.

nurture”). And Lewontin’s polemic against genetic determinism and articulation of his own version of an interactionist approach received just a bit less attention than Ridley’s book. The various alternatives represented by the other books—brain science (Pincus), developmental systems theory (Oyama, and, to some extent, Fausto-Sterling), behavior genetics (Hamer and Copeland)—receive much less attention. It’s true that Pinker is very well known, has a flair for expression, and is thus likely to attract media attention, but the point is to consider the difference between the publication and its reception.

Given only the facts of publication, one might think the various approaches received equal time. Their varying uptake shows again the power of the genetic approach, especially when engagingly presented, to command attention. In addition, all through the responses to these volumes, the question of understanding behavior continues to be represented as a matter of understanding either the etiology of individual behavior or the basis of individual variation. (Do our genes or our physiology make us do it? Our upbringing and social environment? Or both biological and social/experiential factors?) Alternative ways of posing the question, alternative questions about behavior, especially questions about differences in frequency and distribution of behaviors in different populations are rarely, if ever, raised. Aggression is represented as a phenomenon to be mitigated, diminished, by addressing the causes under discussion, as they “affect” individuals. Because the nature-nurture issue is so salient as the dominant controversy, even in those few cases where a population-level causal factor such as income distribution is mentioned, it is only considered in a context focused on factors that act on individuals.¹²

Implications

Why does it matter what kinds of research gets taken up where and by whom? The empirical work whose citation patterns are outlined above concerns behaviors some forms of which are matters of considerable public concern. And, even though the work is empirical in character, it is, as I have suggested, informed by conceptual considerations that constitute implicit theories. Aggression research is understood as a key to understanding negatively valued behavior from classroom disruptiveness to schoolyard bullying to violent crime. Research on sexual orientation is almost exclusively research on homosexuality, which, as recent United States politics demonstrates, still inspires fear and loathing in a significant portion of the population. Scientific

research can be a corrective to misinformation and prejudice, but is also subject to interpretation and selective reading as it moves from laboratory and field to policy deliberation, mass media, and public hearts and minds. Both aggression and homosexuality are valenced as social problems. This valencing changes with time. The negative valuing of homosexuality is also unevenly distributed across social demographic categories, associated largely with religious and other beliefs.

Different kinds of theoretical-conceptual issues entangled in this research play roles in policy and in public understanding. Questions of causation (what accounts for differences in the manifestation of a given behavior?) are obviously relevant in connection with prevention. Questions of concept formation (What is behavior? How should a particular behavior be operationalized?) fix just what is (thought, hoped, or alleged) to be prevented, controlled, or increased. These issues, of course, interact. Thus, when aggression or sexual orientation are understood as individual characteristics or dispositions, intervention will center around methods of manipulating the causes of these dispositions. In ordinary life we interact with other individuals, and it seems natural to think of behavior as a phenomenon to be studied at the level of the individual: what makes Johnny do thus and so? It seems, then, equally natural to look to the sciences to answer questions about individuals. But the knowledge we need for effective policy may not be knowledge about individuals and differences among them, but knowledge of factors operating at a higher level of organization.

Many, if not most, geneticists profess that the complexity of the human genome argues against the prospect of finding a single or even small number of mutations that could be used diagnostically and/or as targets of manipulation. Nevertheless the opponents of genetic approaches, instigated perhaps by the less circumspect among the genetics advocates, invoke Brave New World scenarios in which genetic engineers fix one’s destiny even before birth. Less dramatic, but no less problematic scenarios are described in which protein synthesis or activity might be pharmacologically altered to produce desired personality types. And, more realistically in terms of available technology, some worry about the use of selective abortion on the basis of fetal genotype profiling.

Physiological research either complements genetic research or identifies primarily brain or neurological conditions responsible for or contributory to individual behavioral patterns. Much of the research on physiological determinants of aggressive behavior is read as suggesting that these, too, might be pharmacologically addressed.¹³

¹² This is not to say that no research is carried out in an ecological framework, but that little research focused specifically on human aggression is and what little there is does not get much attention.

¹³ Here the widespread use of Ritalin to control ADHD provides one model of pharmacological intervention (Hawthorne 2010). And of course psychopharmaceuticals are in wide use. The worry is about preemptive administration of pharmacological intervention.

Some physiological research lends itself to treating problematic behavior as expressive of disease and thus a medical rather than legal (or moral) matter.¹⁴ Because the physiological conditions associated with aggression are so various and so variously caused (genetic, congenital, brain injury, infection) this work does not lend itself so easily to hopes of systematic prevention or reduction of violence. While both hormonal and structural causal factors in sexual orientation have been investigated, no studies have been decisive enough to encourage hopes of systematic control. Indeed, while hormonal treatments are employed to assist the development of physical secondary sex characteristics for transgender or transsexual persons, they do not seem to have an effect on sexual orientation, thus reinforcing the distinction between gender identity and sexual orientation. Physiological research on sexual orientation could of course fill in mechanisms of genetic influence and thus is also regarded with suspicion by critics and opponents of genetic research.

Social environment-oriented psychological research is sometimes carried out as clinical research on possible forms of social intervention. Work that studies the effects of teaching alternative communication and interaction styles, both within families and among peers, for example, bypasses research into causes of problematic behavior and investigates the effects of intervention no matter what the cause. This work holds the promise, where sufficiently successful, of general adoption and implementation in clinics and schools to effect changes in individuals' behavior. Other research investigates, using databases, the effects of childhood experiences such as physical abuse on later behavior. As noted earlier, some (friendly) critics of this research suggest that knowledge of biological causal factors might help in directing kinds of intervention to those most likely to be affected. Less friendly critics of the psychological research focused on social environment invoke the memory of B. F. Skinner's behaviorist proposals or Orwell's *1984*, and the social (re-)programming efforts of the Soviet Union. There is also a suggestion that advocates of environmentally directed intervention strategies are demanding that entire social systems be changed, with the likelihood of serious unanticipated effects. Just as the *Brave New World* scenario seems based on a highly oversimplified conception of genetic processes, so, too, the psychological research is not providing knowledge that could be used to implement these social nightmares. Indeed, the teaching of alternative communication and

interaction styles is based on a quite different psychological theory than old school behaviorism.

Finally, DST's emphasis on the interaction of genetic, physiological, and environmental factors presents a picture of organisms sensitive to multiple influences, but resistant to systematic interventions to desired outcomes. Nevertheless, understanding relationships and interactions of key factors and their causal pathways would presumably offer insights into prospects and possible mechanisms for reducing unwanted and enhancing desired behaviors.

Whether genetic, physiological, or social environmental, all these approaches fuel anticipation of intervention at the level of individuals. All involve more complicated, fine-tuned, or sophisticated versions of manipulations already practiced. Breeding, selective embryogenesis and gestation, genetic engineering, surgery, medication, teaching, and influencing through reward and punishment regimes are relatively familiar practices (at least on plants and animals, if not yet all on humans) and they are geared to the production of individual human or nonhuman organisms possessing or lacking particular traits or dispositions.

A population/ecological approach, by contrast, focuses on the behaviors, rather than on the individuals behaving, and on their frequencies and distributions in populations. The emphasis on individuals or populations has implications for how we think of the objects of interest. Individualistic approaches lend themselves to thinking in terms of the criminal, the delinquent, the disruptive child, the homosexual, the pervert, and the differences between them and "normal" individuals. Population approaches lend themselves to thinking in terms of societies and the differences among them: internally violent versus peaceful societies, externally aggressive versus neighborly, productive versus contemplative (subsistence), monomorphic versus polymorphic as regards sexual interactions, rigidly versus flexibly monomorphic, etc. Furthermore, in an ecological approach, the variations in frequency, intensity, diversity, or kinds of interaction are related to variations in population conditions: whether structural, such as age structure, modes of division of labor, or degree of geographical dispersion; or resource-related, such as scarcity versus plenty, increasing versus diminishing, steady versus variable, homogeneous versus heterogeneous—to name just a few of the forms of variation. As a consequence, the direction of intervention would be quite different. Rather than bearing down on an individual (or family) within a society, it would move out from a subgroup in a society to the conditions of the entire society/population, many of which, like age structure, are themselves of such complex origin and sensitive to so many other conditions, that they seem much less responsive to attempts at intervention. Instead, they often seem like the givens of nature. But there may be interventions well short of radical redistributions of

¹⁴ The practice of chemically castrating sex offenders can be read in this way, for example, but the treatment of children classified as ADHD is the most prevalent instance. And many articles in general circulation media hold out the hope for pharmacological "solutions," once the cause of a condition/behavior has been identified.

income or wholesale rearrangement of the physical environment that ecological approaches could make visible. The receptive environment into which the different approaches fall is, however, one concerned with individuals and the media representation of the research reports its relevance to those concerns rather than digging out the implicit, embedded, theories and making them available for consideration. Our own preoccupations are reflected back to us rather than challenged.

Conclusion

There is very little that can count as theory in these approaches. Apart from the self-labeled Developmental Systems Theory, at most informal theories, such as the Caspi and Moffitt $G \times E \times N$ model, are presented as a template for empirical research. But via both the pattern of mutual intra-approach citation and the representation of the research outside its immediate research context, large quantities of empirical research reports are connected and given coherence by implicit theories. Representing differences in approach as relevant primarily to the nature-nurture question facilitates a mis-targeting by the political critics of behavioral research. They treat genetic research and its sometime association with biological determinism as a harbinger of dangerous forms of social control, but social environment research is just as deterministic (or non-deterministic, as both trade in frequencies and probabilities). Each side can accuse the other of facilitating problematic scenarios, but these are based not on examination of the research produced by their conjured opponents, but primarily on, if anything, its representation in popular venues. Thus the criticism does not engage with the research but with its mythologizing. More problematically, these polemics remain mired in the nature-nurture framework about the etiology of behavioral dispositions in individuals. Social critics should be more worried about the ways in which the behaviors in question are operationalized and about the way in which certain questions about behavior are privileged while others are practically invisible.

With respect to epistemological aspects, if one simply considers the different approaches available in the professional literature, the field looks very pluralistic. But, if one looks at citation patterns, only some approaches get significant uptake, and uptake tends to be in research venues publishing on the same approach or clinical/policy venues in which suggestions for application are made. And, if one looks at public communication venues, the message that tends to be communicated is about potential value of different research approaches, in particular about the long-term expected success of genetic and, to some extent,

neurophysiological approaches. The epistemological benefits of plurality, the mutual criticism that could lead to scrutiny of observational data, of hypotheses, and of assumptions, remains potential rather than realized. One may speculate that as long as the implicit theories remain implicit, there is less of a target for inter-approach critical interaction that might bring out the assumptions and limitations of the approaches than would be the case were the implicit theories made explicit.

The implicit theories of behavioral research, laden with policy and clinical applications/implications, get differential uptake, thus presenting to the public a quite different picture of the state of knowledge than one might obtain from a review directly of the research venues themselves. This differential uptake reflects the preoccupations of the social and cultural context back to it, rather than challenging them. In this respect, theory is most effective when it remains unvoiced, shaping, but protected from challenge by, empirical research.

References

- Adam BD (1985) Age, structure, and sexuality: reflections on the anthropological evidence on homosexual relations. *J Homosex* 11:19–33
- Bailey JM, Pillard R (1991) A genetic study of male sexual orientation. *Arch Gen Psychiat* 48:1089–1096
- Best M, Williams JM, Coccaro EF (2002) Evidence for a dysfunctional prefrontal circuit in patients with an impulsive aggressive disorder. *Proc Natl Acad Sci USA* 99:8448–8453
- Blackburn S (2002a) Meet the Flintstones. *New Republic* 227(22): 28–33
- Blackburn S (2002b) Born not made. *New Sci* 175(2399):56
- Blumstein A (1997a) U.S. criminal justice conundrum: rising prison populations and stable crime rates. *Crime Delinquency* 44:127–135
- Blumstein A (1997b) Interaction of criminological research and public policy. *J Quant Criminol* 12:349–361
- Carver R, Waldahl R, Breivik J (2008) Frame that Gene. *EMBO Rep* 9:943–947
- Caspi A, Moffitt T (2006) Gene-environment interactions in psychiatry: joining forces with neuroscience. *Nat Rev Neurosci* 7:583–590
- Caspi A, McClay J, Moffitt T, Mill J, Martin J, Craig IW, Taylor A, Poulton R (2002) Role of genotype in the cycle of violence in maltreated children. *Science* 297:851–854
- Caspi A, Sugden K, Moffitt T et al (2003) Influence of life stress on depression: moderation by a polymorphism in the 5-HTT gene. *Science* 301:386–389
- Caspi A, Moffitt T, Cannon M, McClay J, Murray R, Harrington H, Taylor A, Arseneault L, Williams B, Braithwaite A, Poulton R, Craig IW (2005) Moderation of the effect of adolescent-onset cannabis use on adult psychosis by a functional polymorphism in the catechol-O-methyltransferase gene: longitudinal evidence of a gene \times environment Interaction. *Biol Psychiatry* 57: 1117–1127
- Coccaro E, Kavoussi RJ, Lesser JC (1992) Self- and other-directed human aggression: the role of the central serotonergic system. *Int Clin Psychopharm* 6(Suppl.6):70–83

- de Waal F (1992) Aggression as a well-integrated part of primate social relationships. In: Silverberg J, Gray JP (eds) *Aggression and peacefulness in human and other primates*. Oxford University Press, New York, pp 37–56
- Dickemann M (1993) Reproductive strategies and gender construction. *J Homosex* 24:55–71
- Fagan J, Davies G (2004) The natural history of neighborhood violence. *J Contemp Crim Justice* 127:127–147
- Fagan J, West V, Holland J (2003) Reciprocal effects of crime and incarceration in New York City neighborhoods. *Fordham Urb L J* 30:1551–1602
- Fausto-Sterling A (2000) *Sexing the body: gender politics and the construction of sexuality*. Basic Books, New York
- Gottesman I, Hill Goldsmith H (1994) Developmental psychopathology of antisocial behavior: inserting genes into its ontogenesis and epigenesis. In: Nelson CA (ed) *Threats to optimal development: integrating biological, psychological, and social risk factors*. The Minnesota symposia on child psychology, vol 27. Erlbaum, Hillsdale, pp 69–104
- Gottlieb G (1991) Experimental canalization of behavioral development: theory. *Dev Psychol* 27:4–13
- Gottlieb G (1997) *Synthesizing nature-nurture: prenatal roots of instinctive behavior*. Erlbaum, Mahwah
- Gottlieb G, Wahlsten D, Lickliter R (2006) The significance of biology for human development: a developmental psychobiological systems view. In: Lerner RM (ed) *Handbook of child psychology*. Vol 1: theoretical models of human development. Wiley, New York, pp 233–273
- Hamer D, Copeland P (1998) *Living with our genes: why they matter more than you think*. Doubleday, New York
- Hamer D, Hu S, Magnuson VL, Pattatucci AM (1993) A linkage between DNA markers on the X chromosome and male sexual orientation. *Science* 261:321–327
- Hawthorne S (2010) Institutionalized intolerance of ADHD: sources and consequences. *Hypatia* 25:504–525
- Lee R, Coccaro E (2001) The neuropsychopharmacology of criminality and aggression. *Can J Psychiat* 46:35–44
- Lewontin RC (1991) *Biology as ideology: the doctrine of DNA*. Anansi, Concord
- Longino HE (2001a) What do we measure when we measure behavior? *Stud Hist Philos Sci* 32:685–701
- Longino HE (2001b) *The fate of knowledge*. Princeton University Press, Princeton
- Longino HE (2006) Theoretical pluralism and the scientific study of behavior. In: Kellert S, Longino H, Waters CK (eds) *Scientific pluralism*. University of Minnesota Press, Minneapolis, pp 102–131
- Longino HE (in press) Studying human behavior: how scientists investigate aggression and sexual orientation. Chicago University Press, Chicago
- Mabry P, Olster DH, Morgan GD, Abrams DB (2008) Interdisciplinary and systems science to improve population health: a view from the NIH Office of Behavioral and Social Sciences Research. *Am J Prev Med* 35:211–224
- Nelkin D, Lindee S (1995) *The DNA mystique*. Freeman, New York
- Oyama S (2000) *The ontogeny of information: developmental systems and evolution*, 2nd edn. Duke University Press, Durham
- Pigliucci M (2012) On the different ways of “doing theory” in biology. *Biol Theory* 7. doi:10.1007/s13752-012-0047-1
- Pincus J (2001) *Base instincts: what makes killers kill?*. Norton, New York
- Pinker S (2002) *The blank slate*. Viking Penguin, New York
- Rhee SH, Waldman ID (2002) Genetic and environmental influences on antisocial behavior: a meta-analysis of twin and adoption studies. *Psych Bull* 128:490–529
- Ridley M (2003) *Nature via nurture: genes, experience, and what makes us human*. Harper Collins, New York
- Widom C (1989) Does violence beget violence? *Psych Bull* 106:3–28