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Biological Variables in Social Surveys[*]

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Abstract

Social scientists have long virtually ignored the biological constraints of human behavior. Yet if the prediction of behavior is considered essential to a social science, neglecting any variable that might influence human behavior is unacceptable. This paper provides examples of important biological variables and describes their measurement in social surveys.

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1. Introduction

Social surveys today are collecting increasing amounts of data on biological variables that might influence social behavior. I will refer to such variables in the following as "biologically relevant variables" or "biological variables" for short. These include biometric features (e.g., fingerprints), biomarkers (e.g., cortisone levels), biomaterial (e.g., hair), and measures of anthropo-metric variables (e.g., body-mass index, or BMI).

Historical background Social scientists have long virtually ignored the biological constraints of human behavior.[1] This historical development culminated in the qualitative conception of sociology as a "text science" dealing solely with how social actors understand and interpret one another. For this kind of sociology, the goal of social science is not to develop predictive models of social behavior but to reconstruct meaning. As such, quantitative and qualitative sociology do not differ methodologically but in their scientific objectives. If the prediction of behavior is considered essential for a social science, it cannot afford to neglect any variable that might influence human behavior. This paper will cite examples of important biological variables and describe their measurement in social surveys.

Biosocial surveys The combination of questionnaire data and biological variables measured in a random sample of a population is increasingly denoted as a "biosocial survey." Such surveys have the advantage of every large sample: population parameters can be estimated even for small subgroups of a population. In general, this is impossible with the small sample sizes common in biopsychology, biology, and medicine. Furthermore in many cases samples in these disciplines are not random samples of a population but convenience samples of self-selected populations. Finally, most medical surveys are restricted to health variables, thereby lacking biographical data and those dependent variables of most interest for social scientists: employment history, mating behavior, value systems, and fertility. On the other hand, biological variables are usually not measured in social science surveys. Even studies on divorce seldom measure the obvious relevant and time-varying variables like body and face symmetries, BMI, fertility indicators, testosterone levels, etc.

1 Steven Pinker (2002) has discussed this at length in "The blank slate".

Using biological variables affecting social behavior as independent variables together with sociologically relevant dependent variables in large-scale surveys will allow more detailed examination of longstanding sociological problems. More technically: the goal of including biological variables in social science population surveys is to reduce unexplained variance and the amount of misspecification in social science models.[2]

2. Increase of studies with biosocial variables in core social-science journals

Sociobiological hypotheses and biosocial surveys are still considered exotic by many social scientists, and prominent sociobiologists are often regarded with some suspicion. This will change very slowly. Two books published by the National Academy Press are of particular importance for this process. The first was the book *Cells and Surveys*, edited by Finch et al. (2001), with the rhetorical subtitle "Should Biological Measurements be included in Social Science Research?". The follow-up volume, *Biosocial Surveys*, was edited by Weinstein et al. (2008).

A review by Freese et al. (2003), appearing in the *Annual Review of Sociology*, was the beginning of a series of publications on biosocial variables in core journals of the social sciences. The *American Political Science Review* published an article on the genetic transmission of political orientations in 2005 (Alford et al. 2005), followed in 2008 by an article on genetic variations in political participation (Fowler et al. 2008). *Social Forces* published an issue in September 2006 with the editorial "The Linking of Sociology and Biology" (Guo 2006), containing four articles on biosocial variables. *Sociological Methods Research* had a "Special Issue on Society and Genetics" in 2008. Even the *American Journal of Sociology* released a special issue in 2008 on "Exploring Genetics and Social Structure" (Volume 114, Supplement 2008). Parallel to these publications, the steering groups of the large-scale panel studies in the social sciences published recommen-dations for the inclusion of biosocial indicators in surveys (Lillard and Wagner 2006; Kumari et al. 2006).

To sum up, biosocial problems, hypotheses, and studies can now be found even in the core social science journals – at least the American ones. The technical and statistical level of these publications is still not up to the standards of the medical literature, but given sociology's longstanding neglect of biology, this was to be expected.

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2 The self-restriction of model builders on likelihood-ratios and Wald-statistics as inferior substitutes for model testing and residual diagnostics keep them forgetting about the small explanatory power of social sciences models. Even for simple problems like voting, fertility decisions or divorce, the proportional reduction of error of the model compared with the marginal distribution is rarely larger than 10%. After 40 years of multivariate research this is quite shameful.

3. Biosocial data for social sciences applications

There are many examples of sociological problems in which biological variables set constraints for human behavior. Among them are genetic factors, variables on mating behavior, and perinatal variables. Only a few examples will be given; a complete and systematic review is still missing from the scientific literature.

Genetic factors For many traditional social science problems, empirical evidence of genetic effects has been found. Examples are suicide (Voracek and Loibl 2007), aggressive behavior (Craig and Halton 2009), and "anti-social behavior" in general (Moffitt 2005).

The list of dependent variables of social science interest for which genetic effects or gene-environment interactions have been reported is growing daily: from the frequency of life events (Bemmels et al. 2008) to economic decision making (Zhong et al. 2009) and the preference for coffee (Vink et al. 2009). Particularly interesting are genetic variations that correlate with numerous dependent behavioral variables. Another politically relevant topic in this context is ADHD: there are a considerable number of candidate genes for attention-deficit hyperactivity disorder (ADHD).[3] At the Bremen Institute for Prevention Research and Social Medicine (BIPS), the new study "German Population Based Long Term Follow Up of ADHD" was launched in July 2009. This study will track treated and non-treated children displaying ADHD over 12 years. Variables of interest are medical aspects, like symptoms of ADHD and other psychiatric diseases, as well as accidents, drug abuse, school achievement, juvenile crime, professional careers, and indicators of life quality.

Mating and marital stability A surprising amount of research in German sociology over the last 15 years had been done on divorce. Even more surprising is the almost complete lack of biological variables associated with mating behavior in this literature. Even obvious factors, which might be varying with time, like differential attractiveness of the partners, have seldom been considered.[4] Despite the fact that many of the possibly relevant measurements (for example: BMI, facial and body symmetry, waist-to-hip ratio, fertility indicators) could have been measured easily and inexpensively,[5] these variables have been included in almost no study to date. Other variables associated with mating behavior, such as odor (Ebberfeld 2005), are much more difficult to measure within a survey context, but still not impossible. Due to

3 see Gizer et al. (2009).
4 see Hill and Kopp (2006).
5 see Zebrowitz (1997), Rhodes and Zebrowitz (2002), and Swami and Furnham (2008).

technical problems and circadian effects, interpersonal and intrapersonal hormonal differences are even harder to measure within surveys. Nevertheless examples do exist in the sociological literature (for testosterone levels, see Booth et al. 2006).

Perinatal variables Different perinatal variables have been associated with human behavior in later life. An important example is the level of intrauterine testosterone (see Manning 2002). The clinical quality of births is often accessed with the so called Apgar Score; furthermore, birth weight and size of the newborn are considered as predictors of many mortality events. There are studies on long-term effects, for example, of birth weight on cognitive development (Goosby and Cheadle 2009). Even effects of birth order have been studied, for example, with regard to school achievements (Booth and Kee 2009) and homosexuality (Blanchard 2008).

4. Biorelevant data in medical surveys

Medical surveys measure numerous variables on health status. To clarify the discussion, we should distinguish between medical surveys and examination surveys. Examination surveys usually ask medical survey respondents to visit an examination center. Due to the required technical equipment for techniques like sonography, CT, radiology, MR, EEG and ECG, mobile examination centers have sometimes been used. These high-tech exams are hardly the most practicable measures for use in social surveys. Of prime interest are measurements that can be conducted by medically untrained interviewers in respondent households. These include respondent weight and height, waist-to-hip ratio, and blood pressure. Even more interesting for social scientists are measurements of a more general state of health, for example, grip strength with a dynamometer or a simple pulmonary function test ("peak flow meter").[6] A simple but useful test of limited mobility that is occasionally used in surveys of the elderly is how long it takes the respondent to pick up a pencil from the floor.

[6] see ibid.

5. Bio-materials in the tue meaning of the word

Blood. Perhaps the most versatile bio-material usable in surveys is blood. Many analyses can be done with venous blood. Unfortunately, to draw blood, German law requires the presence of an MD. The collection of blood samples thus faces practical restrictions. Even preparing blood samples for transport to a laboratory is an unusual task for non-medical fieldworkers and requires special training. Finally, the long-term storage of blood samples requires significant technical effort and costs. Taking blood using the "finger prick" method, where a drop of blood from a fingertip is dried on a small piece of paper (dried blood spot, DBS) is much easier. The analytical options are restricted compared to those of venous blood, but sampling, transport, and storage of the samples is considerably simpler. So far – with the exception of pure medical surveys – little is known about the general willingness to participate in blood samples and the long-term storage of the samples.

Saliva. Collecting saliva is the easiest way to obtain material for DNA analysis. Saliva may be used for other tests such as the level of cortisol (as a stress indicator or in the context of aggressive behavior; see Yu and Shi 2009) and cotinin (as an indicator of nicotine exposure; see Shahab et al. 2008). Saliva is usually collected from the mouth using a cotton swab. Today, a number of analyses are even possible on material collected with chewing gum. This method is non-invasive and has the potential to become widely accepted to collect such data in random samples of the population.

Hair. Hair and fingernails can be collected without any problems even under survey conditions. These materials can be used for the analysis of absorbed contaminants ("biomonitoring") and consumed drugs.[7]

Urine. McCadden et al. (2005) report on a random sample of 5105 men and women (aged 16 to 44), who were asked for a urine sample after a CAPI interview. Of these, 3628 (71%) agreed, and 3608 samples were collected successfully. The samples are used to screen for "chlamydia trachomatis," a sexually transmittable bacteria that causes almost no immediate but serious long-term problems in women. Another noteworthy study collected urine in a mail survey of a random sample of 21,000 Dutch men and women (age 15-29), for whom van

7 The book edited by Tobin (2005) gives an overview on the chemical analysis of human hair. For potential usages of other noninvasive bio-materials, see Esteban and Castano (2009).

Bergen et al. (2006) reports a response rate of almost 41 percent. A number of other similar studies are now available; Low et al. (2007) give an overview.

6. Long-term measurements organization conducting the survey

For studies on specific population such as overweight children or diabetics, long-term measurement instruments are used. These include instruments for recording blood pressure, heart rate, and intensity of movement (more specifically acceleration, using a device called an accelerometer).[8] Small-sized sensors like SmartPatch and SmartBand allow wireless measurements of heart rate (via WLAN), breathing rate, oxygen saturation of the blood, and temperature for 24 hours, even on infants.[9] Although such instruments are becoming much smaller, more portable, and less annoying, they still affect daily routine. Technical developments open up new perspectives every day, for example, the use of mobile phones with GPS as a substitute for accelerometers, since subjects carry mobile phones anyway. Another example is "intelligent clothing," where sensors in the clothes provide information on temperature, pulse rate, skin resistance, and transpiration (see Solaz et al. 2006).[10] For many cognitive tasks (and of course for diabetics), glucose levels throughout the day are important. A newly developed probe that can be mounted by trained persons in abdominal fat allows continuous recording of glucose levels. The corresponding electronic device is currently carried in a waist bag and barely affects daily activities (Dye et al. 2010).

7. Environmental data

Many health surveys collect samples of environmental materials to determine environmental pollution. These include samples of soil, tap water, and air. In Switzerland there is a nationwide noise map in which the objective magnitude of noise exposure is measured or interpolated (Ingold and Koepfli 2009). Such maps exist in other countries as well, but covering only particular regions.[11] With the consent of the respondents, some studies collect items of daily practical use, like toothbrushes, washcloths, combs, and vacuum cleaner bags.[12]

8 For accelerometers, see Puyau et al. (2004) and Murphy (2009).
9 www.intelligentclothing.com/wireless.html.
10 Another example might be „intelligent shoes", where sensors measure speed or pressure distribution. An early example is the „Adidas Micropacer".
11 EU- directive 2002/49/EG (June 25th 2002) states that communities with a population over 250.000 people are committed to publish regional noise maps, see also www.lärmkarte.de.
12 The German environmental survey of 1990/1992 collected (for subsamples) respondents hair in order to measure aluminium, barium, plumb, boron, cadmium, calcium, chrome, copper, magnesium, phosphorus, platinum, strontium, thallium, zinc, caesium, palladium, uranium, vanadium as well as nicotine and cotinin. In the environmental survey of 1998 blood and urine samples were taken for "human biomonitoring". In subsamples, tap water was analysed for arsenic, plumbum, boron, cadmium, copper, nickel and zinc.

In at least one older American study, household garbage was collected for response validation without the consent of the respondents (see Rathje 1984).

8. Research Needs

Extensive research is needed on the use of biosocial variables in social surveys. This is especially true for problems of respondent cooperation in biosocial surveys.

Cooperation problems. Few studies exist on the willingness of respondents to cooperate in the collection of biological indicators within social surveys. If respondents correctly identify the purpose of a survey as non-medical, this will have strong effects on the perceived cost/benefit ratio of participation. Nearly nothing is known up to now on the resulting biases. Most biological variables in social surveys are measured in panel studies. Repeated participation in a panel may result in a biased remaining sample, but the repeated participation may also increase respondents' trust that their participation will not entail negative consequences. Results based on panels should therefore be treated with care when generalized to standard surveys. Furthermore it has to be taken into consideration that, as a rule, respondents (as well as scholars) react positively to most new methods: cooperation rates are initially high for most data collection modes (in person, by phone, and by the Internet), but deteriorate quickly with the widespread use of these techniques. This also seems plausible for the measurement of biosocial variables in social surveys. For this reason, experimental studies are urgently needed on response rates in the general population depending on organization conducting the survey, type of biological indicator, incentives used, and explanations of the survey given to respondents.[13]

Collecting and processing biosocial variables. In medical surveys, medically trained staff members are available for collecting and processing biological materials. Very little is known about whether medically untrained persons who do the fieldwork in social science surveys can be used for collecting biosocial information, ranging from the simple measurement of the BMI to collecting dried blood spots. Recent experiences with the low quality of paradata

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Dustbags content was analysed for PCB, biocides, phtalates and triphosphates. The surprisingly short list of publications based on the survey can be found on the homepage of "Umweltbundesamt" at www.Umweltbundesamt.de/gesundheit/publikationen. More interesting for social scientists may be a volume on environmental justice by another federal agency (Bundesamt für Strahlenschutz et al. 2008).

13 The comparison of stated cooperation in factorial surveys and actual cooperation in factorial experiments might be interesting in itself: I expect only a small amount of agreement.

recorded by interviewers may raise some doubt as to the feasibility of traditionally trained interviewers collecting non-standard data. This doubt is even greater since the results of such fieldwork can hardly be controlled at this stage of research: after all, nothing is known about the data quality that can be expected under such field conditions.[14]

The standard procedure for special survey measurements with high technical demands is the use of few, but highly trained qualified interviewers. Adoption of this procedure for biological variables will result in considerable interviewer effects, since measurement errors are clustered within interviewers. Therefore, intraclass correlations are high. Usually, the effective decrease in sample size due to interviewer effects is computed by multiplication of interviewer workload with the intraclass correlation (Schnell and Kreuter 2005). High intraclass correlations multiplied with high workloads will yield a considerable underestimation of population variance. Therefore, more highly trained interviewers than usual will be needed for biosocial surveys, further increasing the cost of such surveys. Finally, neglect of these kinds of interviewer effects will increase the amount of errors of the first kind (alpha error rate) in biosocial surveys. Therefore, detailed studies of interviewer effects on biosocial variables are needed.

Long-term storage. For research with biological material, long-term storage of the samples is highly desirable. This allows the material to be tested at a later stage using analytical techniques that currently do not exist or on research problems that are still unknown. Long-term storage of biological samples creates considerable technical and logistical problems, however, and these remain unresolved, even for medical research in Germany.[15]

By comparison with other countries in Europe, the situation in Germany is disheartening: Due to the large number of federal statistical agencies and the oligarchic structure of German academic medicine, the country still does not even have a mortality register, which would provide fascinating research opportunities if it were linked to samples on long-term storage in a biobank. The UK Biobank (www.ukbiobank.ac.uk) is based on precisely this concept. More than 10 assessment centers will collect biosamples of 500,000 persons (at present between 40 and 69 years) across the entire United Kingdom. The resulting biodata will be combined with environmental and lifestyle data. The corresponding German project (the “Helmholtz cohort”)

14 Exceptions are Kroh (2005) and Jaszczak et al. (2009).
15 On technical requirements for the storage of human tissue see Troyer (2008). Helpful advice on storing other biomaterials can be found in „Cancer Epidemiology, Biomarkers and Prevention“ of September 2006 (Volume 15, Issue 9).

has just completed the stage of identifying institutions willing and able to recruit participants for the study.

Data protection problems. The German national ethics review board (*Nationaler Ethikrat*) published a detailed statement on the ethical problems and legal restrictions of biobanks in 2004. A special problem of biobanks results from the fact that persons could raise objections to the use of their samples for scientific projects that were not foreseen at the time of their consent to sample storage. Scientific progress may require disclosure of biological information to third parties. The ethics review board reminded researchers that biological samples may reveal information not only about the person from whom the sample was taken but also about his genetic relatives, perhaps even subgroups of the population or the total population of a country (2004, 109). Finally, the protection of persons unable to consent must be taken into account. The ethics review board noted, in conclusion, that collecting, storing, handling, and analysis of biological samples must be carried out in accordance with the protection of the individual. A corresponding legal framework has to be developed at an international level.[16]

The absence of a clear legal framework imposes considerable problems on social scientists seeking approval of biosocial projects from university ethics review boards, and resistance has to be expected, especially from other social scientists. In order to promote this kind of research, we need some successful examples of biosocial surveys – preferably not conducted by social scientists – to overcome institutional resistance. Under the current conditions in Germany, I personally consider cooperation with foreign research groups more promising.

Lack of biosocial theories for biological variables in surveys. A theoretical foundation for the use of biological variables in social surveys is lacking. Sociobiologists have proposed plausible hypotheses on generative behavior, some on hormonal differences, morbidity differences, and deviant behavior, and a few isolated results on trust, justice, risk behavior, and even voting behavior.[17] But by and large, we simply have very few theories on biological constraints of human behavior at present. Filling this research gap will require far closer cooperation among biologists, psychologists, and social scientists than ever before. Without a corresponding new infrastructure for research, this seems impossible to me.

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16 For an european discussion, see the book edited by Hayry et al. (2007).

17 The typical combination of a small number of cases with surprisingly strong effects reminds on the problem of publishing only significant effects after thousand of tests. Without independent replications the statistical problems of multiple testing must be kept in mind.

9. Recommendations

Inclusion of biosocial hypotheses and techniques in graduate studies. Due to the very slow adoption of new techniques in the social sciences in general and the tentative reception of sociobiological considerations in particular, the fastest way to promote biosocial research in the social sciences may be to include sociobiological theories and techniques in graduate studies and summer schools.

- In order to promote this kind of research, expertise is needed in the committees deciding on the topics in large-scale social science projects.
- GESIS should therefore, for the first time, include biologists and behavioral scientists on their committees.
- Since the technical details of collecting, processing, analyzing, and storing biomarkers are unknown outside the scientific fields from which they originate, appropriate training seminars should be included in the list of the standard GESIS summer schools.

Research on the willingness to cooperate. Research is necessary on respondents' willingness to cooperate in the collection of biosocial information and indicators in non-health surveys.

- We urgently need experiments on respondents' willingness to cooperate in the collection of different biomarkers, depending on the explanation given of the purpose of the survey, the organization conducting the survey and different incentives.

Funding opportunities. German research traditions make interdisciplinary research fields like sociobiology quite difficult. None of the traditional academic fields (medicine, biology, psychology, anthropology, the social sciences, etc.) consider human sociobiology a central research topic. There-fore, this seemingly exotic field is competing for research grants under relatively unfavorable conditions.

- To promote biosocial research we will need new tools for granting research proposals.
- An interdisciplinary priority program of the DFG (German Research Foundation) (*Schwerpunktprogramm*) in human sociobiology or even better on biosocial surveys would be a first step.
- Due to the resistance from German sociologists and the organizational structure of German university medicine, an EU project on human sociobiology seems to me more promising than an attempt to change German decision-making structures.

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