Philosophy of the Social Sciences
43(3) 341–357

DOI: 10.1177/0048393113489100
pos.sagepub.com
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Nature's Experiments and Natural Experiments in the Social Sciences

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Abstract
This article explores the characteristics of research sites that scientists have called "natural experiments" to understand and develop usable distinctions for the social sciences between "Nature's or Society's experiments" and "natural experiments." In this analysis, natural experiments emerge as the retro-fitting by social scientists of events that have happened in the social world into the traditional forms of field or randomized trial experiments. By contrast, "Society's experiments" figure as events in the world that happen in circumstances that are already sufficiently "controlled" to be open for direct analysis without reconstruction work.

Keywords
natural experiment, Nature's or Society's experiment, passive data, randomization, comparative cases

1. Introduction

The term *natural experiment* has become fashionable in the applied social sciences, but both the characteristics and the scope of this category of experiment remain unclear as reflected in their eclectic use of the label. While there have

Received 10 April 2013

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Table 1. Experimental Forms.

Experiment: Control Intervention	"Control" by Nature/ Society	Scientist Designs Experiments to Fit in with the World	Designed and Controlled by Scientist
"Intervention" by Nature/ Society	Nature's/ Society's Experiments	Natural Experiments: Events in the world post hoc reconstructed as such experiments	
Intervention by Scientist		Field Experiments: A priori designed for the world	Laboratory Experiment

been considerable methodological discussions of the topic in these specialist scientific communities, philosophers of science have shown rather less interest. In one of few comments on the genre, in Hans Radder's volume on philosophy of experiment, James Woodward (2003, 94) writes of "natural experiments" as an "important and philosophically neglected category." While Reiss (2008) discusses them in the context of economics, this paper offers a more general analysis of them for the social sciences. First, it proposes and explains a distinction between two such kinds of experiments: "Nature's experiments" and "natural experiments" based on comparison of these categories with those of laboratory and field experiments. Second, it offers a break down of Nature's experiments into a number of subcategories based on their relevant *ceteris paribus* conditions. Third, in the absence of those conditions, it outlines the recipes that social scientists use to turn research sites into "natural experiments." Examples are used to show how both these categories appear in the social sciences. Finally, it uses two of these examples to show why the distinction between Nature's experiments and natural experiments needs to be maintained because the former cannot necessarily be reduced to the latter.

2. Experiments

I begin my analysis with "laboratory experiments" (in Table 1, bottom right), a form which offers the most restricted type of experiment, one against which other kinds are often assessed, and which suggests the characteristics that have to be attended to (or substituted for) in the practice of other types. The typical characteristics of ideal experiments in the laboratory are a controlled intervention into nature designed and executed by scientists and carried out

within an artificial environment of the laboratory, one that shields the objects and events of the experimental materials from the effects of other factors and disturbances by strict protocols of both intervention and control. This epistemic recipe is reputed to isolate a process of interest. "Field experiments" (bottom middle) are experiments designed and carried out by scientists to ape these laboratory conditions in the field. The interventions are controlled by means such as dividing subject units into treated and untreated groups in order that experimental effects can be isolated. But of course the environment is a largely uncontrollable world (in place of the laboratory), so that the other important factors and disturbances are dealt which by design features such as randomization in treatment levels, or in treatment/nontreatment assignment, which seek to mitigate or wash out the effect of those other unknown but interacting factors at the level of the individual unit, be it person, field plot, or firm. The roots of these design ideas lie in the development of medical treatment regimes and in a longer tradition of agricultural experimentation brought together by R. A. Fisher who developed the statistical framework for designing and validating these practical field experiments.

Other kinds of experiments also occur outside the laboratory, in a variety of research sites, in different forms, and in which different elements of the latter's ideal-type recipe for experiments hold. An analysis of this variety suggests that two modes of experimentation—relevant both for the natural and the social world—can be construed within this broader category. In the account that follows, these will be labeled "Nature's (or Society's) experiments" and "natural experiments," although it is important to add that most social scientists make no such distinction and that most of their practical work falls into my second class—one that both they and I label "natural experiments."

"Nature's experiments" may be defined as natural situations holding the characteristics of experiments. However, as Rob Kohler (2002) rightly points out, this definition is ambiguous in two ways. First of all, nature is in a constant state of flux and experimentation, so why are some events singled out as Nature's experiments? Second, it is the scientist who, by practical experience, chooses certain places, situations, or events in the field, and conceives of these as offering Nature's experiments. Both points are equally valid for the social world. The social world is also in a constant state of flux that we can conceive of as continuous experimentation. And while the social scientist may pick out some of these as Society's experiments (in parallel to Nature's experiments), a more commonplace form of experiment also exists in the social realm, namely, new social policies in education, prison reform, and so forth—which Campbell (1967/1988, 253) usefully labeled "administrative experiments." In natural worlds, there are reasons

to avoid placing the agency of the experimenter onto Nature, but in the social realm, the idea for some experiments may well go back to some social scientific research suggesting, and even designing, the delivery of those administrative experiments. Nevertheless, one can, for both natural and social worlds, pick out candidate cases where one would hardly seek to attribute agency to the scientist but rather to Nature or Society. The important point is that these events occur as if by experimental intervention (whether by random accident, natural/social causes, or known human intervention) within an open environment.

But further definitional work is required, and as suggested by Table 1 (top left), I take the term to imply that those events we single out as Nature's (or Society's) experiments must not only have an intervention that stems from (is created or caused by) Nature or Society but also where controls—or valid substitutes for control—over the experimental environment are also instantiated in Society/Nature. It is the source of both intervention and control that distinguish Nature's experiment from the field experiment. But it is only the source of control that distinguishes Nature's experiment from the natural experiment, for the latter is also an experiment from the agency of Nature or Society but without their "control" systems in play. Those controls are not naturally present but have to be added retrospectively by the scientist to establish the natural experimental site.[1] I shall return to fill out this process of establishing a natural experiment later.

3. Society's and Nature's Experiments

3.1. The Characteristics of Such Experiments

Understanding why an event can be treated as one of Nature's or Society's experiments lies in analyzing it and seeing how controls are instantiated. Examples of Nature's and Society's experiments suggest four different subkinds, each of which offers a different way in which the *ceteris paribus* controls of the laboratory can be understood as present.

[1]Woodward (2003, 94) concurs with some of this in arguing that "'natural experiments' typically involves the occurrence of processes in nature that have the characteristics of an intervention." But I diverge from him when he suggests that they "do not involve human action or at least are not brought about by deliberate human design" (Woodward 2003, 94). This does not work as a definition for the social science domains, where human action but not scientific action is often involved in the experimental intervention. More seriously, it does not recognize the importance of scientists in the post hoc process of refitting such events into an experimental framework as suggested in my account of "natural experiments."

I. Massive interventions that make issues of control and isolation from disturbing causes irrelevant.

There are events or processes of sufficiently massive scale and spontaneity creating very substantial effects that swamp any and all other effects or disturbances from other causes and from instability in the environment. Many such examples cross the natural/social divide. One is found in the "green rubble" effect: the extraordinary speed with which urban bomb sites turned green after World War II as investigated by ecologists. Another is provided by the Black Death of 1348–1350, an epidemiological event of huge population loss understood to have hastened the end of serfdom in England via various social and economic processes as investigated by social science historians. Cases which are more obviously ones of Society's experiments are offered by the French Revolution, the forced transition into socialism by the Soviet Union, or the latter equally sudden transition back to capitalism.

II. Situations of total isolation, where natural or social processes go on in an uncontrolled way within their local (isolated) environment.

Social or natural isolation of the experimental site from the rest of society/nature works as an alternative to control within it. The most obvious examples come from the natural world, epitomized in Darwin's study of island life-forms. A direct comparison between Nature's experiments in such isolated but open natural environments with the enclosed isolation of laboratory experiments is discussed by John Beatty. He compares scientists who study post hoc the evolution of lizards on isolated islands (which falls into my category of Nature's experiments, although he refers to as a "macroevolutionary 'natural experiment'") compared with "a laboratory-controlled, microevolutionary experiment" (Beatty 2006, 336) upon created populations of *E. coli* in the lab. Social scientists can point to a number of well-known, isolated communities that foster the appearance of particular behaviors and phenomena. For example, where an isolated society is formed without access to conventional money as in WWII prisoner of war camps, cigarettes became the currency of exchange; in the context of a seventeenth-century French Canadian garrison town, playing cards were the answer, a Society's experiment sometimes credited with the invention of paper money.

III. Events that stand out in some way as unusual and yet take place in very stable situations.

Many, perhaps most, events in the natural and social world occur with lots of other events happening around them, but some individual events happen in short time periods in specific places where it is reasonable to suppose that the environmental features are very stable, and the other causal factors (that might normally vary over space or time) are also rather stable. For example, Orson Welles's radio broadcast of H. G. Wells' *War of the Worlds* that caused such panic in America in 1938 happened in such a short period that there was no reason to assume the environment and other factors that influenced people's response to this were not stable. This self-contained event was effectively treated as one of Society's experiments: it prompted a sociological (interview-based) investigation into how people responded and why certain people panicked (see Cantril, Gaudet, and Herzog 1940).

IV. Situations where the environment is controlled and within which Society's or Nature's experimental interventions are also carefully controlled.

Some situations present themselves as if an experimenter has designed a laboratory experiment within the world. One such case could be "Genie," not a wild child (grown up in the natural world), but a child kept prisoner and controlled for many years indoors and lacking language and abilities for social relations compared with normal children (see Curtiss 1977). In another, following the tradition of Bentham's panopticon, Erving Goffman writes of mental asylums as "total institutions," places where "each is a natural experiment [in my terms a Society's experiment] on what can be done to the self" as all privacy is denied its inmates (see Rieman 1976, 40). The level of both internal and environmental control suggests that the definitional boundary line between a Nature's or Society's and a laboratory experiment has become very thin, for these institutions are in many ways like laboratories. But it is important (as I argue later in further discussion of Genie's case) that laboratories rarely host such very complex ecological or social behavioral systems. While something like a laboratory maybe created within Nature or Society (e.g., the biospheres that are designed to create small versions of particular whole ecologies), it is not so easy to put Nature or Society into a laboratory.

A useful way of clarifying the distinctions between these four subkinds is to understand how they instantiate different forms of experimental control. Such controls are often referred to generically as the *ceteris paribus* condition, a catchall promissory note that is used to support scientific experimental results. But, as Marcel Boumans (1999) has pointed out, this actually consists of three kinds of conditions. One condition is *ceteris neglectis*: that all the other causes

are so small that they can be neglected—this is the version of the clause holding in the swamping events of Category (I) above. The second condition is *ceteris absentibus*: that all other interfering causes are absent—this is the version holding for the social or natural "islands" of Category (II) above. The third condition is *ceteris paribus*: that all other things are held at the same level, or constant, the same as in Category (III) above. Category (IV) events occur in a laboratory-like environment created inside the natural or social world and in which the intervention is also controlled - but not by the scientist's agency. Here, all three kinds of *ceteris paribus* conditions are assumed to hold.

All four of these versions of Nature's (or Society's) experiment involve events or situations or phenomena thrown up in Nature/Society rather than caused by an intervention by a scientist according to some rules of scientific method. Of course, in matters of *ceteris paribus* controls, most of the sites that might offer Nature's or Society's experiments for study do not fulfill these ideal requirements. But that most fall short is equally true of other kinds of experiments—those in the laboratory or field also fall short of their ideals in practical ways to a greater or lesser degree. Being less than perfect in any of these kinds of experiments may create problems for making valid inferences about them but does not seriously eat into the validity of the category outlined here of Society's or Nature's experiments. The most common form of Nature's experiments is probably those of Class III, the presence of an intervention with unambiguous effect, with a high level of stability in the environment and in other influencing factors. These cases might have been designed as experiments—but they were not. They just happened in such a way that they can be studied by scientists after the event as if they were designed experiments in the field—no retrofitting of the events nor of the environment is required. I explore one of these events to show how a social scientist makes use of such a Society's experiment.

3.2. Society's Experiments: The Example of Merton's Investigation of Mass Propaganda

An example of a Society's experiment studied by sociologists is given by a mass propaganda event in WWII, which had a sufficiently unexpected outcome that it prompted Robert Merton and a team of researchers (from the Bureau of Applied Social Research) to study it, and he later referred to it as a "strategic research site." The event itself was a radio-marathon to sell war bonds to the U.S. public in 1943. Previous war-bond drives by the radio star Kate Smith had raised $1millon and $2million, respectively, whereas this one raised $39million—a spectacular success. This clear case of mass

persuasion prompted Merton's immediate investigation and within a few days, his team was interviewing members of the public to investigate the "emotional freight"—the feelings—which had prompted individuals' responses to the stimulus of the drive before they faded from mind.

In their book length account, Merton, Fiske, and Curtis (1946, 3–10) effectively justified their study as an investigation into—in my terms—one of Society's experiments when he listed six virtues of the research site that made it far superior in both intervention and environment compared with the problematic alternatives available in an equivalent laboratory experiment:

> 1) it was a "'real life' situation rather than a synthetically arranged event" (such sites were rare and preferred to the laboratory where bias was expected in subjects' responses because of the environment);
> 2) the bond purchase provided "a crude index of effective persuasion" (the event overcame the usual problem, namely how to assess or measure when propaganda had altered people's opinions)
> 3) the situation was "emotionally freighted" (whereas in the laboratory, generating the emotions that went along with mass propaganda was difficult for emotions typically remain thin);
> 4) the objective stimulus pattern: what happened in the broadcasts - could be known via a content analysis of the transcripts, unfortunately not recordings (whereas most retrospective field studies could not recreate the stimulus in any objective way)
> 5) the subject informants were drawn from a wide pool of the public (rather than being a "hapless group of students"!)
> 6) the response to the broadcast "occurred within a well-defined [socio]cultural context" which gave materials for wider interpretation (in other words, the socio-cultural environment was known and understood). He might also have mentioned in this context, but did not, that the 18hour stretch of time it took for the bond-drive meant that this context was very stable.

This Society's experiment was a stimulus–response event: society created an intervention in the form of an obvious *stimulus* (the two-minute radio-slots every fifteen minutes), and there was an obvious measuring rod of the response in the amount of bonds purchased—the effectiveness of the stimulus could be measured by the level of *response* to the bond drive. These were the "objective" elements in the experiment. Merton, Fiske, and Curtis merely took advantage, piggybacking onto Society's experiment to investigate exactly when, how, and why people responded as they did—that is, the "subjective" part of the response to this Society's experiment. These investigations included

a "content analysis" of the radio scripts; in-depth "focused" interviews of exactly how, when, and why individuals reacted to these "contents"; and "polling" interviews to provide a statistical picture against which the smaller numbers of focused interviews could be compared. For these purposes, Society's experiment was set up in a sufficiently stable subject pool and environment that controls on other factors were not taken to be an important issue.

Merton, Fiske, and Curtis (1946) described the opportunity provided by the bond drive as giving him the chance for close study of a case of mass persuasion. Perhaps the best way to describe Merton's investigations is that he, as scientist, dug into the gardens of this Society's experiment to understand how the whole process worked, not just one hypothesis about one bit, and not just as an interested scientist, but as a person who worried about how to avoid being persuaded "in spite of ourselves."

4. Natural Experiments in the Social World

4.1. The Characteristics of "Natural Experiments" in the Social Science Domains

Unlike the generic forms of Nature or Society's experiment, there is no evident environmental stability for most events that happen in the natural or social worlds. To make such uncontrolled natural or social events tractable for study, the scientists must somehow reconstruct these missing *ceteris paribus* controls to turn a natural or social event into an experimental site for their study. In other words, the scientists must find means to shield out interfering causes, to drive away small disturbances, or to find equivalent stable cases for comparison, all designed to turn the intervention by Nature/Society into a site for study that can produce natural experimental results. Social scientists reconstruct the normal events of life into natural experiments by post hoc "reverse designing" the natural/social situation in its environment into an experimental one. "Reverse designing" is used here to imply that actual controlled experimental interventions might have been designed a priori along these lines by the relevant scientific communities (assuming no ethical constraints). It is these reconstructed events that I, and the social science community, labels "natural experiments."[2]

[2]A more accurate label would be "social scientized experiments," which avoids both overlap with Campbell's "administrative experiments," and the connotations of "social experiments."

It is important here to emphasize the difference between scientists reconstructing those events that happen in the uncontrolled natural or social world into natural experiments—and actual experimental interventions made by scientists in the social or natural field (i.e., the difference between the top and bottom elements in the middle of Table 1). Field experiments in the natural world are a well-accepted category, and are becoming increasingly common in the social sciences. Social scientists were largely responsible for the innovative New Jersey Negative Income Tax Experiment 1968–1972 in which a specially stratified sample of workers went onto an alternative income tax regime in which low-paid workers received automatic payments from the state as an income supplement akin to the tax payments made by higher income workers. The experiment was designed along the lines of a regular field trial with a carefully selected sample of the population taking part to make sure that the resulting statistics could be analyzed. Similar attention to the design of intervention and control by scientists and administrators can be found in the more recent poverty reduction field experiments conducted by the World Bank, given a philosophical analysis by Cartwright (2012). Such field experiments do not fall into the category of "natural experiments" as I have defined them, rather, they are experiments in the natural or social field in which scientists make their own planned interventions and institute their own forms of control within the natural or social world (rather than in the laboratory). Such designs (as discussed in Section 2) typically include processes of determining a control group versus a treatment group, allocating units to these groups by randomization, controlling the treatment or intervention, and so forth, to make the experiment reveal the effect of the treatment and produce data valid for statistical interpretation. These standard elements of field experiments are now widely evident in developing social policy programs.

I now need to clarify how scientists take the events that happen in Nature and Society—but that have no evident controls—and reconfigure the terrain such as to construe those events as natural scientific experiments. The terminology of reverse design becomes immediately apt here for the recipes used are closely modeled on the ones used in the design of field experiments in the social sciences (as indicated above). Yet, it appears that different social scientific communities have privileged different elements of that recipe, and I focus on three main principles: randomization, control versus treatment site/group, and statistical analysis as substitutes for controls.

The principle of randomization, or "as if randomization", is taken to be the defining feature of a data set that, if present, allows political scientists to treat and exploit that data as having come from a natural experiment, according to Thad Dunning (2008). Like others, he explicitly relies on the famous work of public health medic, John Snow, who inferred the cause of cholera in

mid-nineteenth-century London. His case involved two water companies, one with cleaner water and lower disease rates compared with the one supplying dirtier water. The inference depended on the fact that both companies were delivering water as if randomly to households distributed across the houses and streets. Dunning uses this as the paradigmatic example for political scientists to explain how as if randomization works. Thus, units experiencing different administrations, for example, across jurisdictional or political borders of areas with otherwise similar people, enable the political scientists to construct their analyses as if the data had come from a predesigned randomized experiment. He cites studies on election fraud, on voter turnout, on congressional responsiveness to constituencies, and so forth, in which as if randomization is present as examples of the success of this natural experimental approach in political science.

The principle of finding comparable sites/groups to act as "control" sites or groups is an example of an old, well-understood research design—the matched pair. There is nothing fundamentally new here, except to point out that it is only in locating or choosing a second site to act as "the control" or comparator site that the first one becomes usable in assessing the outcomes of a natural experiment. Suppose one site shows signs of a causal intervention, but there is no means of judging the effect of the intervention because no background or normal level had been established before the intervention, that is, there is no before–after comparison possible. Here the scientist searches out an equivalent but unrelated situation (or place or group), which is otherwise similar enough except in that one particular causal factor to make a comparison with the first site. Thus, for example, in a sociological/management study, the innovation records of the instrument maker Zeiss in the old East and old West Germany were taken as comparable cases for a natural experiment to access the institutional effects of market versus socialist systems on firm innovation, and thence to provide an insight into the transition shock experienced only by the Eastern firm as socialism gave way to capitalism (Kogut and Zander 2000).

This principle of finding relevant comparison groups—that have experienced treatment, or not, or have been variously treated—is taken as the critical ingredient by Diamond and Robinson (2010) for social science history, whether qualitative or quantitative in approach. They use the language of natural experiment both to draw out this criterion as the important element giving validity to comparative history and to formalize these comparisons into differences in initial conditions and differences in perturbations in the natural experiment. Treating such comparative history materials as if they come from a natural experiment allows them, they claim, to assess, for example: the effects of different kinds of land tenure in India under different forms of British colonial rule,

the relationships between different levels of deforestation and socioeconomic characteristics across a range of Pacific islands, the different long-term effects from the introduction of the Napoleonic code across Europe, and so forth.

Principles of statistical control and isolation of effects provide the recipe preferred in economics, where there is a long tradition of applied statistical work in which the data are regarded as "passive observations" from "the stream of experiments that Nature is steadily turning out from her own enormous laboratory, and which we merely watch as passive observers" (Haavelmo 1944, 14). Statisticians have generated a host of general statistical techniques on such "passive" data to (1) hold other causal variables present at their average measured values so their impact can be parsed out, (2) take out small residual errors, and (3) rule out other variables that might—a priori—have had influence. In other words, these statistical techniques instantiate the three kinds of *ceteris paribus* conditions as analyzed by Boumans (2005; see above). The importance of such statistical approaches is often critical in reconstructing events into so-called natural experiments. But economists have also developed their own particular "instrumental variable" method, which may offer an as if randomization, to help them achieve these aims (see Reiss 2008).

This statistical treatment approach is neatly captured in the claim by Ozonoff and Boden (1987, 71) that "epidemiology can be viewed as the science of observing natural experiments," where this notion of observing means analyzing the data from such events/situations to observe the outcomes of "natural experiments" that lie hidden in the data. The example that constitutes their case is the problem of sorting out the effects of a particular form of toxic waste on long-term health states in an area—a more complicated version of John Snow's classic case. Once again, it should be clear that the agency of intervention is Nature or Society, not the scientist, but the scientist retrospectively uses statistical techniques that substitute for the laboratory's *ceteris paribus* conditions or field randomization to validate the measurement of experimental effects.

4.2. Natural Experiments in the Social Domain: The Example of Card and Krueger's Investigation of Minimum Wage Effects

It was an investigation of the effects of increasing the minimum wage in New Jersey, USA, in 1992 that made the term *natural experiment* fashionable in economics. Card and Krueger (1994, 1995) used a combination of all three of the above elements in their study: choosing two other site groups as their "controls," using random choice processes to pick out the units for observation, and using statistical techniques to pre- and retro-construct the

administrative change into a natural experiment—a label they used explicitly. This was not a field experiment, but it was unusual that they were at work ahead of the administrative change so were able to design their investigations so as to make some of the observations before the change as well as after the change.

In constructing and justifying their account of their observed event, they took, as their ideal kind of experiment not the controlled experimental design of the laboratory but the experimental design of medicine, with its control and treatment groups, and its random assignment of patients into those groups. Unlike those medical designs, the intervention was not under their control—it was an administrative (political and economic) intervention. Nor was their randomization a randomization of treatments. They realized, of course, that they could not randomly assign some states or towns, or individual firms into control and treatment groups, for as they point out, "An idealized experiment would have to involve random assignment of entire (isolated) labor markets" (Card and Krueger 1994, 22; a remark that takes us back to the sense of Society's experiments). Nor could they randomly choose the individual firms for treatment because the law applied to all establishments, so they chose random samples from both the treated and the untreated (control) groups, for survey, data collection, and analysis.

First, they had to locate those controlled sites for comparison by finding a similar group that did not experience the change in policy. Card and Krueger (1995) presented the choice of this control group as the critical issue that would make their case study into a "natural experiment" (in their book discussion). For their analysis of the effects of raising the minimum wage, they chose fast food takeaways in New Jersey as their treatment group (i.e., a random sample of firms in which the intervention happened). They chose an equivalent sample from a set of outlets in Pennsylvania as one control group experiencing no increase in minimum wage, and another sample from a group of outlets paying more than the new minimum wage in New Jersey as a second control group. For both control groups, increasing the minimum wage in New Jersey should make no difference. All establishments in the treatment and control groups were surveyed to collect a variety of economic information, both before and after the treatment, that is, the increase in the minimum wage. These data were subject to some rigorous statistical analysis using standard statistical control techniques (comparing the outcomes in the treatment group with those from the two control groups), to test the thesis that a rise in the minimum wage would reduce employment in those affected jobs, a thesis that was overturned by the results of the analysis. This surprising (counter-to-theory) result was instrumental in placing the label of natural experiment on the map for economists. The point here is not whether their

analysis of the material was valid, rather it is to show how the recipe to construct an administrative act into a natural experiment is done within a social science community.

5. Society's Experiments and Natural Experiments

This article began with a comparison between laboratory experiments and Society's or Nature's experiments, now I want to explore the contrast of the latter with natural experiments. One of the virtues of Society's experiments is that they offer the materials for the social scientist to study the relational elements of social life within their natural environment rather than detach individual relations for investigation as in natural experiments. Faced with a complex natural or social world, the traditional notion of experiment proceeds by focusing on one aspect or relation and "deletes" or otherwise controls the rest. This is obvious in the way that laboratory science works. But this "isolation" approach also sits at the base of natural experiments in the way that they have been discussed above where controls on and deletions of interferences from related events are imposed by the scientist post hoc rather than by Nature as part of the event itself. It is the presence of these complex relational issues that prompted Susan Leigh Star (1995, 505) to complain of the way scientists portrayed the shut-away child Genie as providing a natural experiment to investigate the absence of language: "Was she really a 'natural experiment' or was the experiment fatally flawed?" Leigh Star argued that describing the situation as one of a single deletion—the absence of language—could not be a valid way to interpret Genie's situation and to study her. She goes on to wonder about a science that considers human relations in terms of having or not having certain elements: "You do not have, at time 1, (Genie+society), and then at time 2, (Genie-society) = (natural experiment in society deprivation)" (Leigh Star 1995, 505).

My account suggests that the event should have been labeled a Nature's or Society's experiment for the child was shut away from Society (the intervention), and the conditions were controlled. The problem comes because scientists interpreted that event as a narrow experiment in language deficiency, and so reconstructed the events of that Society's experiment as a much more limited natural experiment.

In contrast, as Leigh Star (1995, 505) points out, "Culture and society, no more than gender or race, are not independent variables that can be manipulated. Genie lived in a relational web that is barely imaginable to me." Of course merely to label this one of Society's experiments does not immediately open that relational web for investigation. Society's experiments provide rich sites for scientists to research, as Merton found in his investigations of the processes of

mass persuasion. Merton's site allowed him access to a concentrated moment of mass persuasion from which his research revealed a complex of personal, social, and cultural responses. But this does not imply that all Society's experiments will be so easily accessible, just as Genie's case suggests they will not be flexible for reconstruction as a kind of natural experiment, for any social scientist who wants to focus on any particular topics or to answer particular questions. Such sites are not necessarily manipulable in post-experimental analysis in such a way as to isolate the effect of any one element in the web. To attempt to do so might well render these Society's experiments nonvalid as natural experiments, as Leigh Star in effect argues. Perhaps the best test of whether a Society's experiment could be turned into a natural experiment lies in whether a field or laboratory experimental design could be conceived to measure and test the independent effect of any single element under investigation.

This point about the inadmissibility of breaking complex relations into a set of independent relations in making assumptions about the social realm is a general one that can be easily reinforced by the comparison with ecology research in the natural realm. The introduction of myxomatosis into Australia (or indeed, mammals into New Zealand earlier) is a well-recorded example of Nature's (or perhaps Society's) experiments. Arguable the former stemmed from scientific intervention, but now so long ago that the origin seems irrelevant, for the ups and downs of the disease and its targets have waxed and waned as the process of evolution of the host and infection go along together. Studying these events as if they can be separated from their web of ecological relations is problematic. Such complaints surface particularly in contrasts between field ecologists and laboratory experimentalists or those who conduct experiments in "bottles": "a molecular biologist who isolates ribosomes is working on ribosomes; an ecologist who isolates organisms in a bottle may not be working on communities or ecosystems in any relevant sense" (Carpenter 1996, quoted in Oldenbaugh 2006, 726). It is surely because it is so difficult to get society into a bottle that Nature's/Society's experiments can prove fruitful research sites, but that same difficulty emphasizes why the reconstruction of complex social events into natural experiments may prove a problematic or even counterproductive way of treating a research site. It is this difficulty that supports my earlier cut between the two categories: Nature's or Society's experiments and natural experiments.

Acknowledgment

The author thanks Marcel Boumans, Julian Reiss, Francesco Guala, and participants at the European Network for the Philosophy of Social Sciences Conference, Copenhagen, September 2012, and three referees of this journal, for their comments. Also, she thanks the British Academy and Wolfson Foundation for funding her Research Professorship on "Re-Thinking Case Studies Across the Social Sciences".

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This research was funded by the Wolfson Foundation via the British Academy.

References

Beatty, John. 2006. "Replaying Life's Tapes." *Journal of Philosophy* 103 (7): 336–62.

Boumans, Marcel. 1999. "Representation and Stability in Testing and Measuring Rational Expectations." *Journal of Economic Methodology* 6:381–401.

Boumans, Marcel. 2005. *How Economists Model the World into Numbers*. London: Routledge.

Campbell, Donald T. 1967/1988. "Administrative Experimentation, Institutional Records, and Nonreactive Measures." In *Methodology and Epistemology for Social Science: Selected Papers of Donald T. Campbell*, edited by E. E. Samuel Overman, 243–60. Chicago: University of Chicago Press.

Cantril, Hadley with Hazel Gaudet, and Herta Herzog. 1940. *The Invasion from Mars*. Princeton: Princeton University Press.

Card, David, and Alan B. Krueger. 1994. "Minimum Wages and Employment: A Case Study of the Fast-Food Industry in New Jersey and Pennsylvania." *American Economic Review* 84 (4): 772–93.

Card, David, and Alan B. Krueger. 1995. *Myth and Measurement: The New Economics of the Minimum Wage*. Princeton: Princeton University Press.

Cartwright, Nancy D. 2012. "Will This Policy Work for You? Predicting Effectiveness Better: How Philosophy Helps." *Philosophy of Science* 79 (5): 973–89.

Curtiss, Susan. 1977. *Genie: A Psycholinguistic Study of a Modern-Day "Wild Child."* New York: Academic Press.

Diamond, Jared, and James A. Robinson, eds. 2010. *Natural Experiments of History*. Cambridge, MA: Belknap Press.

Dunning, Thad. 2008. "Improving Causal Inference: Strengths and Limitations of Natural Experiments." *Political Research Quarterly* 61 (2): 282–93.

Haavelmo, Trygve. 1944. "The Probability Approach in Economics." *Econometrica* 12 (Supplement): 14.

Kogut, Bruce, and Udo Zander. 2000. "Did Socialism Fail to Innovate: A Natural Experiment of the Two Zeiss Companies." *American Sociological Review* 65: 169–90.

Kohler, Robert E. 2002. *Landscapes and Labscapes*. Chicago: University of Chicago Press.

Leigh Star, Susan. 1995. "Epilogue: Work and Practice in Social Studies of Science, Medicine, and Technology." *Science, Technology, & Human Values* 20 (4): 501–507.

Merton, Robert K., with Marjorie Fiske and Alberta Curtis. 1946. *Mass Persuasion: The Social Psychology of a War Bond Drive*. New York: Harper.

Oldenbaugh, Jay. 2006. "Message in the Bottle: The Constraints of Experimentation on Model Building." *Philosophy of Science* 73 (5): 720–29.

Ozonoff, David, and Leslie I. Boden. 1987. "Truth and Consequences: Health Agency Responses to Environmental Health Problems." *Science, Technology, & Human Values* 12 (3/4): 70–77.

Reiss, Julian. 2008. *Error in Economics*. London: Routledge.

Rieman, Jeffrey H. 1976. "Privacy, Intimacy, and Personhood." *Philosophy and Public Affairs* 6 (1): 26–44.

Woodward, Jim. 2003. "Experimentation, Causal Inference, and Instrumental Realism." In *The Philosophy of Scientific Experimentation*, edited by Hans Radder, 87–118. Pittsburgh: University of Pittsburgh Press.

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