Evaluating Heterodox Theories*

EVAN FALES, *University of Iowa*
BARRY MARKOVSKY, *University of Iowa*

Abstract

Active and heterogeneous disciplines constantly spawn new theories and theoretical variants. By definition, each such offering is heterodox to the degree that its veracity would diminish accepted theories. Most often heterodox theories are dismissed out of hand for nonrational reasons, such that they just seem too bizarre. Most of the time, too, rational analysis supports such rejection. Of course, many important theories in science once seemed bizarre but later were accepted as evidence accumulated for them and against received views. But the lag between a premature rejection and ultimate acceptance is an inefficiency built into the theory evaluation process. Is there a way to reduce this inefficiency? Through examining a heterodox sociological exemplar, we discuss the standards to which such theories should be held in order to deserve (1) hearings in their relevant disciplines, (2) serious attention, and (3) assignment of a high likelihood of being true.

In every scientific discipline there arise from time to time challenges to mainstream thinking that appeal to heterodox theoretical frameworks or observational claims, or both. How should such challenges be treated? On the one hand, novelty is the lever of progress, opening to view new possibilities. On the other hand, no discipline can afford to devote serious attention to every unorthodox notion that comes over the horizon. This problem is an especially sensitive one for sociology, given the

* *The authors contributed equally to this project. We are grateful to Scott Eliason, Jeffrey Erger, Donald Krieger, Michael Lovaglia, and Philip Schrodt for their insights and comments on an earlier draft. A much more comprehensive treatment of the issues and analyses in this article is available from the authors upon request.* *Direct correspondence to Evan Fales, Department of Philosophy, or Barry Markovsky, Department of Sociology, University of Iowa, Iowa City, IA, 52242. E-mail evan-fales@uiowa.edu or barry-markovsky@uiowa.edu.*

complexity and multilevel nature of the phenomena we study and our correspondingly rudimentary understanding of them.

It is not our purpose to say how scientific disciplines in fact produce or receive heterodox theories. Instead, we address *normative* issues: (1) the standards to which a heterodox theory should be held in order to merit a hearing; (2) the criteria it must satisfy to merit serious attention within a discipline; and (3) methods for determining its likelihood of being true. We provide general criteria for theory evaluation, then discuss special problems of, and guidelines for, the heterodox. Our thesis is illustrated by an analysis of a published report claiming that people practicing Transcendental Meditation at one geographic location have immediate beneficial effects on social indicators *at distant locations.*

Evaluating Theories

Scientific theories (henceforward "theories") consist of structured sets of claims, subject to evaluation via objective criteria (Cohen 1989; Markovsky 1994, 1996). These criteria bear upon a theory's internal structure, its standing vis-à-vis prior theories, and its relationship to the empirical world.

THEORY STRUCTURE

Theoretical arguments consist of statements that consist of terms. Because scientific theories offer unique, nonintuitive ways of understanding the world, they frequently employ terms with unfamiliar meanings. To be communicable, however, all terms must be understood in the same way by members of the intended audience. This requires a hierarchical conceptual system. At its base are undefined or *primitive* terms whose meanings are shared by the theorist and audience. Primitive terms are crafted into combinations that comprise definitions or indicate correct usage for *defined terms.* In turn, higher-order concepts are conveyed by definitions that include primitives and/or terms previously defined. A parsimonious conceptual system imparts clear meanings to just those terms needed to express the theory's statements.

A theory may be unimpeachable formally, but if meanings of terms are unclear, deriving and interpreting predictions becomes a haphazard affair. A theory purporting to have scientific credentials must be articulated with sufficient precision and specificity that the contents of its claims can be linked to empirical referents and procedures for testing. That is, it must present a sufficiently precise picture of the constituents and causal processes of some natural domain that one can construct procedures for detecting and measuring the properties of those constituents. Those procedures also will employ causal knowledge concerning the ways that measuring devices or empirical phenomena should be influenced by the mechanisms under investigation.

Vagueness about a theory's empirical referents or how they interact with previously understood parts of our world will undermine any attempt to claim that certain phenomena provide evidence for (or against) that theory. For to say that some observed phenomenon measures, or is sensitive to, the presence of some underlying mechanism presupposes some idea of how that mechanism behaves — and specifically, how it can be expected to behave in the conditions under which the observation was made.

Even if all its terms are well defined, a theory still can be toppled by a single logical flaw. If one claims empirical confirmation for a hypothesis derived from a theory, but logical analysis finds that the statement is the product of an *invalid* argument, then no longer can the theory justify the prediction, connect to the hypothesis, or benefit from the test results.

Confirmation Issues

There is no fully agreed-upon metric for theory confirmation. However, a Bayesian framework captures several universal scientific values: For given levels of empirical evidence and prior knowledge, a theory's confirmation is greater to the extent that (1) it is compelling in view of prior knowledge; (2) the datum whose evidential value is to be assessed is made probable by theory and prior knowledge; and (3) the datum is not probable relative to alternative hypotheses and prior knowledge.[1] Even without precise measures of these components, Bayes' Theorem permits ceteris paribus assessments of relative confirmation across theories. So with all else approximately equal between theories A and B, if A explains the evidence better than B, then A has the higher confirmation status of the two. Furthermore, when all three criteria favor B over A, no ceteris paribus provision is needed: B will always have the higher confirmation status.

Special Considerations for the Heterodox

Even if analysis reveals terminological ambiguities or questionable logic, publication still may be warranted if a theory is the best in its class. However, journals have limited space and cannot print every such effort, so the decision process becomes more complicated. Should an exciting, new, but untested theory have priority over a relatively workaday confirmation of a well-established formulation? What of the heterodox theory that comes bolstered by evidence, but flies in the face of established knowledge?

There are good reasons to publish heterodox work. First, it is difficult to justify rejecting a submission on grounds that it is heterodox when otherwise it satisfies normal standards. Second, heterodox views, if put forward with some competence, deserve a hearing if only because sometimes one of them turns out to be right and

makes a major advance. This mandates a policy of relative tolerance in publication decisions. The low prior probability of a theory should not contribute, at least in a *direct* way, to its being denied a hearing.

On the other hand, there are good reasons to subject heterodox viewpoints to higher than normal standards: A corollary of Bayes' Theorem suggests that data providing significant and exclusive support for a very improbable theory deserve especially cautious and careful scrutiny.[2] Whatever evidence we have for the improbability of a heterodox theory is, *a fortiori,* evidence for the illegitimacy of data purportedly favoring that theory. The case against the heterodox is strongest when a competing hypothesis can be established.

Is it right, however, that orthodoxy must supply a detailed rebuttal of all the data in order to deflect every heterodox challenge? It depends. For instance, if "all the data" are ten similarly flawed experiments, then refuting one of them refutes the other nine. Or if the claimant asserts that one study supplies especially critical support, then the identification of flaws in that study provides an equally critical falsification. In fact, it is sufficient that a well-entrenched position offer *plausible* alternative explanations for the challenging data. The burden of refuting those explanations lies with the proponents of the heterodox challenge.[3]

The Theory Behind the "Maharishi Effect"

To illustrate our thesis, we examine a study that was organized by researchers affiliated with the Transcendental Meditation (TM) movement founded by Maharishi Mahesh Yogi. Orme-Johnson et al. (1988) purportedly confirmed a theory asserting that variations in the number of TM-Sidhis — advanced TM practitioners — in a given location cause measurable variations in social phenomena elsewhere through the operation of a "unified field." The research was conducted in East Jerusalem and employed social indicators from Jerusalem, Israel, and Lebanon. Meditators' participation was voluntary and self-selected, their numbers varying from 65-241 between Aug. 1 and Sept. 30, 1983. The investigators predicted and found that meditation group size correlated negatively with crime rates, automobile accidents, and fires in Jerusalem; positively with stock market prices and a national mood indicator in Israel; and negatively with war intensity and war fatalities in Lebanon.

Researchers, spokespersons, and politicians affiliated with the Transcendental Meditation movement claim that this so-called "Maharishi Effect" is now scientifically proven through rigorous empirical research, replicated numerous times, and reported in peer-reviewed journals. Newspaper accounts, promotional materials, subsequent research reports, and our own communications with Transcendental Meditation researchers, representatives, followers and defectors all indicate that, perhaps more than any other, the article we shall discuss provides a special source of pride, vindication, and scientific legitimation for all affiliated with

the movement. In the subsection to follow we examine the coherence of the theory behind the Mararishi Effect and its standing vis-à-vis prior theories. Following that we address research-related issues, noting methodological loopholes and alternative explanations.

The Theory

Orme-Johnson et al. devoted considerable space to the Maharishi Effect theory. Its central ideas come from Maharishi's theory of consciousness, developed further by physicist John Hagelin (1987, 1989).[4] The following are their core argument and key terms, with numbers added for subsequent reference.

> (1) Collective consciousness is the wholeness of consciousness of the group, that is more than the sum of the consciousnesses of all individuals composing that group. (778)
>
> (2) [The theory] posits a unified field of "pure consciousness" as the basis of the diverse activities of all individual minds. All processes of thought and perception are viewed as fluctuations or qualified expressions of this underlying, unqualified, least-excited state of consciousness. Maharishi likens the individual mind transcending its more active levels and experiencing its basis in pure consciousness to a localized wave settling to become the silent, unbounded surface of the ocean. Such experiences are said to create nonlocal, fieldlike effects of order and coherence in the environment. (778-79)
>
> (3) Nonlocal effects could be mediated through the agency of the unified quantum field due to the intrinsically nonlocal structure of space-time at this scale. (784)
>
> (4) A potential explanation for the apparent propagation of such coherent effects may lie, however, at the ultimate scale of superunification, the Planck scale of 10^{-33} cm and 10^{-44} sec, where the fundamental forces and matter fields are said to become fully unified. (784)
>
> (5) The localized conscious awareness of the individual becomes experientially connected back to pure consciousness, the unified source of order and intelligence at its base, thus increasing coherence, reducing stress, and accelerating development in the larger society. (784)

Transcendental Meditation thus is assumed to permit the individual to experience his/her minds' "basis in pure consciousness," which is embedded in the "unified quantum field" at extremely small scales (4).[5] Individual and environment are linked by this field (3), and so the consciousnesses of meditators cause "nonlocal effects" (2) or actions-at-a-distance. Meditators acting in concert create, it is claimed, a greater wave of coherence in the unified quantum field than could be achieved by meditators acting separately. The Maharashi Effect influences anyone in the field's reach (5), creating *in them* TM-like coherence. The affected

population is ME = $aN_1 + bN_2^2$ where N_1 is the number of meditators in the population, N_2 is the TM-Sidhi group size, a and b are approximately 100, and $N_2 > 100$.

Theory Analysis

The theory receives low marks for meaningfulness. Key terms are undefined or only roughly characterized using other complex, undefined terms or metaphors. "Planck scale" and "unified quantum field" are defined in physics, but the meanings of many crucial expressions are not so clear, including "consciousness," "collective consciousness," "pure consciousness," and "experientially connected." Consider collective consciousness, defined loosely in (1). First, it relies on another undefined term (*consciousness*), the meaning of which is not self-evident. Second, the expression "the wholeness of" is vacuous. Third, identifying what collective consciousness *is more than* still does not tell the reader what it *is*. Linking collective consciousness to "pure consciousness" does not help either, for the latter is characterized through an avalanche of still more vague esoterica. Without clear definitions, the authors must rely on metaphors — an ocean surface, a laser, radio signals — all of which break down. Unlike the ocean surface, the laser and radio signals, collective consciousness is, respectively, nonmaterial, omnidirectional, and in violation of the inverse-square law of signal strength (785).

To evaluate the plausibility of the argument, readers (and journal referees) would need solid grounding in contemporary physics. We consulted several nuclear and particle physicists and learned that detailed experimental evidence is lacking for Planck scale phenomena. Also, a number of unified theories compatible with the existing experimental constraints have been considered in this highly speculative area (Davies & Brown 1988).[6] Moreover, physicists examining purported links to the Maharashi Effect theory find them highly dubious (e.g., Pagels 1986; Stenger 1990). Thus, although Orme-Johnson et al. give the impression that their assumptions are well grounded, the soundness of the Maharishi Effect theory's quantum field connections is an open question at best.

Though more rigorous than the rest of the theory, the Maharishi Effect equation also has problems. First, no rationale is offered for its thresholds. The cut-offs of 100 are arbitrary, and the functional discontinuity they entail produces a rather awkward behavioral model. Second, why is the measurement unit *number of people* rather than, say, *physical distance*? The implication is paradoxical. Assume there is a 100-person TM-Sidhi group in downtown Chicago and another in rural Fairfield, Iowa. Ignoring for this example the smaller effect of non-TM Sidhi meditators, ME = 1,000,000 for both groups. This means that the effect would have a radius of possibly a couple of miles for the Chicago group, but more than 50 times that distance for the other group. Chicago's unified field then would somehow have to "know" that it is not supposed to affect people if they happen to be more than 27

(or however many) blocks from the meditation group, and Fairfield's unified field would have to realize that it must keep going (and going) to affect its quota of citizens. Although Orme-Johnson et al. make many claims for their unified field, this level of sentience is not one of them.[7]

Theory Context

One component of Bayes' theorem pertains to theoretical contexts — the likelihood that the theory is correct in view of its consistency with, and plausibility relative to, prior knowledge. In statements such as number 3 above, Orme-Johnson et al. imply that Maharishi Effect theory is consistent with the theories of contemporary physics. Indeed, Hagelin (1987, 1989) argues first that the identification of the mental with the physical is plausible within the framework of quantum mechanics and, second, that this identification — and a fully worked-out theory of mind/matter that anticipates contemporary unified-field theories — is found in the oldest sacred Hindu texts, the Vedas.

Hagelin's case rests on three pillars: (1) supernormal phenomena ("sidhis"), such as the Maharishi Effect, levitation and invisibility, have no other natural explanation; (2) parallels between an esoteric theory of consciousness and quantum mechanics; and (3) parallels between a theory allegedly embedded in the Vedas and contemporary unified-field theories. Regarding supernormal phenomena, Hagelin goes to some lengths to invoke the more recherché possibilities allowable by quantum theory, in particular, levitation. The problem is that, ignoring for now the Maharishi Effect, no sidhis are validated and so the far-fetched explanation lacks purpose. Under the circumstances, Hagelin assigns premier importance to the Maharishi Effect, saying it provides "the central core of experimental evidence in support of the proposed identity between pure consciousness and the unified field" (1987:73).

Hagelin's (and Orme-Johnson et al.'s) other pillars are equally shaky. His argument for a unified field-consciousness identity suggests that some quantum-mechanical properties of physical fields match characteristics of consciousness. However, his argument relies critically upon ambiguity and obscurity in the terms denoting these properties. For instance, he notes that "creativity of consciousness" describes intellectual inventiveness, whereas "creativity of matter" describes the quantum field's capacity to generate particles. Both kinds of creativity share the characteristic of *production*, but Hagelin does nothing to show that these two *kinds* of production are the same, or even interestingly analogous. This is about as cogent as arguing that the mind is a sort of mirror because both reflect, but it does capture the essence of Hagelin's approach.

To draw his parallels between the Vedas and contemporary unified-field theories, Hagelin relies on numerological and exegetical styles of reasoning. For example,

his evidence for linkages between the Vedas, the unified quantum field, and consciousness includes the fact that there are five special Vedic terms called *tanmatras*, and there are five "spin-types" in quantum mechanics. Moreover, the quantum field theory that Hagelin especially favors is known among physicists as a "superstring" theory. In corroboration, Hagelin offers a line from a Vedic text that he translates as "My body is called a string."[8] Hagelin's interpretations of physical fields in terms of consciousness are supported by nothing more than the construction of arbitrary formal isomorphisms, metaphors, and a reliance upon ambiguity and vague analogy.

In sum, Orme-Johnson et al.'s theory does not pass minimal criteria of meaningfulness and logical integrity. Even if it did, where the theory in question is that which is at best foreshadowed in Hagelin's writings, and where prior knowledge includes knowledge of physical laws and neurophysiology, the probability of the Maharishi Effect theory is very close to zero.[9]

Evidence for the "Maharishi Effect"

Even if the Maharishi Effect theory is not compelling, the kinds of empirical results claimed to support the theory would be noteworthy if true. As indicated by Abelson (n.d.)[10] and Schrodt (1990), however, the empirical claims are weakened considerably by the nature of the research design and statistical techniques used by Orme-Johnson et al. These critics emphasize problems endemic to nonrandom treatment conditions, and the proneness of time-series analyses to Type II (false positive) errors.[11] In contrast, we take a more direct approach suggested by the two remaining components of Bayes' theorem: whether the evidence offered for the Maharishi effect theory is actually predicted by the theory, and whether specific alternative hypotheses explain the evidence.[12]

Do Predictions Derive from the Theory?

To be credible, Maharishi Effect theory must explain (1) how group meditation affects the unified field, (2) how these effects in turn cause changes in the actions of individual human beings, and (3) how those individual actions have their claimed social impact. Not clear in the theory is how meditators' brains spontaneously synchronize to produce "coherence," how coherence modifies physiochemical structures within the brains of distant others, why coherence only causes phenomena that happen to be defined socioculturally as "positive," and how the distribution of behaviors is affected at the population level.[13]

Hagelin (1987:69) concedes that Maharishi Effect theory does not explain how meditators affect the ostensible unified field and the emotions, thoughts, and behaviors of people within it. Moreover, if the material world is presumed to be

influenced by collective meditation (as it must be if the unified field is affected), then more direct measures are possible: *inanimate* Marishi Effect-detectors should be placed at varying distances from the meditation group.[14] As it stands, causal linkages from individual TM practitioners to, for instance, a diminished likelihood of Nebraskans wrecking their cars, are hidden in a very "black box."

Another indication that predictions do not derive from the theory is that lagged effects were not specified prior to the research. The researchers then interpret any significant correlation at any nonnegative time lag for any indicator as supporting their theory. This multiplies the likelihood of finding "supportive" evidence, but opens the door to Type II errors even wider.

The Maharishi Effect equation, from which specific hypotheses might have been derived, was ignored completely in the research. The time-series analysis employed each day's number of Sidhi meditators rather than its square, and the number of non-Sidhi meditators was not included in the test. There also were periods during the study when meditation group size fell below assumed thresholds for affecting Lebanon, or both Lebanon and Israel, but Sidhi-group size rather than zero was used as the independent variable.[15] In fact, the Sidhi group should not have been powerful enough to influence the Lebanese war, or even most of Israel. Orme-Johnson et al. argue that the roughly 38,000 non-Sidhi meditators in Israel and 2,000 more in Lebanon provided the needed boost. However, Orme-Johnson et al. provide no information about the geographic distribution of these meditators or evidence to support their assumption that they were in the area and meditating during the vacation month of August, which comprises half the test period.

In sum, Maharishi Effect predictions cannot be derived from the Maharishi Effect theory. There are gaps in the causal chain from group meditation to the phenomena supposedly affected, there are no specified time lags for the Maharishi Effect, and despite the capacity of the Maharishi Effect theory's formal component to generate specific Maharishi Effect predictions, the model is ignored. Thus, evidence offered for the Maharishi Effect cannot significantly increase confidence in the veracity of the theory.

Can Alternative Hypotheses Explain the Evidence?

Orme-Johnson et al. 1988 presented their empirical findings several ways, but the most compelling showed superimposed graphs of (1) a daily composite index of Jerusalem crime rates, auto accidents and fires; Israeli crimes and "national mood," and Lebanese war intensity; and (2) the number of meditators in the larger of each day's two meditation groups. Time-series analyses confirmed a statistically significant relationship between the number of meditators and the composite index for lags ≥ 0. We focus on a few specific factors that were not included in the analysis but readily could have influenced *both* the meditators' decisions to participate *and* the social indicators used as dependent variables. Importantly, the research design

prevents us from knowing how many other factors may have contributed to a spurious correlation.

HOLIDAYS AND VACATION MONTH

Orme-Johnson et al. recognize that mundane events affect both meditation group size and their social indicators: Their statistical model compensates for weekend effects and for three Jewish holidays, but there are other factors for which the authors failed to invoke statistical controls. Perhaps the most obvious omission was that of three *other* major Jewish holidays during the study period — Succoth, Shemini Azeret, and Simhat Torah. Nearly all of the meditators who participated in the research came from the liberal end of the Jewish religious spectrum.[16] As was clear in the graph of meditation group sizes, they were willing to travel and meditate on the Sabbath and holidays. In contrast, Orthodox Jews do not cook, light fires, or travel in cars on religious holidays or the Sabbath. Undoubtedly the holidays also produce some elevation in mood, and may coincide with reductions in war hostilities measured from nearby Lebanon. Therefore, the same factors that increase meditation group sizes at certain times would also correspond to the abstinence from cooking and travel for a very significant portion of the Israeli population. We might then expect to find not only a heightening in national mood at the same time that larger numbers of meditators turned out for the study, but also coincident reductions in domestic fires and automobile accidents.

Another effect, obvious in the graph of meditation group sizes, is attributable to August being vacation month in Israel. During August Israelis leave the country in large numbers. Critically, the investigators did not take into account the effects on fires and auto accidents of the lower population in Israel during August, of the tendency to cook less during hot weather, and of the potential for reduced war hostilities in the desert heat.[17] It may be difficult, but the burden of eliminating these possibilities rests upon the researchers.

THE LEBANON WAR

Orme-Johnson et al. highlighted the negative effects of meditation group size on war intensity in Lebanon. Hostilities in the Lebanon war involved an enormously complex interaction between a multitude of social, political and military forces. A good sense of this complexity can be gleaned from *The New York Times Index* "Middle East" entries for this period.[18] We offer several observations:

Orme-Johnson et al. make no mention of the many widely publicized military and political events that may have both influenced the Lebanon war and induced meditators' patterns of participation. Many such events occurred around the midpoint of the study, coinciding with the wildest fluctuations in group size and war intensity. For example: (1) Israel announced it would withdraw its army from the Shouf mountains overlooking Beirut to a line along a river to the south. Major

fighting erupted in Beirut just before the announced withdrawal date. (2) During the study period Prime Minister Begin both announced his intention to resign, and did so. (3) The Lebanese army completed a successful sweep of Beirut. A lull then occurred until the Israelis withdrew from the Shouf. Fighting promptly erupted among various factions. (4) Within days battles were being waged over the Shouf by U.S. and Druse militia, and the U.S. congress voted to keep the Marines in Lebanon for 18 more months. No effort was made to ask meditators why they showed up or stayed home in droves at various times during this period of the study.[19]

In sum, it is hardly unreasonable to suppose that the fluctuations of the dependent variables measured by Orme-Johnson et al. would have remained exactly as they were even if there had been no meditators at all. The claim that Marishi Effect theory provides the only plausible explanation of these data cannot be sustained. There are alternative explanations that do not depend on esoteric or paranormal influences.

Discussion and Conclusion

We have devoted considerable space to the analysis of a particular heterodox report, the upshot of which is that, at this time, the claims of that report do not merit being taken seriously by the scientific community. The theory motivating the research is ill-constructed and not compelling in view of prior knowledge; the evidence offered is not impressive and mundane alternative hypotheses offer plausible explanations for the findings. Only if its data were above suspicion, and no alternative explanations were known, would Maharishi Effect theory warrant any significant confidence in its truth. It is only by acquiring evidence of a sufficient quality and quantity, rendering any thought of its rejection irrational, that the heterodox theory ultimately can triumph.

Defenders of Orme-Johnson et al. might complain that we have not *really* explained their data. After all, we have not demonstrated that the causal factors we cite account for the observed correlations, nor have we reanalyzed the data to show that the Maharishi effect vanishes when controls are entered for all those test periods when known exogenous factors might be influencing the results (which is almost for the entire duration of the experiment). Such an objection would be entirely misplaced. The ball is in the other court: It is sufficient, for the purposes of defense, that a well-entrenched position offer *plausible* alternative explanations for the challenging data. The detailed task of ruling out those explanations lies properly with the challengers. Failing that, the heterodox theory cannot rise even to the level of being worthy of serious consideration.

Our criticisms may be divided into those directed against the Maharishi Effec theory and those disputing interpretations of their data. As to the first, the main points were that the Maharishi Effect theory has serious problems regarding the

clarity and integrity of its arguments, and it does not cohere well with other strongly confirmed theories, hence conflicting with the evidence supporting those theories. Maharishi Effect theory is underarticulated, often vague or enigmatic, reliant upon specious analyses, and silent about key processes that link causes to their alleged effects. These defects are not uncommon in novel theories, but in this case they allow nothing better than crude plausibility arguments for its extraordinary predictions. Contrast this with, say, the theory of relativity, which was not only formulated in a highly precise fashion, but which entailed relatively simple and numerically precise predictions for its tests. So Marishi Effect theory has a low prior probability. That, after all, is what makes it unorthodox, and its road to plausibility is bound to be arduous. Not only must a great deal of supporting data be amassed but, most likely, an indefinitely large body of established science will have to be overturned or revised to accommodate the new results.[20]

This brings us to interpretation of evidence. The Maharishi Effect theory predicts correlations that are supposed to support its causal claims. Against those claims we have launched, in descending order of importance, (1) arguments that offer concrete explanations of findings without invoking the Maharishi Effect; (2) more speculative arguments from plausible serendipity; and (3) arguments that do not explain a correlation between two variables, but that suggest the dependent variable can be fully explained without recourse to Sidhi group sizes. In the first class fall our suggestions concerning fires, auto accidents, national mood, and the immediate consequences of the Begin resignation; in the second category, our speculations about the lull in the war during part of August; and in the third, our mention of some of the many factors affecting the vicissitudes of the war generally. Even without quantitative support, this sort of defense of normal science is sufficient to undermine claims of plausibility on behalf of unorthodox theories that claim quantitative support. The low prior probability of a heterodox challenger suffices to establish a presumption of guilt.

A further point is relevant to the social and historical sciences, which often treat events that, once passed, can never be duplicated fully. Even worse, relevant details, unless recognized to be significant and recorded at the time, later may be unrecoverable. In this case normal science, inevitably a Johnny-come-lately upon the scene, would suffer an irremediable disadvantage if the demand for a fully developed alternative explanation had to be met. Thus, unless a heterodox challenger can produce experiments that are well controlled, thoroughly analyzable, and replicable, the standard of disproof to which normal science can legitimately be held is quite low. Even arguments of the weakest class (3, above) must be reckoned to weigh heavily against any theory with a prior probability as low as that of Maharishi effect theory.

Finally, we do not pretend to resolve two difficult but important practical issues. First, to what extent should the scientific community devote time, effort, and journal space to debates over unconventional theories, at the expense of more

conventional work that is more likely to be fruitful? We offer two brief observations. First, when research is conducted on behalf of an organized group (as was Orme-Johnson et al. 1988), its results will often find publication in arenas that do not afford an opportunity for informed rebuttal. Second, such rebuttals (as we have shown) need not be overly expansive to undermine an unorthodox theory.

As for the second issue, publication confers a certain aura of legitimacy in the eyes of the lay public and even in the research community. Proponents of unorthodox theories know this and, as with proponents of Transcendental Meditation, often attempt to parlay such recognition into research grants and influence with public policymakers and the public at large. To what extent does the scientific community have a responsibility to allow — or not allow — these considerations to influence its handling of unconventional proposals? How much responsibility the scientific community bears is, in part, a function of the significance of the consequences of public acceptance. Publication of an unorthodox medical claim, for example, might clearly have severe consequences, whereas publication of some novel view about the formation of igneous rocks most likely would not. It is here, in any case, that a much wider understanding of the principle that publication should not be taken to confer respectability in the sense of acceptability, would be beneficial.

Notes

1. This is expressed most rigorously by the formula $P(T|e\&k)=\frac{P(T|k)\times P(e|T\&k)}{P(e|k)}$, where P is the probability or level of confirmation of the theory (T), e is the empirical evidence for T, and k is prior knowledge relevant to T. The formula asserts that T is confirmed to the degree that $P(T|k)\to 1$, $P(e|T\ \&\ k)\to 1$, and $P(e|k)\to 0$.

2. If $P(T|k)\approx 0$, and if, for every competing alternative T, $P(e|\bar{T}\ \&\ k)\approx 0$, then, even if $P(e|T\&k)$ is high, $P(e|k)$ will be very low. This follows from the expansion $P(e|k)=\sum_{i=1}^{n}P(T_i|k)\times P(e|T_i\&k)$. This generalizes to the case where $k<1$, where k includes well-established theories and their supporting data. In effect, because those data support theories that conflict with T, *they* conflict with e. Unless the truth of e has been established beyond *any* possibility of doubt, this weakens rational credence in e. See Falk (1995) for a formal Bayesian analysis.

3. In his classic discussion "Of Miracles," Hume ([1748] 1955) defends an even more cavalier dismissal of heterodoxy. He observes that it is not incumbent upon one to uncover fraud or error in dismissing every miracle report. Nevertheless, we can feel confident in such a dismissal because the occurrence of the miracle would violate our well-entrenched understanding of nature, and would therefore be placed in competition for our allegiance with the enormous mass of evidence which supports that understanding. It will therefore be more likely than not that some undetected — perhaps undetectable — mistake lurks behind the problematic data.

4. See also Wallace (1989) for a more comprehensive but less detailed review. Hagelin is a faculty member of the Maharishi University of Management and was the Natural Law Party's presidential candidate in 1992 and 1996. The NLP promotes Transcendental Meditation as the solution to virtually all of society's ills.

5. Aron and Aron (1986:11) state this more bluntly: "the pure consciousness experience is actually the subjective experience of what in physics is called the 'unified field.'"

6. We are grateful to Wayne Polyzou, Yannick Meurice and Bill Klink of the University of Iowa Department of Physics and Astronomy, for their input.

7. The intuitive answer is that individuals in the field "use up" the "energy" generated by the meditators. However, this is not our understanding of how the underlying physical field is presumed to operate, nor is it a process that we have found discussed in the literature on Transcendental Meditation.

8. Frederick Smith (personal communication), a Sanskritist at the University of Iowa, notes that Hagelin's translation is an esoteric one, dramatically different from that which standard Sanskritic scholarship delivers.

9. Important general questions have been raised by philosophers about the content of *k*, prior knowledge. For practical purposes and in the present context, however, it seems entirely fair to include in *k*, as we have done, those well-established theories and data from physics and biology *to which Hagelin et al. themselves appeal.*

10. In 1994 we were informed by the editor of the *Journal of Conflict Resolution* that Abelson's article was forthcoming. It has not yet appeared at this writing.

11. Schrodt (1990) cites research demonstrating that business cycles "cause" sunspots and that eggs "cause" chickens (but not the reverse). The problem is that the noisier the data, the greater the range of frequencies it contains. Standard time-series methods then become ideally suited to extracting whatever "effect" one desires.

12. A reanalysis of the data also would have been desirable, though not essential for our case. However, David Orme-Johnson has refused numerous requests for a copy of the raw data set.

13. Beyond the purview of this critique are the moral and ethical issues that arise when meditators purport to alter experimentally the moods, thought processes, and behaviors of others without their informed consent, and when the transcendental meditation movement assigns itself the responsibility of manipulating the substrate of all existence.

14. This is the approach adopted by Radin and colleagues in their consciousness research (e.g., Radin, Rebman & Cross 1996). They look for attentional effects in the anomalous output sequences of random number generators.

15. We argue below that Sidhi group size is affected by some of the same factors that influence the social indicators. Including Sidhi group size in the analysis when it is below threshold is thus likely to increase the "confirmatory" observations, artificially increase the apparent Maharishi Effect, and further bias results in a direction favoring the hypothesis.

16. Confirmed in conversation with David Orme-Johnson and Charles Alexander.

17. Confirmed in conversation with Alexander.

18. We also relied on more extensive analyses provided by Frank (1987), Friedman (1991), Schiff and Ya'ari (1984), and Yaniv (1987).

19. Confirmed in conversation with Alexander.

20. Transcendental Meditation researchers claim over 40 replications of the Maharishi Effect. Of those which are published, most are in obscure or newer journals (e.g., Hatchard, Deans, Cavanaugh and Orme-Johnson 1996). Moreover no two "replications" that we have reviewed actually employ identical procedures, measures and/or model specifications, and none of the field studies employed safeguards against the sorts of problems we raise.

References

Abelson, Robert P. N.d. "Editorial Comment." *Journal of Conflict Resolution.*

Aron, Elaine, and Arthur Aron. 1986. *The Maharishi Effect: A Revolution Through Meditation.* Stillpoint.

Cohen, Bernard P. 1989. *Developing Sociological Knowledge.* Nelson-Hall.

Davies, P.C.W., and J. Brown. *Superstrings: A Theory of Everything?* Cambridge.

Fales, Evan, and B. Markovsky. 1995. "Evaluating Heterodox Theories: The Maharishi's Extraordinary Social Physics." Presented at the annual meeting of the American Sociological Association, Washington, D.C.

Falk, Arthur. 1995. "Wisdom Updated." *Philosophy of Science* 62:389-403.

Frank, Benis M. 1987. *U.S. Marines in Lebanon 1982–1984.* Washington, D.C.: History and Museums Division, Headquarters, U.S. Marine Corps. Government Printing Office.

Friedman, Thomas L. 1991. *From Beirut to Jerusalem.* 2d ed. Farrar, Strauss, Giroux.

Hagelin, John S. 1987. "Is Consciousness the Unified Field? A Field Theorist's Perspective." *Modern Science and Vedic Science* 1:28-87.

——. 1989. "Restructuring Physics From its Foundation in Light of Maharishi Vedic Science." *Modern Science and Vedic Science* 3:3-72.

Hatchard, Guy D., Ashley J. Deans, Kenneth L. Cavanaugh and David Orme-Johnson. 1996. "The Maharishi Effect: A Model for Social Improvement. Time Series Analysis of a Phase Transition to Reduced Crime in Merseyside Metropolitan Area." *Psychology, Crime and Law* 2:165-74.

Hume, David. [1748] 1955. *An Inquiry Concerning Human Understanding.* New York: Liberal Arts Press.

Markovsky, Barry. 1994. "The Structure of Theories." In *Group Processes: Sociological Analyses,* edited by Martha Foschi and Edward J. Lawler. Nelson-Hall.

———. 1996. "Theory, Science, and "Micro-macro" Bridges in Structural Social Psychology." *Current Research in Social Psychology* 1(4):30-42, http://www.uiowa.edu/~grpproc.

Orme-Johnson, David W., Charles N. Alexander, John L. Davies, Howard M. Chandler, and Wallace E. Larimore. 1988. "International Peace Project in the Middle East: The effects of the Maharishi Technology of the Unified Field." *Journal of Conflict Resolution* 32:776-812.

Pagels, Heinz R. 1986. Affidavit No. 85-2849, United States District Court for the District of Columbia.

Radin, Dean I., Jannine M. Rebman, and Maikwe P. Cross. 1986. "Anomalous Organization of Random Events by Group Consciousness: Two Exploratory Experiments." *Journal of Scientific Exploration* 10:143-68.

Schiff, Ze'ev, and Ehud Ya'ari. 1984. *Israel's Lebanon War.* Simon & Schuster.

Schrodt, Philip A. 1990. "A Methodological Critique of a Test of the Effects of the Maharishi Technology of the Unified Field." *Journal of Conflict Resolution* 34:745-55.

Stenger, Victor J. 1990. *Physics and Psychics.* Prometheus.

Wallace, Robert Keith. 1989. *The Neurophysiology of Enlightenment.* MIU Press.

Yaniv, Avner. 1987. *Dilemmas of Security: Politics, Strategy, and the Israeli Experience in Lebanon.* Oxford University Press.