The Moon Was Full and Nothing Happened: A Review of Studies on the Moon and Human Behavior and Lunar Beliefs

I. W. Kelly, James Rotton, and Roger Culver

IT IS COMMONLY assumed that a full moon brings out the worst in people. Those who do research in this area invariably begin reports by reminding readers that "lunacy" and "lunatic" are derived from *luna*, the Latin word for moon. Although lunacy is an outdated concept, investigators have tried to link the phases of the moon to such behaviors as alcoholism, madness, epilepsy, somnambulism (moon walking), suicide, homicide, arson, and, of course, lycanthropy (werewolfism).

Arnold Lieber (1978), a Miami psychiatrist, used the term *lunar effect* when referring to supposed links between phases of the moon and behavior. Critics prefer the term *Transylvania effect* (Shapiro et al. 1970). As one might guess, those who defend the lunar hypothesis have objected to the latter "because it conjures up visions of werewolves and Draculas" (Garzino 1982, 399). In our view, however, neither term is appropriate, since the word *effect* implies that investigators can establish something more than a correlation in this area. Obviously, without having had a "control group" on a planet without a moon (perhaps a random sample of Venusians), researchers cannot show that a full moon exerts a causal influence on behavior.

In the first part of this article, we describe results from a meta-analysis of studies that examined relationships between phases of the moon and behavior (Rotton and Kelly 1985a). We also note several studies that appeared after we completed our meta-analysis. In the second part, we speculate about why lunar beliefs persist despite the absence of reliable linkages between phases of the moon and behavior.

Ivan Kelly is an associate professor of educational psychology at the University of Saskatchewan, Canada. James Rotton is an associate professor of psychology at Florida International University. Roger Culver is an astronomer at Colorado State University.

Research on Lunar Cycles and Behavior

Rotton and Kelly (1985a) combined data from 37 published and unpublished studies in a meta-analysis that had examined relationships between the moon's synod (4-phase) cycle and abnormal, deviant, and criminal behavior. Meta-analysis is a statistical procedure that combines results from empirical investigations. It allows reviewers to do three things: (1) estimate the overall or combined probability of results from different studies; (2) assess the size of relationships when results are averaged; and (3) identify factors that might help to explain why some studies have obtained apparently reliable results while others have not. This meta-analysis differed in one important respect from those that have been undertaken to resolve controversies in other areas: It included a reanalysis of results from previously published studies.

Of the 23 studies we checked, nearly one-half contained one or more statistical errors. Some of these were serious enough to prompt us to publish interim reports (Kelly and Rotton 1983; Rotton, Kelly, and Frey 1983) to correct errors that had crept into the literature. For example, we found that Lieber and Sherin (1972) had employed inappropriate and misleading statistical procedures in their often-cited study of homicides in Dade County, Florida. On the basis of binominal tests of significance, they claimed that a disproportionate number of homicides occurred during the 24-hour period before and after full moons. We found that this claim was based upon 48 tests of significance, which are not reported in their article. To make matters worse, their tests were not independent. For example, in one set of analyses they looked "at the three days before and after, three days before, three days after, two days before and after, two days before, two days after, one day before and after, one day before, one to two days after, and one to three days after full moon" (Rotton, Kelly, and Frey 1983, 111; Rotton and Kelly 1985c). Applying more conventional test procedures, it was found that homicides were evenly distributed across phases of the moon.

In another study, Templer, Veleber, and Brooner (1982) claimed that a disproportionate number of traffic accidents occurred during the night hours of the three-day periods of the new moon and the full moon. However, as Kelly and Rotton (1983) noted, a larger number of the full- and new-moon nights cited in the study fell on weekends. They suggested that apparent relationships might stem from the fact that more accidents occur on weekends than on weekdays. This suggestion was later confirmed by reanalysis of their data. Templer, Corgiat, and Brooner (1983) found that relationships vanished when they included controls for holidays, weekends, and months of the year. To their credit, they were willing to revise their original hypothesis: "It is likely that some, perhaps all, of the significant phase-behavior findings in the literature are a function of day of week or holiday or season artifact" (Templer et al. 1983, 994).

As these examples illustrate, a meta-analysis is no better than the studies on which it is based. In our meta-analysis, we took several steps to locate relevant articles and papers, including a computer search of the literature. Correcting for errors in original reports, we found that there was no consistent relationship between phases of the moon and acts usually described as lunatic. Taken as a whole, our results confirm the generally negative conclusions reached in prior reviews (Abell 1981; Cooke and Coles 1978; Campbell and Beets 1978; Kelly 1981). For every study that had found that people behave more strangely than usual when the moon is full, another had found that people's behavior was not affected.

Indeed, phases of the moon accounted for no more than 3/100 of 1 percent of the variance in activities usually termed *lunacy*. Estimating the percentage of unusual episodes that occurred during the quarter (25 percent) of the time when the moon is full, we found that about 25.7 percent of the episodes had occurred during full-moon periods. Of course there may be some who will claim that a difference of 0.7 percent is theoretically interesting. However, we are not impressed by a difference that would require 74,477 cases to attain significance in a conventional (i.e., chi-square) analysis.

Some might also object that we averaged over important differences when we combined data from different studies. To deal with this objection, we considered factors thought to mediate relationships between phases of the moon and behavior: sex of subject, type of lunar cycle (synodic vs. anomalistic or apogee-perigee), geographical features, publication practices, and type of lunacy (namely, mental hospital admissions, disturbed behavior in psychiatric settings, calls to crisis centers, homicides, and other criminal offenses). In only one of these subsidiary analyses did a difference approach significance. There was a slight (but not statistically significant) tendency for stronger relationships to appear in "pay" journals than refereed sources and unpublished theses.

Several additional studies have since come to our attention. In one of these, Russell and Dua (1983) examined relationships between phases of the moon and aggressive episodes during Western Hockey League games. They based their conclusions upon aggressive infractions recorded during the 1978-79 hockey season. After looking at several types of aggression, they concluded that "the present investigation offers no support for a lunar-aggression hypothesis" (p. 43). More recently, Russell and de Graaf (1986) replicated the earlier study on hockey infractions on a new season (1983-84) of the Western Hockey League. As in the earlier study they found no evidence of a relationship between hockey aggression and moon phase. In another study, MacMahon (1983) examined suicide data in the United States over a 7-year period. After plotting suicide rates by lunar phase (using a corrected 30-day cycle), she concluded that "deviations from the mean were small and present no obvious pattern" (p. 747). Likewise, Atlas (1984) uncovered no relationship between lunar phases and violent episodes in Florida prisons.

Finally, Sanduleak (1985) examined relationships between lunar cycle and homicides in Cleveland, Ohio. His study is noteworthy, because Lieber and Sherin (1972) previously claimed that they had uncovered a reliable relationship between lunar cycles and homicides in this city. They based this conclusion on data between 1958 and 1970, whereas Sanduleak covered the period from 1971 through 1981 in his follow-up study. Sanduleak's results are aptly summarized by the title of his article: "The Moon Is Acquitted of Murder in Cleveland."

On the other hand, Davenhill and Johnson (1979) claimed to have detected a relationship between various personality variables as measured by the Eysenck Personality Inventory (EPI) and Cattell's 16 Personality Factors (PF) and changes in the lunar cycle. However, Startup and Russell (1985) criticized their research, pointing out that the Davenhill and Johnson study employed only a very small sample (12 males and 12 females) and only covered a short period of time (two lunar cycles). In addition, using 881 subjects over a two-year period and a more powerful statistical technique, Startup and Russell could replicate none of the findings obtained in the earlier study on the Eysenck Personality Questionnaire (EPQ, a revised form of the EPI) and only one with the 16 PF. However, the minuscule size of the relationship precludes any practical use, and the authors caution that it would be unwise to attach theoretical significance to this finding until it can be replicated by others.

Mirabile (1981) has claimed that he uncovered "a dramatic relationship between the expression of psychopathology and the lunar cycle" (p. 8). This claim, which was repeated in 1984, is based on an analysis of ratings made by an unspecified number of nurses over a two-year period (1976-1978). Nurses rated 156 psychotic and 104 nonpsychotic patients on 31 behavioral scales. It is not clear how often patients were rated, nor does Mirabile present any reliability data for his raters. Although more than 230,000 ratings were obtained, only 52,000 records were analyzed, owing to computer limitations. However, this claim was based upon inappropriate analyses and violations of a number of statistical assumptions.[1]

Belief in Lunar Effects

Rotton and Kelly (1985b) found that one-half (49.7%) of the students in a Florida university agreed that some people behave strangely when the moon is full. Similar levels of beliefs have been recorded for students at a Canadian university (Russell and Dua 1983) and in Singapore (Otis and Kou 1984). What accounts for belief in lunar effects? Although we have only begun to pursue this question, we suspect that belief in lunar effects can be traced to three factors. One of these can be termed *media effects*. Another is misconceptions about physical factors. The third, and in some ways the most interesting, is cognitive biases that lead individuals to look to the moon when they witness unusual and apparently senseless types of behavior.

Media Effects

Newspapers, television programs, and radio shows favor individuals who claim that a full moon influences behavior. Arnold Lieber, one of those favoring the lunar hypothesis, has appeared on several talk-shows, including the nationally syndicated "In Search of . . ." As recently as November 8, 1984, his research was highlighted on ABC's "20/20." This supposedly objective report began with its host, Hugh Downs, suggesting that lunar effects provided evidence for astrology: "The moon's effects are legendary and, according to some, the most obvious example of astrology—that ancient belief that has in the past twenty years become big business."[2] Likewise, Mirabile's (1984) presentation at the Institute of Child Development was widely disseminated in newspapers throughout the United States. Finally, on August 27, 1984, Ann Landers answered a reader's question by telling him, "It's true . . . some people get loonier than others when the moon is full."

Newspapers, of course, are in the business of telling people what happened. "The moon was full, and nothing happened" may be accurate, but it is not a very interesting headline. In research on curiosity and information-seeking, it is something of a truism that "good news is no news" (Rotton, Heslin, and Blake 1983, 49). When reporters call us on the phone, they would probably be happier if we assure them by saying, "The streets are full of loonies when the moon is full." Unfortunately, when one scientist doesn't give them a quotation that can be turned into an interesting headline, they can always find an "expert" who will provide the quotation they need.

For a reporter interested in writing a story, it is not hard to find somebody who will talk about an uncle, say, who acted peculiarly when the moon was full. (Who doesn't have a peculiar uncle?) Those who defend the lunar hypothesis are not above resorting to case histories and personal anecdotes. For example, after failing to uncover a statistical relationship between the moon's apogee-perigee (far-near) cycle and behavior, Lieber and Sherin (1972) indicated that a "perusal of official narratives on individual incidents of homicides indicates that homicides occurring during these periods are often of a particularly bizarre or ruthless nature" (p. 105). As Meyers (1983, 120) has observed, "anecdotes are often more persuasive than factual data." To dramatize the supposed effects of the full moon, for example, "20/20" showed pictures of Miami police being called out to keep a young man from killing himself. The announcer's voiceover:

> Even before the moon has risen and the sun still commands the sky, it starts: A confused young man has a cocked pistol to his head. The special

response team is in place. If the subject points the gun at anyone else, he will be shot. . . . There are scenes like this somewhere every day, but in Dade County, Florida, at least, the special response team call-outs to incidents like this peaked at the time of the full moon—month after month.[3]

Misconceptions

Given the moon's obvious effects upon ocean tides, it is not surprising that scholars as well as students have jumped to the conclusion that it might also affect people's behavior. "If the moon can do that to oceans," our students say, "imagine what it can do to us!" In a similar vein, Lieber (1978) advocates a biological tide hypothesis. He contends (p. 115): "Because the [human] body [like the earth] is composed of 80 percent water and 20 percent 'land' or solids, it is reasonable to assume that gravity exerts a direct effect on the water mass of the body, just as it does on the water mass of the planet."

Lieber's analogy fails because it is too weak to warrant the inference he wants to draw. As Campbell (1982, 421) points out: "Only the *surface* of the earth has this 80:20 ratio . . . yet gravity involves attraction between three-dimensional structures (and their total masses, not just surface composition). Hence, the argument based on a similar water-solid ratio between earth and the human body is 'untenable.' " In addition, the moon causes tides only in unbounded bodies of water like the world's oceans (Abell 1981; Campbell 1982; Culver, Kelly, and Rotton 1986). Bounded bodies of water, such as land-locked lakes, unless they are very large (like the Great Lakes), are negligibly influenced. Clearly the water contained in the human body falls into the "bounded waters" category.

Even if we surmount these problems—for example, by assuming an idealized human who is uniformly covered by a layer of unbounded perspiration—gravitational mechanics still offers no support for the idea of biological tides. The expression for the tidal force F_{TIDE} to which an object of radius R will be subjected can be readily derived from the principles of classical mechanics: $F_{TIDE} = 2GRM/d^3$ where G is the universal gravitation constant, M is the mass of the tide-raising object, and d is the distance between the center of mass of two objects involved. A comparison of the tide-raising capabilities F_1 and F_2 of two separate objects on a given person can then be written as

$$\frac{F_1}{F_2} = \left(\frac{M_1}{M_2}\right)\left(\frac{d_2}{d_1}\right)^3,$$

where M_1 and M_2 are respective masses and d_1 and d_2 the respective distances of the tide-raising objects. As an example, suppose we wish to compare the tidal forces of a mother, the attending doctor, and the building on a new-born child with that of the moon. If the hospital is located on the side of the earth's surface nearest the moon, then the moon's center of mass will be about 378,000 km distant. Assuming the mother's distance from the child while she holds it is 15 cm or so, then a 55 kg mother will exert

$$\left(\frac{55\text{kg}}{7.35 \times 10^{22}\text{kg}}\right)\left(\frac{3.78 \times 10^{8}\text{m}}{0.15\text{m}}\right)^{3} = 1.2 \times 10^{7}$$

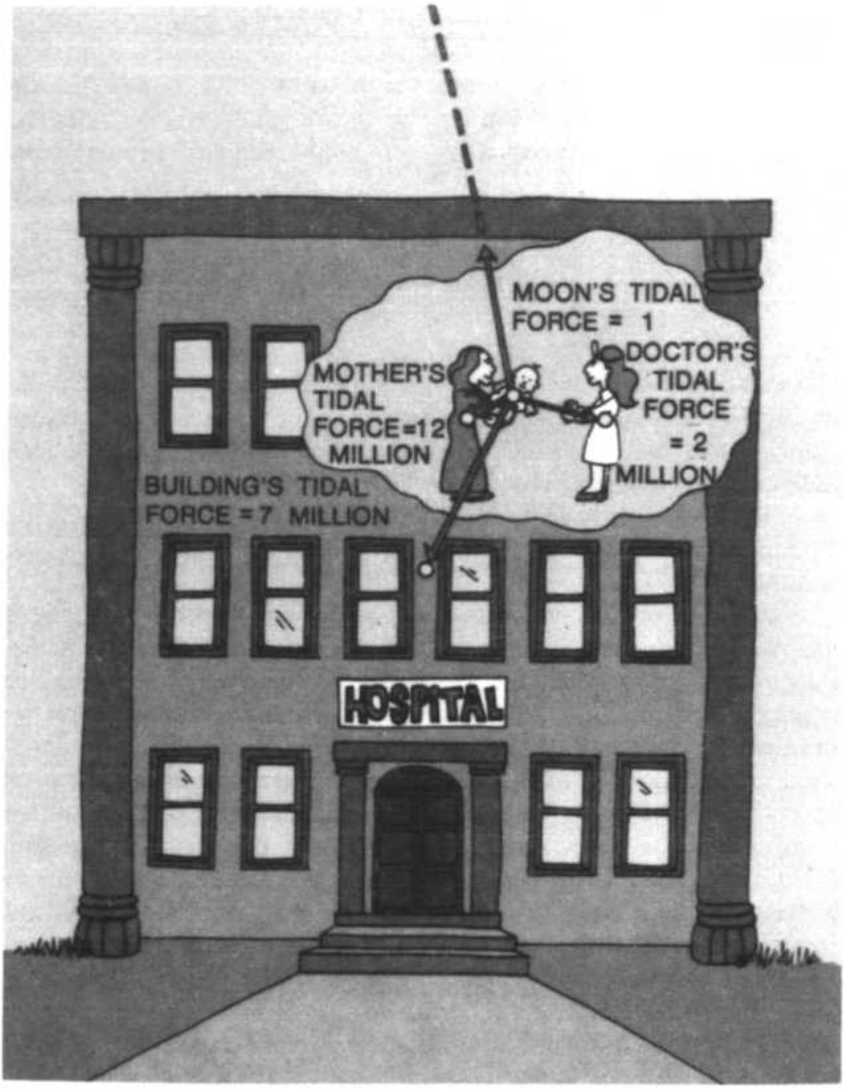
or 12 million times as much tidal force on her child as the moon. Calculations for the doctor and the fractional mass of the building contained within a radius equal to the child-building center of mass distance will yield similar results, which are shown in Figure 1. In fact, it can be easily shown that we would have far more tidal concerns from a downtown area with lots of large-mass buildings and crowded streets than from the sun or the moon.

The biological-tide hypothesis fails on a number of other counts. In our review (Rotton and Kelly 1985a) we found six studies that have looked at the distance of the moon from the earth and various types of behavior. Only one obtained significant results, and these were contrary to the biological-tide theory: More undesirable behavior occurred when the moon was *farthest* from the earth. In addition, Lieber argued that we would expect lunar-related behaviors to be more pronounced at the Equator than at more distant latitudes and to have an amplitude variation in keeping with the times of lunar perigee and apogee. We found no evidence for this contention in our review. Sanduleak (1985) did not obtain significant results when he examined relationships between homicidal assaults and a tidal index that was proportional to the magnitude of the combined lunar and solar tide action. Finally, Russell and de Graaf (1986) found no relationship between the distance of the moon from the earth and aggression in hockey games.

Although Lieber and Sherin (1972) originally attributed supposed correlations between phases of the moon and behavior to water imbalances, Lieber (1978), Katzeff (1981), and others have proposed competing hypotheses.

Garzino, for example, has speculated about ion effects:

> Because the moon modulates the earth's magnetic field, the entering ions follow a lunar cycle. During the full-moon phase, positive ions come down to earth *in great abundance*. But positive charged ions are now suspected by some scientists to create depression and irritability by increasing levels of serotonin in the nervous system. Serotonin is a mood-modifying chemical, a "downer." [Garzino 1982, 408, italics added. See also, Abel 1976; Katzeff 1981; Ossenkopp and Ossenkopp 1973.]



Relative tidal forces exerted on a new-born babe by the moon, its mother, a doctor, and the hospital building. Figures are derived from the formula for the relative tide-raising capabilities of two objects, F_1 and F_2, with masses of m_1 and m_2, respectively: $F_1/F_2 = (m_1/m_2)\ (d_2/d_1)^3$. For example, the following estimate was obtained for a 55 kg mother standing 15 cm (.15 m) from her child on the earth surface nearest to the moon (mass = 7.35×10^{22}) when its distance is approximately 378,000 km: $F_1/F_2 = (55\text{ kg}/7.35 \times 10^{22}\text{kg})\ (3.78 \times 10^8\text{m}/.15\text{m})^3$ or 1.2×10^7. That is, the mother's tidal force is 12 million times more than the moon's. Note: Figure adapted from R. Culver and P. Ianna, *The Gemini Syndrome* (1984, Prometheus), by permission of the authors and publisher.

Although early research on air ions could be criticized on a number of grounds—for example, use of shoddy equipment that produced ozone as well as air ions—more recent studies have demonstrated that people's moods are altered by very high levels of ionized air (Baron, Russell, and Arms 1985; Charry and Hawkinshire 1981). There is fairly compelling evidence that the effects of negative ions are beneficial (e.g., improved mood and better performance on simple tasks), whereas the effects of positive ions appear to be less benign (Fisher, Bell, and Baum 1984). However, these effects depend upon personality factors, such as excitability, and are only found when individuals are exposed to very high concentrations of ions in a controlled (i.e., laboratory) setting.

Although positive ions are more prevalent when the moon is full, positive ion concentrations related to lunar variations are small when compared with those related to air-conditioning and air pollution (Campbell 1982). One is much more likely to feel the effects of positive air ions while working in an enclosed building. However, the question is not "Is there an ion effect?" It is, instead, "Are ion levels high enough when the moon is full to produce effects attributed to them?" The answer to this question appears to be no. Gilbert (1980) measured ion levels in a school for mentally retarded children. He found no evidence for the ion hypothesis. Indeed, in his study, he observed more disturbed behavior when the moon was new than when it was full.

Although ion effects appear to be mediated by serotonin, we have not been able to locate any study that has examined correlations between lunar cycles and serotonin levels. The absence of research on physiological processes is, in many ways, surprising. Some of those who favor the lunar hypothesis are physicians, such as Lieber and Mirabile, who often speculate about physiological processes. Why have they not obtained blood or urine samples to determine if there is, in fact, a lunar component in hormone levels? As Asimov (1985, 8) has observed, such evidence would be much more convincing than statistical analyses of homicide and crime rates: ". . . If these rhythms affect such things as our response to drugs or our tendency to violence or depression, then the rhythms must affect our internal workings. There must be a fourteen-day rise and fall in hormone production; or such a rise and fall in the activity of our immune system, or our cerebral drug receptors, or various aspects of our neurochemistry."

For several years now, investigators have been monitoring individuals' biochemical levels in hospitals and physiological laboratories in research aimed at answering other questions (e.g., Reinberg and Smolensky 1983). In most cases, they use spectral analysis to detect day-to-day and hour-to-hour changes in biological assays and electrodermal activities.[4] Given the large number of scientists involved in this research, it is hard to believe that a 14-day cycle could go undetected. Those who favor the lunar hypothesis often cite Brown's work on the activity patterns of oysters (Brown 1954) and hamsters (Brown and Park 1967). Some of these same authors have published books on biological rhythms (e.g., Garzino 1982). Strangely enough, they do not report anything resembling a 29-day cycle in human activity levels. Given the large number of studies done (in both the United States and West Germany) on the effects of social isolation (e.g., Luce 1971; Minors and Waterhouse 1981), it is surprising that none of them have reported that subjects act restlessly, talk to themselves, or eat or drink more when the moon is full.

Cognitive Biases

A number of cognitive biases contribute to belief in lunar effects. One is selective perception: Individuals are more likely to notice events that support their beliefs than those that do not. Further, individuals are more likely to look for a cause when they notice unusual behavior. Because the moon is conspicuous and its absence is not, it will be an object commonly invoked to explain odd events and behavior. When something odd happens, what other object is so impressively in view as a full moon? However, in research that is now being done at Florida International University, we have found that students do no better than chance when they are asked to guess the moon's phase. As Sanduleak (1985, 6) observed, it does not seem likely that "even the most ardent proponent of a lunar effect could specify the phase of the moon. . . . I have tested audiences and found that only a very small percentage could." Social psychologists have found that most of us look to others when we have to make decisions (i.e., what they call "social reality"), and we often act like "cognitive misers"—that is, we look for simple solutions and base our decisions upon the first piece of information we receive (Fiske and Taylor 1983; Hansen 1980). Thus, we have to wonder how many individuals check to see if the moon is full when an unusual event occurs and somebody says, "Must be a full moon tonight."

Selective recall is another bias that contributes to belief in lunar effects. We often recall positive instances and forget negative ones (Nisbett and Ross 1980). Individuals may recall all the full-moon nights when something untoward happened while forgetting the uneventful full-moon nights and the many more *non*-full-moon nights when they witnessed unusual behavior.

Selective attention and recall contribute to illusory correlations (Rotton 1985a). Individuals find it hard to believe that events are random and unrelated, especially when they vary over time. For some, "Everything is related to everything else" is not just an ecological slogan; it is, instead, a principle that guides their thinking and leads them to interpret randomly distributed events as confirming their beliefs. As Meyers (1983, 129) has observed: "When we believe a correlation exists between two things, we are more likely to notice and recall confirming than disconfirming instances."

Illusory correlation is a special instance of a more general and confirmatory bias (Mahoney and DeMonbreun 1978; Snyder and Swann 1978; Watson and Johnson-Laird, 1972). Most of us seek data that support our beliefs, preconceptions, and hypotheses. It is commonly assumed that scientists are mainly interested in obtaining data that will support their theories and hypotheses. Unfortunately, as philosophers (e.g., Hempel 1966;

Salmon 1984) have suggested, thinking rarely advances when one adopts a confirmatory strategy. We learn a great deal more when our hypotheses are shown to be inadequate.

Yet another bias is selective exposure, which leads believers to watch TV shows and read books that confirm their beliefs. Although research on the selective-exposure hypothesis has produced mixed results, Otis (1979) found belief in one paranormal phenomenon (UFOs) predicts movie preferences. In her study, individuals standing in line to see *Close Encounters of the Third Kind* were more willing to endorse pro-UFO items than were individuals waiting to see other movies (specifically, *The Gauntlet* and *Saturday Night Fever*). There is evidence that beliefs in lunar effects comprise part of a constellation of belief in paranormal phenomena. Rotton and Kelly (1985b) found that students who scored lower on tests of logical ability, and those who believed in reincarnation, ESP, and astrology were more likely to endorse beliefs in lunar effects.

Any of these biases may act as a self-fulfilling prohecy, leading to actions that confirm people's beliefs (Russell and de Graaf 1986). For example, if police officers believe that a full moon causes criminal behavior, they might become more vigilant and make more arrests on full-moon than other nights (Frey, Rotton, and Barry 1979). In this regard, it is interesting to note that Rotton, Kelly, and Elortegui (1986) found that police officers were more likely to endorse items indicative of belief in lunar effects than a haphazard sample of pedestrians (the proverbial "man and woman on the street").

Conclusion

This article outlines the results of a meta-analysis of 37 studies and several more recent studies that examined lunar variables and mental behavior. Our review supports the view that there is no causal relationship between lunar phenomena and human behavior. We also speculate on why belief in such relationships is prevalent in our society. A lack of understanding of physics, psychological biases, and slanted media reporting are suggested as some possible reasons.

It is important to note that there are two hurdles to overcome before any findings on lunar variables and human behavior are deserving of public attention. The first hurdle is that *reliable* (i.e., replicable) findings need to be reported by independent investigators. The second hurdle is that the relationship should not be a trivial one. The lunar hypothesis fails on both counts.

Notes

1. Mirabile based his claim on a computer analysis, which he graciously attached to a letter sent to the first author on November 30, 1984. Mirabile

assigned patients to one of five levels of one factor in terms of their degree of motion sickness. In addition to this between-subject factor, his design consisted of "four seasons centered on the solstices and equinoxes and ten intervals in the lunar monthly cycle" (Mirabile 1981, 7). As he correctly notes, this yields 5 (motion sickness) × 4 (seasons) × 10 (lunar cycles) or 200 cells for comparison. So far, so good. What we have here is a traditional split-plot design. Unfortunately, ignoring the distinction between-group and within-subject factors, Mirabile concluded that each cell in his design contained 156 observations for the psychotic group of patients. As a consequence, the error term in his design was an amalgamation of heterogenous sources of variance (i.e., subjects within groups, lunar cycle × subject within groups, season × subject within groups, etc.). Even if we assume this type of pooling is appropriate, we cannot ignore the fact that Mirabile's F ratio for lunar cycles was based on 9 and *31,000 degrees of freedom!* With so many degrees of freedom, we would be surprised if lunar cycles had not attained "significance." To take another example, Mirabile attempted to interpret a three-way interaction after obtaining a "significant" F of 1.29. With 128 and 31,000 degrees of freedom, his three-way interaction would probably have attained significance if one of the nurses in his study had yawned.

Even if one ignores those statistical errors, lunar cycles accounted for a very small percentage of the variance in paranoid behavior. Mirable (1981) obtained an F of 10.2442 for the factor of lunar cycles in his design. Cohen's (1977) "effect size index" (f) for this F-ratio, with 9 (df_n) and 31,000 (df_e) degrees of freedom is $(df_n F/df_e)^{1/2} = 9(10.2442)/31000)^{1/2}$, or 0.002741. In other words, his lunar factor accounted for a little more than 0.296 of one percent of the variance in ratings of paranoid behavior, since $eta^2 = f^2/(1+f^2) = 0.002963$. We will confess to being gratified by the fact that this figure is close to our previously stated estimate of 0.3 of one percent for relationships in this area.

2. These quotes were transcribed from a cassette recording of the November 8, 1984, broadcast.

3. See note 2.

4. Any complex curve can be described in terms of a number of pure sine-waves that differ in amplitude, frequency (cycles per unit time), and initial phase or starting time. Spectral analysis is simply a mathematical procedure that allows an investigator to describe a wave in terms of pure waves. As Rotton (1985b) has noted, it is ideally suited for uncovering "hidden periodicities" in behavior.

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