THE FULL MOON DOES NOT HAVE A SIGNIFICANT EFFECT ON THE NUMBER OF DISCIPLINE REFERRALS AMONG HIGH SCHOOL STUDENTS

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ABSTRACT

 There has long been the belief that the phase of the moon, particularly the full moon, can have an effect on human behaviors. From werewolves to an increased number of childbirths, there are numerous examples throughout history of the belief in lunar effects. Discipline referrals were selected as a proxy of behavior among high school students. Six years of discipline referral records were obtained and analyzed to determine the average number of discipline referrals on the full moon +/- three (FM) days, and the average number of discipline referrals on all other (AO) days. While two of the years in study did show an increased number of referrals on FM days, only the data for one of those years was significant. Further, when the data for all six years under study was analyzed together, no significant difference was found between FM days and AO days. A review of the literature concludes that the most probable reason for any change in human behavior during FM days is purely psychosomatic.

INTRODUCTION

It has been observed that there is a connection between human behavior and the phase of the moon (Snelson 2004). The literature is, however, ambivalent on the topic (Russell and de Graaf 1985). Many papers suggest that there is a strong correlation (Thakur and Sharma 1984), while others, even those with sample sizes in the thousands, find no significant correlation (Bickis, Kelly and Byrnes 1995). The only phenomenon, social, geophysical or otherwise to which the phase of the moon has been strongly and consistently related is the tides. The phase of the moon causes tides not because of the degree of lunar illumination, but rather because of the location of the moon relative to the earth. The position of the moon relative to that of the sun contributes to the tidal phenomenon as well. At times, the gravitational force of the sun and moon are pulling on the water on the earth in line with each other causing high tides, while sometimes the moon and sun pull at right angles, causing low tides.

 The belief that human behavior can be influenced by the phase of the moon does not, however, have any significant scientific evidence to support it (Snelson 2004). While several studies have shown that a relationship can be demonstrated to exist, there is nothing in the literature to suggest a mechanism for the relationship. As an example, Liu and Tseng (2009) studied the behavior of financial markets in relation to the phase of the moon. Their statistical analysis determined that for the stock markets of G7 countries, the average return per investor is higher during the new moon than during the full moon. Interestingly, they found that in many Asian markets, the average return is higher during the full moon. They also discovered that there were more variations in average return per investor during the full moon in G7 nations. The authors conclude that this data is easily explained by behavior being altered by the phase of the moon, but again fail to suggest a mechanism by which the moon influences human behavior.

 An interesting instrument known as the BILE survey (Belief In Lunar Effects) was developed and has been given numerous times to many thousands of individuals. In one study of 325 individuals (Vance 2005), the author found that 43% of those surveyed thought that the phase of the moon had an effect on human behavior. Snelson (2004) goes on to confirm that nurses working in different wards had different scores on the BILE survey. As an example, those working in mental health wards had a higher BILE score than those working in an emergency room setting. Data from this survey shows that the work or living environment is strongly correlated to a belief in lunar effects, and as such the authors conclude that the mechanism for the upswing in emergency room visits or mental health ward problems is psychosomatic. That is, because many workers believe that more problems are likely on full moon days, they are more willing to perceive a situation as problematic or more likely to be on the “look-out” for evidence to support their theory.

 Removing the human factor from an experiment (and thus, it seems, removing our penchant for unconscious analysis and psychosomatic factors), would seem to be an interesting way to see if an organism can be affected by the phase of the moon. Bhattacharjee et. Al (2000) discovered that the number of humans bitten by dogs is significantly higher on the full moon than on any other day of the month. Further, Raegan et. al. (2007) describe a study in which more visits to a veterinary clinic were noted on “fuller moon” days (days with a large percentage of the moon illuminated, not necessarily just a full moon) than on other days. The authors go on to posit that the increase may be caused by increased nocturnal activity due to the added light from a fuller moon, but, they admit that their clinic is in an urban setting with copious artificial light. This makes the theory seem less plausible. They do not describe any other potential mechanisms. Even so, it must be noted that it is still humans who are bringing animals to the clinic, or humans who are being bitten by dogs, so we cannot completely exclude the behavior of humans even from these animal trials. The humans involved may be behaving in a way that induces injury or bites.

 While the literature is ambivalent on the subject, further study is certainly justified. The aim of this study is to determine if the behavior of high school students is influenced by the phase of the moon, using the number of discipline referrals filed each day as a proxy of behavior.

METHODS

 Data was collected from Tomkins-Seneca-Tioga BOCES in the form of several Microsoft Excel spreadsheets. The data ranged from the 2005-2006 school year to the 2010-2011 school year. The data for the 2010-2011 school year is incomplete and extends only to February, as the school year had not yet finished at the time of analysis. The average number of referrals on the full moon +/- three days was calculated for each year. The average number of referrals on all other days was also calculated. A Student’s t-test was used to evaluate the significance of the findings. In addition to the yearly calculations, all data for all school years was collected into one table for evaluation.

RESULTS

 The school years 2005-2006, 2006-2007 and 2008-2009 were the only years that showed a greater average number of referrals on the full moon +/- three days (FM) than on all other days (AO). Of those three school years, only the 2005-2006 school year had a significant difference (see figure 1). The 2006-2007 and 2008-2009 school years had a greater number of referrals on FM days, but the difference in the data was not significant. All other years showed more referrals on AO days, but only the 2007-2008 school year showed a significant difference.

 When all the data for all years (a total of 1,572 days of data) was collected and analyzed, the data showed that there were a greater number of referrals on AO days, though the results were not significant and the difference was slight (about 0.15 referrals per day).

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| --- | --- | --- | --- | --- |
| **School Year** | **Average Number of Referrals on FM days** | **Average Number of Referrals on AO days** | **T-test** | **Remarks** |
| 2005-2006 | 3.728571429 | 2.307064746 | 0.003266439\* | More referrals on FM days |
| 2006-2007 | 1.523809524 | 1.298578199 | 0.209050622 | More referrals on FM days, but data not significant |
| 2007-2008 | 1.507936508 | 3 | 0.000154989\* | More referrals on AO days |
| 2008-2009 | 3.385714286 | 2.819047619 | 0.162821896 | More referrals on FM days, but data not significant |
| 2009-2010 | 5.419354839 | 6.645454545 | 0.104687509 | More referrals on AO days |
| 2010-2011 | 6.285714286 | 7.213114754 | 0.227024133 | More referrals on AO days |
| ***All Years*** | ***3.483783784*** | ***3.635078969*** | ***0.305482202*** | ***More referrals on AO days*** |

Figure 1. The average number of referrals on FM and AO days. T-test results with an asterisk are significant (p-value < 0.05).

DISCUSSION

 This study, though not equal in scope to many others, is not unusual in that the data were, on the whole, somewhat ambivalent. Within the data set, there were three years during which there were more referrals on FM days than on AO days. However, the difference was significant in only one of these years. Overall, though, the data points to the fact that there is no significant difference between the number of referrals on FM days vs. AO days.

 The study has several limitations. The data has not been corrected for changes in administrators or teachers. The data also only encompasses six school years. This may not be enough time to see patterns that may emerge over a longer period of time. Further study is also needed to correct for the number of students enrolled (which changed each year) and for full moons that coincide with holidays, weekends, etc.

 All sources of error aside, the more salient discussion surrounds why the phase of the moon might have any effect on the behavior of students in the first place. Several studies and metastudies have shown that in a large number of situations ranging from maternity wards (Kuss and Kuehn 2008) and crisis call centers (Wilson and Tobacyk 1989) to emergency rooms in India (Zargar et. al. 2004) and hockey fights in Canada (Russl and deGraaf 1985), there is no correlation between the phase of the moon and human behavior. So why does this belief persist in the population?

 Rotton and Kelly (1985) devised a survey called the Belief In Lunar Effect (BILE) test. It has been administered widely and often, and in one case, 46% of undergraduate students surveyed indicated that they believed that humans behaved strangely during the full moon. Possible reasons for the persistence of this belief in the power of the moon can be attributed to folklore, stories or other societal reasons. The fact remains, however, that there is precious little science to back up these claims. Careful consideration will lead the reader to understand that the only two things that might have a reasonable chance of affecting behavior are the gravitational force exerted by the moon or the amount of light that it reflects toward the earth.

 The moon is in an eccentric orbit, and as such is at some points closer or farther away from the earth (by about 50,000 km). These changes, though, do not always line up with the phase of the moon. On average, the perigee (the closest point of the moon to the earth) only lines up with a full moon once about every 1.2 years. Even so, the force of gravity exerted by the moon is not much different during perigee and apogee.

 At the closest recorded perigee in recent history, the force of gravity between the earth and moon was about 2.31 x 1020 N. At the farthest calculated apogee, the force will be about 1.77 x 1020 N. While we are contending with very large numbers (on the order of 17,000 to 23,000 exanetwtons), the difference between these values is insignificant. It is also misleading, because we are concerned with the effect of gravity on humans, not the earth. Running those numbers, we find that at perigree, a 70 kg human would experience a force of 0.2179 N from the moon, while at apogree, the human would experience a force of 0.1687 N. Keeping in mind that a newton is very small amount of force, it is hard to imagine that this small change would have an effect on behavior, and even more difficult to find support for the idea in the literature.

 There is, however, some evidence that supports the idea that gravity (or the lack thereof) can affect humans physiologically, if not their behaviorally. Koga (2004) describes a study in which EMG readings were taken of neck muscles of an astronaut on earth and in space. The readings were different when the astronaut was performing the same task in the two environments. The author attributes this difference to the lack of a gravity cue to orient the subject. Further, Grabherr and Mast (2010) conducted a review of several other low-gravity studies, and found that certain aspects of cognition (such as estimated body tilt or writing with closed eyes) were affected by a lack of gravity. It would be a very large logical leap to suggest that simply because body movements or writing were different in altered gravity environments, that behavior would be altered as well.

 Going deeper, several studies presented by Sajdel-Sulkowska (2008) suggest that increased or decreased gravity can affect the development of the central nervous system in laboratory animals. Further, gene expression in the nervous system of mature laboratory animals can be altered with increased or decreased gravity. While both of these factors may logically lead to a change in behavior, the gravity changes described in the study were many times greater, more rapid and repeated than those experienced by humans from the moon.

 The one idea that has been put forth involving gravity is that of “human tidal waves.” The logic, however fuzzy, for this argument is that being made mostly of water, humans are affected in much the same way as large bodies of water, e.g., they experience tides. This logic is faulted to the point of absurdity; the only reasons that large bodies of water are affected are that they are (a) deformable, and (b) large. Their mass allows them to experience a greater force than a 70 kg human. In addition, humans are not always pointed toward the moon, and so the water, even if it was being tugged upon by the moon, would be moving in different directions in each person.

 The other factor that might be different between FM days and AO days is the amount of light reflected from the sun. It is highly unlikely that the amount of light reflected is a cause of behavioral changes in human. Full moon nights are not always clear, and, while there is evidence to suggest that length of day can affect human mood, hormone levels and gene expression, there is no evidence that suggests that the amount of moonlight can affect mood.

 Absent any factor that could logically affect the behavior of humans, we are left to conclude that the root cause of any possible changes in behavior is purely psychosomatic. That is, the persistence of the belief in lunar effects (as demonstrated by instruments such as the BILE survey) has caused humans to alter their behavior themselves, without any gravity or light induced physiological changes.

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