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Alida Westman

AN INVESTIGATION OF PARANORMAL BELIEFS AND SCIENCE MOTIVATION
AMONG PSYCHOLOGY AND BIOLOGY STUDENTS

By Eric Prichard

A Senior Thesis Submitted to the

Eastern Michigan University

Honors College

in Partial Fulfillment of the Requirements for Graduation

with Honors in Psychology

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Abstract

Samples of introductory psychology students, advanced psychology students, and advanced biology students completed the Revised Paranormal Beliefs Scale (R-PBS) and the Science Motivation Questionnaire (SMQ). Results indicated that introductory psychology students reported having more paranormal beliefs than either advanced psychology students or advanced biology students. The advanced psychology and biology students did not differ from each other in paranormal beliefs. The biology students reported higher levels of science motivation than psychology students at all levels. Subsequent exploratory analyses indicate that science motivation predicts lower levels of paranormal belief when the R-PBS scores are adjusted for the level of traditional religion. Further exploratory analyses indicate that differences in science motivation between advanced psychology and biology students disappear when the SMQ scores are adjusted for differences in perceived relevance of science to one's personal goals. This suggests that it may be beneficial for psychology instructors to focus on improving science motivation by emphasizing the ways in which science is relevant to their personal goals.

In 2003, a Seattle based think tank published a defense, along with a reproduction, of a 1999 fundraising proposal which has come to be called *The Wedge Document* (Discovery Institute). The document states that one of the primary goals of the think tank is “nothing less than the over throw of materialism and its cultural legacies” (Discovery Institute, 2003). Furthermore, the Discovery Institute (2003), as the think tank is called, claims that it has employed numerous scholars whose research into “developments in biology, physics and cognitive science raise serious doubt about scientific materialism and have re-opened the case for a broadly theistic understanding of nature.” In other words, the institute, which is at the forefront of a public relations battle on the behalf of those in favor of teaching Intelligent Design as a viable biological theory, is proposing a radical redefinition of science to include phenomena which cannot be observed or tested as possible explanations for natural events. At a time when there is an active attempt to displace the methodological naturalism by which science has accumulated knowledge that can be shared and understood across cultures, it is my opinion that a healthy skepticism and an appreciation for science is as important as ever for consumers of research. This is especially true for psychology students who are actively studying a science that has been marred with popular misconceptions (Taylor & Kowalski, 2004).

The American Psychological Association’s (2007) curricular guideline for undergraduate programs also emphasizes research and critical thinking as essential to psychology as a discipline. Nonetheless, there seem to be a number of stumbling blocks to the realization of the educational goals outlined by the APA. Taylor and Kowalski (2004) found that one is the pervasiveness of misconceptions in psychology. However, by carefully designing the curriculum for their introductory psychology courses, they found that they could reduce albeit not eliminate students’ misconceptions about the discipline. Specifically, they found that they experienced

problems convincing students to think of psychology as a science that is dependent upon research.

Holmes and Beins (2009) recently set out to determine whether there were any significant relationships between progress in the psychology major, science literacy, interest in science, enjoyment of cognition, the tendency of psychology students to see psychology as a science, and the career orientation of psychology students. While they found that science literacy did increase as psychology students took more advanced classes in the major, the increase in science *literacy* did not reliably predict an interest in science or a tendency to view psychology as a science. However, they found that an *interest* in science did predict the tendency to view psychology as a science and the tendency to enjoy cognition. Furthermore, they found that the tendency to have a stronger orientation towards clinical work, as opposed to research, did not reliably predict the tendency to view psychology as a science.

If, as Holmes and Beins (2009) demonstrated, the extent to which students of psychology are interested in science predicts their tendency to view psychology as science, it may well have repercussions for the way in which clinicians without any particular interest in science practice psychology.

The interest in science which Holmes and Beins (2009) explored might show up as a world view, and a scientific worldview has been found to be important. Specifically, Pettersen and Olsen (2007) found that among students planning to go into health services, those who held less scientific worldviews, as measured by their tendencies to accept paranormal beliefs, were more likely to endorse alternative medicine. If there are indeed some psychology students with clinical interests who do not view themselves as students of a science and do not consider the material they are learning as necessarily derived from scientific research, what are their

epistemic values? This is a crucial question, as the way clinicians evaluate knowledge will affect the way they evaluate potential treatments.

The purpose of this research was to begin to investigate the question of whether there really is a difference between the way clinically oriented students feel about learning science, or whether they have a greater tendency towards having the kind of paranormal beliefs that predicts support for alternative treatments than research oriented students feel. When trying to do the study, this purpose could not be implemented, because too few respondents expressed an interest in research oriented careers to make comparison feasible. As a result, a secondary research question became the primary topic of interest. This focused on comparing entry level psychology students with advanced psychology students in order to see whether progress through the psychology major had any effect on students' attitudes towards science and paranormal topics. I further compared psychology students to a sample of students who were pursuing either a major or minor in biology in order to investigate the extent to which the attitudes of psychology students differ from students in another science. This study included a comparison with biology students for two reasons. The first reason is that biology, like psychology, is a science that studies organisms and their interactions with their environments. An argument can be made that they are related sciences. The second reason for choosing biology is more practical. Limiting the study to students from only one other science limited the scope of this study for the sake of manageability. It was predicted that students in the biology major would tend to have a more positive attitude toward studying science than would psychology students taken as a whole. In addition, it was suspected that biology majors would tend to have fewer paranormal beliefs than psychology students as a whole. Introductory psychology students were expected to differ from biology students in their attitudes to a greater extent than advanced psychology students, because

the biology sample was taken from students who were fairly far along in their discipline. Advanced psychology students were predicted to have a more positive attitude toward studying science than students just beginning the major, but it was suspected that the extent to which paranormal beliefs are held would be more strongly predicted by the person's attitude toward studying science than progress in the psychology major. After testing the main hypotheses, several exploratory analyses were done using subscale data extracted from the two main questionnaires used in the study.

Method

Participants

The participants consisted of 112 undergraduate students ($M = 22.58$ yrs., $SD = 5.68$) at Eastern Michigan University. They were split into three samples: 50 students were taking EMU's introductory psychology course ($M = 22.52$ yrs., $SD = 7.92$), 46 students were enrolled in either a 300 or 400 level psychology course ($M = 22.93$ yrs., $SD = 2.67$), and 16 students were taking either a 300 or 400 level biology course ($M = 21.73$ yrs., $SD = 3.53$).

Instruments

After completing an Informed Consent Form, the subjects received a questionnaire booklet. The first questionnaire was the Revised Paranormal Belief Scale (Tobacyk, 2004), also referred to as the R-PBS. It consists of 26 statements about paranormal phenomena which are answered with a seven point Likert scale, anchored by Strongly Disagree (scored as 1), through Neutral/Uncertain (scored as 4), and Strongly Agree (scored as 7). According to Tobacyk (2004), the four week test-retest reliability for the full scale is .92. The validity is face validity. The questionnaire contains the following subscales: traditional religious belief, psi, witchcraft,

superstition, spiritualism, extraterrestrial life, and precognition. Scores for the subscales, and the test as a whole, are obtained by summing the responses.

The second scale was the Science Motivation Questionnaire (Glynn & Koballa, 2006; Glynn, Taasoobshirazi, & Brickman, 2009). The Science Motivation Questionnaire (SMQ) consists of 30 five-level items which pertain to a student's motivation to learn science or take part in scholastic activities that result in the learning of scientific material. The levels range from *never* motivated to *always* motivated. The scale is scored by assigning each level a numerical value from 1 to 5, with 1 indicating the lowest measure of motivation and 5 indicating the highest level of motivation, and adding all 30 items. Glynn, Taasoobshirazi, and Brickman (2009) obtained a Chronbach coefficient alpha of .93 as evidence of reliability. Further, in order to find evidence that the scale is valid, the authors correlated the scores with variables that might predict high science motivation. They found science motivation significant correlated with GPA ($r = .56, p < .01$) and with the belief that science is relevant to people's professional goals ($r = .51, p < .01$). If desired, the scale can be broken down into six sub-scales: intrinsic motivation, personal relevance, self-efficacy and assessment anxiety, self-determination, career motivation, and grade motivation.

Some additional questions asked about demographics, career interests, areas of academic concentration, and orientation to religion and science.

The questionnaires were distributed in classes and collected by the instructors during the first three months of 2010. Students received extra-credit for participating.

Results

Science Motivation Questionnaire

The tables below show summary statistics taken from the Science Motivation Questionnaire (SMQ) and a summary of the single factor analysis of variance used to determine whether there were differences between groups. A single factor analysis of variance revealed that at least two of the groups differed significantly. Post hoc *t*-tests revealed that advanced biology students were more motivated to learn science than either introductory psychology students ($t_{64} = 3.13, p < .01$) or advanced psychology students ($t_{60} = 2.32, p < .05$). There was no statistical difference between introductory and advanced psychology students ($t_{94} = -1.35, p = .18$).

Analysis of the Science Motivation Questionnaire (SMQ) Scores

SMQ scores			
<i>Groups</i>	<i>n</i>	<i>Mean</i>	<i>SD</i>
Intro Psych	50	101.88	15.84
Advanced Psych	46	106.09	14.44
Advanced Bio	16	115.75	14.03

ANOVA					
<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>
Between Groups	2351.17	2	1175.59	5.20	0.007
Within Groups	24627.93	109	225.94		
Total	26979.11	111			

Revised Paranormal Belief Scale

A similar analysis was performed on the data which were obtained from the Revised Paranormal Belief Scale (R-PBS). A single factor analysis of variance revealed that at least two of the groups differed from each other. Post hoc *t*-tests revealed that introductory psychology students were more likely to believe in paranormal events than either advanced psychology students ($t_{94} = 3.29, p < .01$) or advanced biology students ($t_{64} = 2.42, p < .05$). Not all of the students in the introductory psychology sample had identified as psychology majors or minors.

Even after removing those students from the sample and comparing only introductory psychology students planning to major or minor in psychology to advanced psychology students, a significant difference was still obtained between introductory psychology and advanced psychology students, with introductory psychology students reporting more paranormal beliefs ($t_{55} = 2.62, p < .05$). There was no significant difference between advanced psychology and advanced biology students ($t_{60} = .20, p = .84$).

Analysis of the Revised Paranormal Belief Scale (R-PBS) Scores

R-PBS scores

<i>Groups</i>	<i>n</i>	<i>Mean</i>	<i>SD</i>
Intro Psych	50	96.04	26.96
Adv Psych	46	78.15	26.24
Bio	16	76.56	31.04

ANOVA

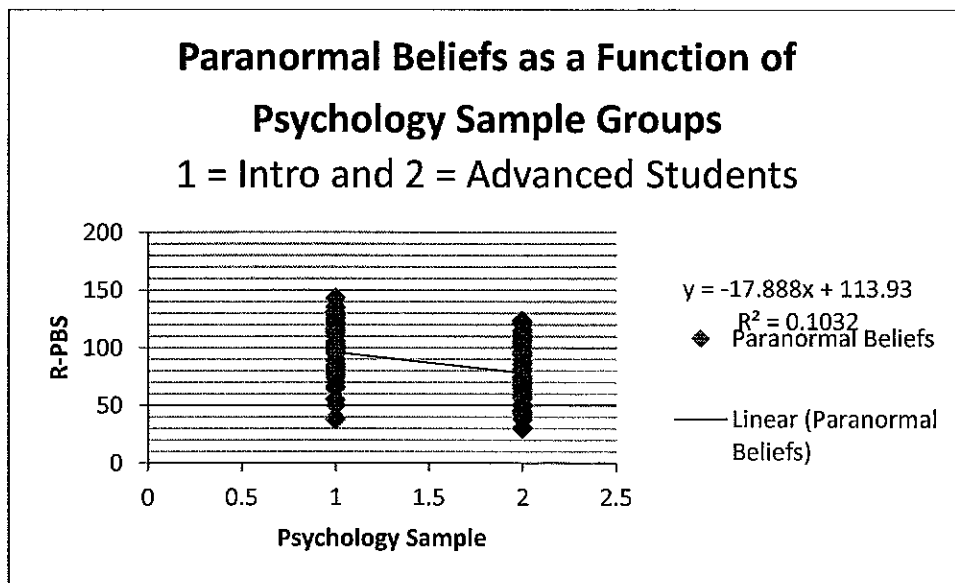
<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>
Between Groups	9297.31	2	4648.66	6.25	0.003
Within Groups	81061.79	109	743.67		
Total	90359.11	111			

Post Hoc Exploratory Analyses and Results

The subscales emphasize the importance and potential effectiveness of motivating psychology students to learn science when attempting to cultivate critical thinking skills. Further they provided several significant results that suggest further research.

In addition to using single factor analysis of variance, the analyses below also make use of the derivatives of trend lines to draw tentative conclusions. If we were to think of the data from the tables above in such a way that paranormal beliefs were taken as a function of linear

regression with paranormal beliefs and amount of psychology taken as predictor variables, the ANOVA's seemed to falsify the hypothesis that motivation to learn science was a better predictor of paranormal beliefs among psychology students than amount of psychology taken. Nonetheless it is useful to take another look at the relationships between these variables. First to be considered will be the relationship between group membership among psychology students and paranormal beliefs. An ANOVA showed that the two groups differed, with advanced psychology students holding fewer paranormal beliefs. Another way to show the same thing is to create a scatter plot, with an equation for a trend line, as shown below.



The square root of r^2 is r , which in the current case is about .321. The probability of obtaining this correlation coefficient by chance is about .0014, and this is roughly the p -value obtained after performing a t -test comparing the R-PBS means for the two groups. Furthermore, the slope of the trend, which is also the derivative of the trend line, is approximately equal to difference between the means of the two groups. Since the first derivative can be thought of as a rate of change, a mean difference of 17.9 points on the R-PBS can be thought of as an average rate of change of -17.9 points/progression through the psychology major. However, this is still a

correlational relationship. As a result it can't be definitively concluded that progression through the major is the actual cause of the change and that the difference is not the result of randomly obtaining a sample of advanced psychology students who were merely more skeptical in their thinking style. However, if a longitudinal study were to be conducted, the rate of change would become an effective tool for a measure of the relative effectiveness of a given science major at reducing paranormal beliefs if several samples from different majors were compared over time. As a result, a longitudinal study is suggested.

Thinking in terms of the slope and what it reveals, it would be possible to predict in theory how much a subject's R-PBS score would decrease on average with an increase in motivation to learn science as measured by the SMQ. It would not necessarily mean that motivation to learn science itself causes one to have fewer paranormal beliefs, but it may suggest that motivation to learn science can lead to a more skeptical kind of thinking or that more skeptically inclined individuals are drawn to learning science, or both. Nonetheless, the potential for gains in critical analysis of paranormal claims could strengthen the argument for attempting to increase science motivation among psychology students. However, among psychology students, the SMQ failed to significantly predict scores on the R-PBS ($r_{94} = -.0945$, $p = .36$). In fact, even when biology students were added, raising both sample size and the average SMQ score, the SMQ still failed to predict R-PBS scores ($r_{110} = -.18$, $p = .0572$).

Exploratory analyses were done with the subscales in order to understand the results better. A recent Pew Research Center (2009) poll indicated that 51% of scientists questioned either believed in God or a higher power, 48% were affiliated with a religion, and that younger scientists, some of whom were only slightly older than the typical student questioned in this study, were more likely to express a belief in God than older scientists. Given these findings, it

was suspected that the traditional religion subscale may have been artificially inflating R-PBS scores. When the mean scores from the religion subscales were compared across groups, a single factor ANOVA revealed that the three samples did not differ significantly ($F_{111} = 1.21, p = .302$).

Analysis of Religion Scores

Religion			
<i>Groups</i>	<i>n</i>	<i>Average</i>	<i>SD</i>
Intro Psych	50	19.24	7.93
Adv Psych	46	17.46	8.21
Bio	16	16.00	7.42

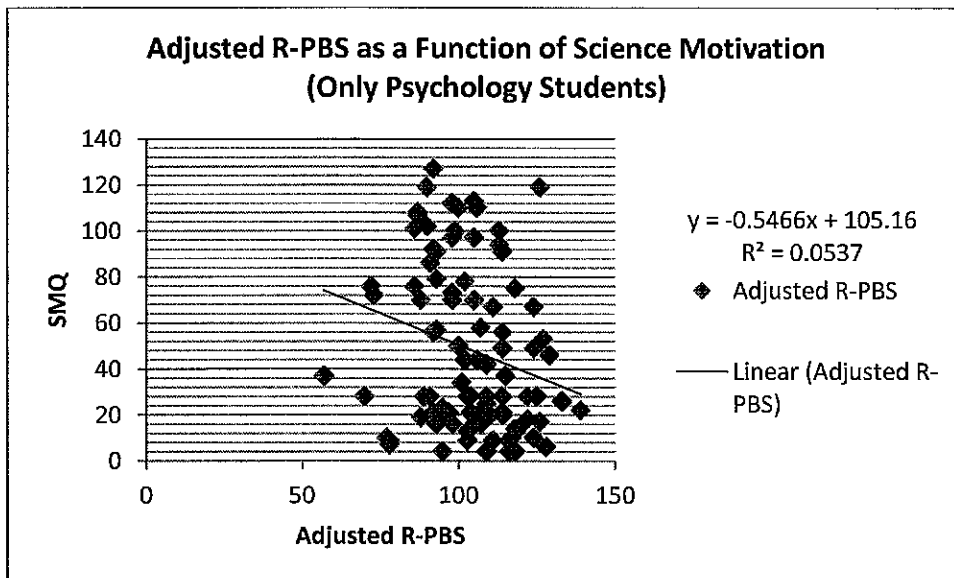
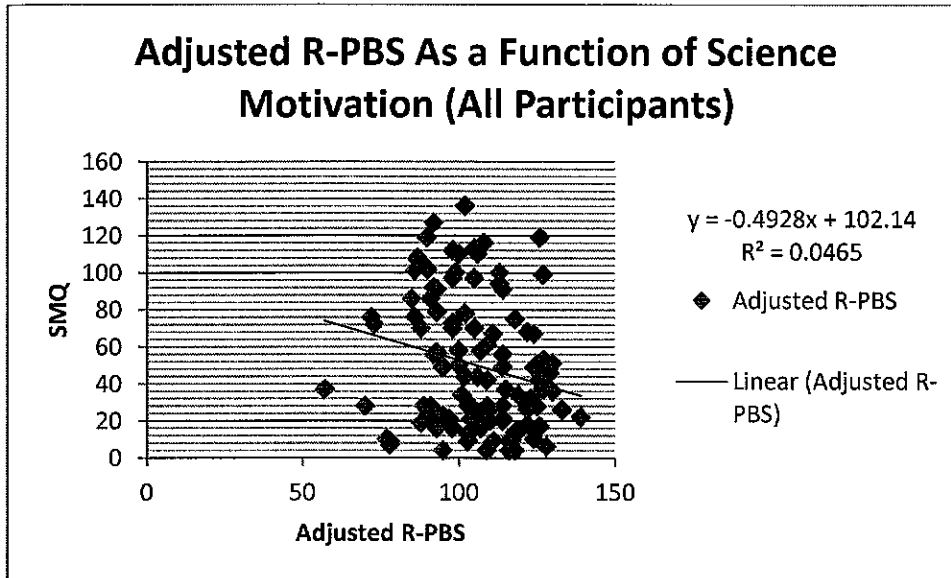
ANOVA					
<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>
Between Groups	154.2437	2	77.12	1.21	0.302
Within Groups	6940.533	109	63.67		
Total	7094.777	111			

When the mean scores of the R-PBS were compared while taking the religions subscale into account, a significant result was still obtained ($F_{111} = 5.11, p < .01$). In other words, when the P-PBS was adjusted by subtracting each subject's religion subscale score, introductory psychology students were still more likely to report having more paranormal beliefs. Hereafter the term "adjusted R-PBS" indicates the summed scores of the psi, witchcraft, superstition, spiritualism, extraterrestrial life, and precognition subscales. The adjustment is merely the removal of the data from the traditional religion subscale.

The correlation matrix reveals several important things. First, the religion subscale does not predict higher scores on the rest of the R-PBS ($r_{110} = -.017, p = .86$). Second, there is no significant relationship between religiosity, as measured by the R-PBS, and science motivation as measured by the SMQ ($r_{110} = .039, p = .68$). Finally, and most importantly, when the religion subscale data are subtracted from the R-PBS, there is a significant relationship between Science Motivation and the Revised-Paranormal Belief Scores ($r_{110} = -0.198, p < .05$). More striking still is the effect that ignoring religion has on the relationship between science motivation and paranormal beliefs among only psychology students. Whereas the relationship was non-significant when the entire R-PBS was taken as a function of the Science Motivation Questionnaire (SMQ), it also became significant when the adjusted R-PBS was taken as a function of the SMQ ($r_{94} = -.23, p < .05$).

With these relationships established, it is possible to return to slope. Though further research is needed to determine whether there is any kind of causal link between science motivation, especially as measured by the SMQ, and paranormal beliefs as measured by the R-PBS, the slope of a trend line can give a quick estimate of how much, on average, the increased motivation to learn science will predict a decrease in paranormal beliefs not associated with traditional religious belief. Consider the following two graphs.

Regardless of whether or not biology students are included, an increase of one point on the SMQ predicts an average decrease of around half a point on the adjusted R-PBS scale. If the trend were to hold, a modest increase in science motivation among advanced psychology students would have predicted a decline in non-religious paranormal beliefs to a level below that of the average biology student. However, the point form almost a circle around the line, suggesting that the correlation is very small and the effect, even at best, will be limited.



The final series of exploratory analyses dealt with the issue of why even advanced psychology students, on average, reported lower levels of science motivation than biology students. Using the findings of Holmes and Beins (2009) as a starting point, the SMQ subscale targeted the subscale labeled *relevance of learning science for personal goals*. If, as Holmes and Beins suggest, some clinically oriented students don't see psychology as particularly scientific or science as particularly interesting, might advanced psychology students, on the whole, be less

inclined to see science as relevant for their personal goals than biology students? A single factor ANOVA comparing the mean relevance scores of each sample revealed a highly significant difference, with biology students being, on average, more inclined to see science as relevant ($F_{60} = 10.54, p < .01$).

Analysis of Relevance of Science to Personal Goals

Relevance			
<i>Groups</i>	<i>n</i>	<i>Average</i>	<i>SD</i>
Advanced Psych	46	17.33	3.45
Bio	16	20.44	2.83

ANOVA					
<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>
Between Groups	114.92	1	114.92	10.54	0.002
Within Groups	654.05	60	10.9		
Total	768.97	61			

Given that the difference was very significant, a second single factor ANVOA comparing the SMQ scores of the two groups without scores from the personal relevance subscale was conducted. In other words, the SMQ was adjusted by subtracting only the personal relevance subscale data and summing only the data from the intrinsic motivation, self-efficacy and assessment anxiety, self-determination, career motivation, and grade motivation subscales. This time a barely significant difference was obtained ($F_{60} = 4.03, p < .05$).

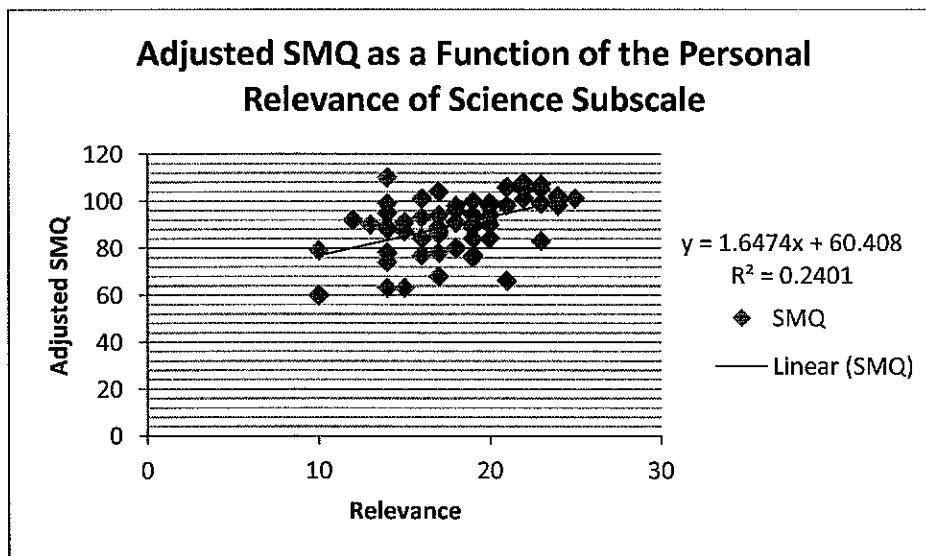
Analysis of the SMQ with Only the Personal Relevance Scale Subtracted Out and the Other Scales Summed together, that is, the Intrinsic Motivation, Self-Efficacy and Assessment Anxiety, Self-Determination, Career Motivation, and Grade Motivation Subscales

Adjusted SMQ			
<i>Groups</i>	<i>n</i>	<i>Average</i>	<i>SD</i>
Advanced Psych	46	88.52	11.6
Bio	16	95.31	11.79

ANOVA

<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>
Between Groups	547.42	1	547.42	4.03	0.049
Within Groups	8144.92	60	135.75		
Total	8692.34	61			

Without considering the SMQ's measure of the reported personal relevance of science, biology students and psychology students barely differed. This prompted a final analysis, which was conducted to investigate whether a higher reported sense of the relevance of learning science predicted higher scores on the other areas of the SMQ. First, the relevance scores of advanced psychology and biology students were correlated with SMQ scores that did not include the relevance measure. The correlation was highly significant ($r_{60} = .49, p < .0001$). Next, the following graph was constructed:



The slope of the trend line predicts an average 1.65 point increase on the overall non-relevance portions of the SMQ with every 1 point increase on the personal relevance subscale. If the trend were to hold, a modest increase in perceived relevance among psychology students would predict

the disappearance of a statistically significant difference between psychology and biology students on the combined non-relevance portions of the SMQ.

Discussion

This study explored whether motivation to learn science was higher among advanced biology than psychology students and higher among advanced than introductory psychology students. Further, the study explored whether increased motivation to learn science was associated with a decrease in paranormal beliefs. Biology students seem to have a greater motivation towards studying science, as measured by the Science Motivation Questionnaire (SMQ), than either psychology group, but biology students did not seem to hold fewer paranormal beliefs than advanced psychology students. Further, advanced psychology students were not statistically more likely to report higher levels of science motivation than beginning psychology students, and progression through the psychology major was a better predictor of a decrease in paranormal beliefs than science motivation.

While any statistically based conclusions are, on some level, tentative, those of the subsequent exploratory analyses which were done must be considered especially so. Nonetheless, the depth they add to the initial analyses and the support they lend for emphasizing the relevance of science in the psychology classroom make them worthy of consideration in future research. The inclusion of the *traditional religious belief* subscale suggested that religiosity was a critical factor. The Pew Research Center (2009) indicated that a majority of scientists in the U.S. believe in some sort of higher power, it suggests that the presence of religious thought may be a poor measure of whether a scientifically trained individual generally tends to think supernaturally or unscientifically. Indeed, there were no predictive relationships between scores on the religion subscale of the R-PBS and scores on the SMQ.

It cannot be definitively concluded that science motivation leads to more skeptical thinking regarding paranormal beliefs, and not that more skeptical people are more motivated to learn science; however, the mere possibility that increased motivation to learn about science could produce psychology students more critical of paranormal claims suggests that this relationship is worthy of further inquiry. Furthermore, ways to increase science motivation among psychology students should be investigated.

An investigation of one area of science motivation that may be worth targeting in future instruction revealed something that should be particularly disturbing to psychology instructors. Mining the SMQ's subscale data revealed that advanced psychology students reported significantly lower scores on the SMQ's subscale measuring *perceived personal relevance* of science for personal goals than did biology students. Plotting the relationship between this subscale and the rest of the SMQ revealed that the personal relevance subscale highly predicts higher combined scores on the non-relevance portions of the SMQ. Once again, although it cannot be firmly concluded that the relationship is causal, the possibility that doing a better job of convincing psychology students that science is relevant to their personal lives and to what they are doing could lead to more overall motivation to learn science. Furthermore, the mere fact that individuals who were pursuing either a major or a minor in a science, ostensibly in the pursuit of personal goals, were on average less likely to believe science to be relevant to their personal goals than another group of science students is itself a strong argument that more can be done to stress the relevance of science to psychology.

As a final note, several caveats should be mentioned. The sample sizes were smaller than initially planned. This was especially true of the biology sample. Future research should increase sample sizes and collect data from more samples. Furthermore, when introductory psychology

students were taken as a whole, the sample included students who did not indicate an intent to major or minor in psychology. If possible, future research of this sort may be better conducted in a longitudinal fashion, so that the individuals involved are definitely moving through a psychology curriculum and stronger evidence can be obtained for an effect that is the result of completing a psychology curriculum. The conclusions from the subsequent supplementary analyses are very tentative, but they suggested hypotheses for further research on the topics of science motivation and paranormal beliefs among students in psychology and other sciences. Further, the exploratory analyses provide some evidence that science motivation and the relevance of science should be more widely emphasized during instruction.

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Appendix A

The First Three Questions on the Questionnaire. These were followed by the Revised Paranormal Belief Scale (Appendix B), the Science Motivation Questionnaire (Appendix C), and other items, including demographic information (Appendix D).

1) What is your Major at EMU?

A. Psychology

B. Biology

C. Neither of these. Please indicate your intended Major _____

D. Don't know yet

2) What is your Minor at EMU?

A. Psychology

B. Biology

C. Neither of these. Please indicate your intended Minor _____

D. Don't know yet

3) Are you planning to concentrate mainly on a research-oriented career or a therapy, field service oriented career?

A. Research-oriented career

B. Therapy, field service

C. Both

D. Neither. Please indicate the type of job you would prefer _____

Appendix B

Revised Paranormal Belief Scale

Please put a number next to each item to indicate how much you agree or disagree with that item. Use the numbers as indicated below. There are no right or wrong answers. This is a sample of your own beliefs and attitudes. Thank you.

1=Strongly Disagree 2=Moderately Disagree 3=Slightly Disagree
4=Uncertain 5=Slightly Agree 6=Moderately Agree 7=Strongly Agree

1. The soul continues to exist though the body may die.
2. Some individuals are able to levitate (lift) objects through mental forces.
3. Black magic really exists.
4. Black cats can bring bad luck.
5. Your mind or soul can leave your body and travel (astral projection).
6. The abominable snowman of Tibet exists.
7. Astrology is a way to accurately predict the future.
8. There is a devil.
9. Psychokinesis, the movement of objects through psychic powers, does exist.
10. Witches do exist.
11. If you break a mirror, you will have bad luck.
12. During altered states, such as sleep or trances, the spirit can leave the body.
13. The Loch Ness monster of Scotland exists.
14. The horoscope accurately tells a person's future.
15. I believe in God
16. A person's thoughts can influence the movement of a physical object.
17. Through the use of formulas and incantations, it is possible to cast spells on persons.
18. The number "13" is unlucky.
19. Reincarnation does occur.
20. There is life on other planets.
21. Some psychics can accurately predict the future.
22. There is a heaven and a hell.
23. Mind reading is not possible.
24. There are actual cases of witchcraft.
25. It is possible to communicate with the dead.
26. Some people have an unexplained ability to predict the future.

Appendix C

Science Motivation Questionnaire (SMQ)

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In order to better understand what you think and feel about your college science courses, please respond to each of the following statements from the perspective of:

“When I am in a college science course...”

01. I enjoy learning the science.

Never Rarely Sometimes Usually Always

02. The science I learn relates to my personal goals.

Never Rarely Sometimes Usually Always

03. I like to do better than the other students on the science tests.

Never Rarely Sometimes Usually Always

04. I am nervous about how I will do on the science tests.

Never Rarely Sometimes Usually Always

05. If I am having trouble learning the science, I try to figure out why.

Never Rarely Sometimes Usually Always

06. I become anxious when it is time to take a science test.

Never Rarely Sometimes Usually Always

07. Earning a good science grade is important to me.

Never Rarely Sometimes Usually Always

08. I put enough effort into learning the science.

Never Rarely Sometimes Usually Always

09. I use strategies that ensure I learn the science well.

Never Rarely Sometimes Usually Always

10. I think about how learning the science can help me get a good job.

Never Rarely Sometimes Usually Always

11. I think about how the science I learn will be helpful to me.

Never Rarely Sometimes Usually Always

12. I expect to do as well as or better than other students in the science course.

Never Rarely Sometimes Usually Always

13. I worry about failing the science tests.

Never Rarely Sometimes Usually Always

14. I am concerned that the other students are better in science.

Never Rarely Sometimes Usually Always

15. I think about how my science grade will affect my overall grade point average.

Never Rarely Sometimes Usually Always

16. The science I learn is more important to me than the grade I receive.

Never Rarely Sometimes Usually Always

17. I think about how learning the science can help my career.

Never Rarely Sometimes Usually Always

18. I hate taking the science tests.

Never Rarely Sometimes Usually Always

19. I think about how I will use the science I learn.

Never Rarely Sometimes Usually Always

20. It is my fault, if I do not understand the science.

Never Rarely Sometimes Usually Always

21. I am confident I will do well on the science labs and projects.

Never Rarely Sometimes Usually Always

22. I find learning the science interesting.

Never Rarely Sometimes Usually Always

23. The science I learn is relevant to my life.

Never Rarely Sometimes Usually Always

24. I believe I can master the knowledge and skills in the science course.

Never Rarely Sometimes Usually Always

25. The science I learn has practical value for me.

Never Rarely Sometimes Usually Always

26. I prepare well for the science tests and labs.

Never Rarely Sometimes Usually Always

27. I like science that challenges me.

Never Rarely Sometimes Usually Always

28. I am confident I will do well on the science tests.

Never Rarely Sometimes Usually Always

29. I believe I can earn a grade of "A" in the science course.

Never Rarely Sometimes Usually Always

30. Understanding the science gives me a sense of accomplishment.

Never Rarely Sometimes Usually Always

Appendix D

Other items:

1. I am a very religious or spiritual person. YES NO
2. I pray or meditate at least once each day. YES NO
3. I try to live by my religious beliefs. YES NO
4. I attend religious services whenever possible. YES NO
5. As I was growing up, my parents were very religious. YES NO
6. I believe firmly in the teachings of my religion. YES NO
7. I consider myself very scientifically oriented. YES NO
8. When there is a conflict between religion and science, I go with the scientific findings. YES NO
9. Science should exclude non-natural explanations for events. YES NO

Demographics; these were the last questions

1. Sex A: Male B: Female

2. My marital status is:

- A. Single: *Never Married*
- B. Single: *Divorced or Separated*
- C. Single: *Widowed*
- D. Living with a significant other: *Unmarried, heterosexual relationship*
- E. Living with a significant other: *Unmarried, homosexual relationship*
- F. Married
- G. Remarried

3. How would you describe the economic situation of your family as you were growing up? We had:

- A. almost enough to get by
- B. enough go get by, but no more
- C. definitely enough of everything
- D. plenty of extras, but no luxuries
- E. plenty of luxuries

4. How would you describe your economic situation now?

- A. almost enough to get by
- B. enough go get by, but no more
- C. definitely enough of everything
- D. plenty of extras, but no luxuries
- E. plenty of luxuries

5. Your racial/ethnic group membership is:

- A. African-American
- B. Asian-American (including Indian and Pacific Island regions)
- C. Caucasian or Euro-American
- D. Hispanic American; Latino, Latina
- E. Native American
- F. Middle Eastern
- G. Other: *Please enter here:* _____

H. Multiracial: *Please enter here:* _____

Please put your scantron in the questionnaire and write your answers to these last two questions directly on the questionnaire.

6. My age is: _____

7. My religious affiliation is: _____

Please be as specific as possible