

REACTIONS TO RECEIPT OF A MESSAGE FROM EXTRATERRESTRIAL INTELLIGENCE: A CROSS- CULTURAL EMPIRICAL STUDY†

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Abstract—If we ever receive a message from extraterrestrial intelligence (ETI), the societal impact may be significant. To date, several authors have speculated on factors that may predict people's reactions, but there have been no systematic empirical studies on the range of responses. One obstacle to conducting such studies is that there has been no questionnaire to assess such reactions. In the current study we have designed a psychometrically sound set of scales to assess six beliefs: (1) that extraterrestrial life *exists*, (2) that ETI would be *benevolent* and that we *should respond* to a message, (3) that ETI would be *malevolent*, (4) that message receipt would be *unsettling*, (5) that message receipt would be *religiously significant* and (6) that *experts* should determine the content of a reply. We report on the construction and use of these new scales, drawing on data gathered from American and Chinese undergraduate students. Respondents also completed measures of alienation, optimism, anthropocentrism and religiosity. This allowed us to predict beliefs about ETI based on personal characteristics and beliefs of the respondents. © 2000 Elsevier Science Ltd. All rights reserved

1. INTRODUCTION

With the continuation of programs in the search for extraterrestrial intelligence (SETI) and the concomitant possibility of a successful search, it is becoming increasingly important to assess individuals' beliefs about extraterrestrial intelligence (ETI). Prior to contact, this can fulfill the pragmatic purpose of identifying what kinds of individuals are most and least supportive of SETI programs, which could have implications for funding of SETI. After signal detection, a range of responses might be expected as individuals adjust to a new sense of their place in the universe. But to date, there has been little empirical research to suggest the factors that may influence these responses.

In the current study, we examine variables that predict beliefs about ETI, including attitudes about the prevalence of extraterrestrial life, the probable nature of ETI, and appropriate responses after signal detection. First, we describe the construction of a series of scales that can be used to assess these beliefs. Then we explore the extent to which these beliefs can be predicted by a person's religious beliefs, level of optimism, level of alienation and

degree of anthropocentrism. The current study has the unique feature of assessing attitudes of both Americans and Chinese.

Several earlier studies have examined whether or not people believe that extraterrestrial life is likely to exist [1–7]. Although these studies shed light on attitudes relevant to SETI, many of these surveys included questions specifically about UFOs, which are not the focus of traditional SETI programs. Many prior studies also have the limitation that they are based on single questions for each domain. However, a single question is unlikely to tap fully the network of interrelated ideas that people draw upon when reflecting on issues as complex as whether or not ETI exists, and if it does, what it would be like. Thus, in the current study we have empirically identified sets of interrelated statements that more adequately capture the complexity of people's beliefs about ETI.

Previous work that goes beyond beliefs about the likelihood of ETI existing, and instead focuses on predicting people's reactions to news of contact with ETI has been largely theoretical. For example, it has been proposed that we can examine possible reactions to learning ETI exists along a continuum — from extreme negative (“paranoid”) reactions, through neutral reactions, to extreme positive (“pronoid”) responses [8]. But to date there has been no empirical investigation of whether a particular person's responses to signal detection would all lie at the same point

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along this continuum, or whether the same person might have divergent — and perhaps even contradictory — responses. One possibility is that any particular person will tend to view contact with ETI as being either positive, negative, or neutral — but only one of these three. However, it is also conceivable that the same person could have strong hopes that ETI will be benevolent, but also have grave concerns that ETI may be malevolent. One purpose of the current study is to examine empirically whether beliefs about ETI fall along a continuum *for individuals*, or whether we can better understand the various responses as independent — though possibly interrelated — factors.

In addition, we will examine whether we can systematically predict people's attitudes about ETI by knowing their personal characteristics. For example, religious beliefs have been shown to be related to beliefs about the likelihood of ETI existing. Specifically, fundamentalist Christians are less likely to believe ETI exists than are less fundamentalist individuals [2,4]. But how would religiosity affect a person's beliefs *after* learning that we had detected a signal from ETI? How would religious beliefs affect whether a person views ETI as likely being benevolent, malevolent or religiously significant?

Alternatively, how would factors like dispositional optimism and feelings of alienation affect views of ETI? It seems plausible that an initial signal from ETI may be difficult to understand [9,10]. Even if it were clear that a message were superimposed on the signal, it may take some time before it would be decoded [11]. In the meantime, people might try to make sense of an ambiguous situation by projecting some of their own attributes onto the senders of the message. Thus, optimistic people may view ETI as being benevolent, whereas alienated people may see ETI as harsh, cold and rejecting, much as they experience the rest of the world. On the other hand, people may not project their *fears* and *concerns* onto an ambiguous signal, but rather their *wishes* and *hopes*. People who feel that their lives lack sufficient meaning may imbue the message with meaning, hoping that the senders are benevolent, or that their message might provide comfort and wisdom.

Similarly, we would expect anthropocentric individuals to be more skeptical about the existence of ETI, because this would demonstrate that humankind is, in certain respects, not unique and does not occupy a privileged place in the universe. But after a signal is detected, how would anthropocentric individuals respond?

Finally, what factors influence people's beliefs about whether we should send a reply? Recently, over three-fourths of Spanish people surveyed were in favor of responding to a signal from ETI [5]. But what discriminates those who favor a response, and those who do not? Moreover, if a message is sent,

who should construct it — a range of individuals from all walks of life or a group of experts?

2. METHOD

2.1. Subjects

Subjects for the current study were undergraduate students at the Chinese University of Hong Kong, Shatin, New Territories, Hong Kong and at Vanderbilt University, Nashville, TN, USA. To ensure that the following analyses would not be biased by unequal numbers of subjects in the two groups, or by differing proportions of male and female subjects of the two nationalities, each group consisted of 137 subjects, with 89 women and 48 men from each country. Thus, a total of 274 subjects were used for the analyses described in this study. For each sex, the two groups were matched as closely as possible on age. Within these constraints, subjects were randomly selected from a larger pool of 395 students, with the maximum number of subjects used that would allow the two groups to have equal numbers of men and women.

2.2. Existing measures for characterizing individuals

Individual differences between subjects were assessed in four domains. Dispositional optimism was measured by the six-item Revised Life Orientation Test [12], which consists of statements such as "Overall, I expect more good things to happen to me than bad". Anthropocentrism was assessed by Factor A of the Anthropocentrism Scale [13,14], which contains 10 items such as "Man is the most important species on earth". Religiosity was measured by Genia's nine-item scale of Intrinsic Religiosity [15], based on the Allport-Ross Religious Orientation Scale [16,17]. This measure of religiosity is particularly appropriate for cross-cultural studies because it includes statements about the inner significance of religions without reference to a particular religious tradition, such as "Religion is especially important to me because it answers many questions about the meaning of life". Finally, degree of alienation was measured by six items of the Margins of Society (MOS) Alienation Scale [18], which includes statements such as "My whole world feels like it's falling apart". Each of these four scales was used to predict beliefs about ETI, as described below.

2.3. New measures assessing beliefs about ETI

Two types of scales were constructed for assessing beliefs about ETI. First, participants responded to 20 items generated to assess their current beliefs about ETI, such as "I just cannot seriously believe that we will ever make contact with extraterrestrials". These 20 items were presented along with

the items of the four predictor variables noted above. All items in all scales were rated on a 6-point Likert-type scale, where 1 = completely disagree, 2 = moderately disagree, 3 = slightly disagree, 4 = slightly agree, 5 = moderately agree, and 6 = completely agree. For each item, subjects were responding to the following instructions: "For each statement, circle ONE number that best describes your view".

Immediately after completing the above items, subjects were presented with the following hypothetical scenario: "Imagine that we have received a radio signal with a message from intelligent life in outer space. For each of the following statements, assume that a message from extraterrestrials (ETs) has already been received. For each statement, circle ONE number that best describes your view". Subjects then responded on the 6-point Likert-type scale described above to 60 items generated to cover four domains: probable benevolence of ETI, probable malevolence of ETI, religious significance of ETI and appropriate reply policy.

3. RESULTS

3.1. Analyses

Separate factor analyses were conducted for (1) the 20 items assessing beliefs about the existence of extraterrestrial life and (2) the 60 items tapping post-contact reactions. Factor solutions were transformed using a varimax rotation, which yields relatively independent factors. In both analyses, the largest number of factors was extracted that met the standard criterion of having an eigenvalue > 1.0 . For each factor, items with factor loadings of at least 0.40 in absolute magnitude were retained for inclusion on a corresponding scale created to summarize this factor. Scales with at least minimal internal consistency were retained, as assessed by values of Cronbach's $\alpha > 0.65$. Using these criteria, a single factor was extracted from the 20 items assessing beliefs about the *existence of life beyond earth* (13 items loading at > 0.40 ; $\alpha = 0.90$). In addition, five distinct factors were extracted from the 60 items about post-contact reactions. These factors assess beliefs that (1) ETI would be *benevolent* and/or that we *should reply* (15 items; $\alpha = 0.87$), (2) ETI would be *malevolent* (8 items; $\alpha = 0.77$), (3) ETI would provide *religious guidance* (11 items; $\alpha = 0.86$), (4) learning about ETI would be *unsettling* (5 items; $\alpha = 0.68$), and (5) *experts* should construct reply messages (4 items; $\alpha = 0.75$).

The fact that separate factors were found for beliefs that ETI would be benevolent and malevolent, as well as that receipt of a signal would be unsettling, suggests that it may be useful to consider reactions not in terms of a single dimension ranging from paranoia to pronia, but rather in terms of discrete responses that may be evidenced by the

same individual. That is, these findings suggest that any given individual may have expectations that ETI could be benevolent *and* that they may be malevolent, and that this may not be a simple "either/or" view. This independence of the two factors of benevolence and malevolence is particularly striking for the Chinese students, for whom the correlation was a mere -0.01 ($p < 0.94$). In contrast, American students showed the pattern that is predicted by a more unidimensional model of reactions: there is a significant negative correlation between their scores on the factors of benevolence and malevolence ($r = -0.36$, $p < 0.001$). That is, American subjects who believed that ETI are likely to be benevolent were unlikely to think they might also be malevolent. The Chinese students appeared not to view the possibilities as dichotomously as the American students.

Items loading heavily on each factor are indicated, followed by their factor loadings. An item is reverse scored if the sign of its factor loading is the opposite of the sign of the majority of items on that scale. For example, in the scale measuring belief that extraterrestrial life is prevalent, the item "Humans are the only intelligent form of life in the universe" would be reverse scored. That is, responses by subjects who responded "6" (completely agree) would receive a score of "1" for that item, and so on for other scores ("5" changes to "2," "4" changes to "3", etc.) so that a high score on the scale corresponds to belief that extraterrestrial life is likely to be common.

After listing the items in each scale, we list the predictor variables that are significantly correlated with that scale. In all cases, we report only those correlations that are significant at $p < 0.05$. For the two nationalities separately, we identify which of the predictor variables (measures of optimism, alienation, religiosity and anthropocentrism) is significantly correlated with the total scale score.

3.2. Scales about ETI and their significant predictors

3.2.1. *Prevalence of extraterrestrial life.* The following items loaded heavily on a factor reflecting the belief that extraterrestrial life would be common:

1. There are so many stars in the universe that there must be life around some of them (0.81).
2. Because the laws of nature are the same throughout the known universe, extraterrestrial intelligence probably exists (0.79).
3. Perhaps some day humans and extraterrestrials will make contact with one another (0.78).
4. I just cannot seriously believe that we will ever make contact with extraterrestrials (-0.74 ; reverse score item).
5. Spacecraft from other planets may be observing the earth right now (0.71).

6. There are no forms of life in other star systems that are as advanced as humans (-0.71 ; reverse score item).
7. Any of our spacecraft that leave our solar system should carry messages on them, just in case they are found later by extraterrestrials (0.66).
8. A search for messages from extraterrestrials will probably be successful if it lasts long enough (0.64).
9. We should send space probes to other stars to try to make contact with extraterrestrials (0.64).
10. It is a waste of education to have scientists spend their time looking for extraterrestrials (-0.57 ; reverse score item).
11. Governments should refuse to fund radio searches for extraterrestrials, because the money could be used better here on earth (-0.47 ; reverse score item).
12. If extraterrestrial civilizations exist, they are probably very advanced compared to our civilization (0.46).
13. Humans are the only intelligent form of life in the universe (-0.44 ; reverse score item).
1. We should send a reply message because perhaps ETs could help us with some of the problems we face here on earth (0.71).
2. We should send a reply message so that we can open up a two-way dialogue with the ETs (0.65).
3. ETs are probably kind and caring toward humans (0.63).
4. If we replied to the message from ETs, they would probably send us an even more detailed message (0.62).
5. ETs could probably help us solve some of our environmental problems (0.61).
6. ETs would probably value and respect the differences between themselves and humans (0.61).
7. ETs could probably teach us how to live together in peace and harmony (0.60).
8. We should help ETs if this does not harm us (0.52).
9. We should send a reply message because it's only fair, since they sent us a message (0.51).
10. Humans would probably be able to understand the message from ETs if we took enough time (0.47).
11. ETs are probably honest in what they say in the message (0.45).
12. No matter what scientists reported, I would be skeptical about ETs existing because it goes against my religious beliefs (-0.44 ; reverse score item).
13. In the most important ways, humans and ETs are probably basically the same (0.43).
14. We should not send a reply message under any circumstances (-0.41 ; reverse score item).
15. ETs would probably hope to learn about what makes life meaningful for humans (0.40).

For both American and Chinese subjects, more religious subjects were less likely to believe in the existence of extraterrestrial life as compared to less religious subjects ($r = -0.42$, $p < 0.001$; $r = -0.39$, $p < 0.001$, respectively). This is consistent with previous studies that have focused more specifically on Christian beliefs, finding that fundamentalist Christians are less likely to believe that extraterrestrial life exists [2,4].

As might be expected, more anthropocentric students from both countries were also less open to the existence of extraterrestrial life than were their less human-centered counterparts (American $r = -0.25$, $p < 0.004$; Chinese $r = -0.45$, $p < 0.001$). This is in opposition to Dreger and Chandler's [14] claim that "the suggestion...that belief in extraterrestrial life is somehow related to anthropocentrism...seems to be a false lead" (p. 201). The discrepancy between the current study and that of Dreger and Chandler may be due to the specific three items used by the latter in constructing their scale for assessing beliefs in extraterrestrial life, as compared to the broader and more complete range of 13 items in the present study. The current study is more consistent with the expected finding that anthropocentric individuals may find the notion of extraterrestrial life inconsistent with their view that humans occupy a privileged place in the universe.

The remaining scales constructed in this study are drawn from the items that were presented in the context of a hypothetical scenario in which we receive a signal from ETI.

3.2.2. *ETs are benevolent/we should reply.* The following items loaded heavily on a scale assessing beliefs that ETI will be benevolent and/or that we should reply to their message:

For American students, the only significant predictor of a belief that ETI would be benevolent and that we should send a reply message was religiosity. Specifically, *less* religious Americans were more likely to think that ETI would be benevolent and that we should reply ($r = -0.26$, $p < 0.003$). This is consistent with a previous study of American college students [2], which indicated that "there is...perhaps something in irreligiousness which encourages support [of communication with ETI]" (p. 302). Alternatively, this could indicate that more religious students have a fear of contact with ETI.

For Chinese students, increased belief that ETI would be benevolent was predicted by lower scores on the Anthropocentrism Scale ($r = -0.17$, $p < 0.047$). That is, students who were less invested in believing that humans are at the center of the universe were more likely to assume ETI would be benevolent and that we should attempt to reply to a message we might receive.

3.2.3. *ETs are malevolent.* The following items compose the scale measuring beliefs that ETI may be hostile or malevolent:

1. ETs are probably looking for planets they can take over for themselves (0.67).
2. ETs would probably want to make humans their slaves (0.66).
3. ETs would probably look at humans like we are nothing more than animals that belong in their zoos (0.57).
4. If we reply to the message from ETs, they might come to earth and take over our world (0.56).
5. We should not reply to the message from ETs because they might be hostile (0.46).
6. The message from ETs may contain a hidden message that could be harmful to humans (0.45).
7. We should not believe what the message says, because the ETs may be lying (0.43).
8. Humans would probably not be able to understand the message from ETs because humans and ETs are just too different (0.41).

For both Americans and Chinese, more alienated subjects were more likely to think that ETI would be hostile ($r = 0.19, p < 0.031$; $r = 0.25, p < 0.003$, respectively). This suggests that alienated people in both countries may carry their view of the world into their assumptions about what ETI would be like. In the same manner, less optimistic Americans were also more likely to view ETI as being malevolent ($r = -0.20, p < 0.024$). Thus, there is evidence that people's negative expectations can generalize to their views about ETI.

For Americans only, more intrinsically religious individuals were more likely to view ETI as being hostile or untrustworthy ($r = 0.22, p < 0.013$). This is consistent with the finding noted above: less religious Americans more often thought that ETI would be benevolent.

3.2.4. Message receipt would be unsettling. Five items tap attitudes about the extent to which it would be disturbing to learn of the existence of ETI:

1. The night I learned that ETs existed, I would probably have a bad dream (0.59).
2. Learning that ETs exist would probably cause widespread panic among people (0.57).
3. I would be somewhat afraid to know exactly what ETs look like (0.53).
4. It would be disturbing to learn that humans are not the only intelligent beings in the universe (0.50).
5. It's natural to feel a bit uneasy about ETs (0.50).

In a manner reminiscent to their attitudes about the likelihood of ETI being benevolent, more anthropocentric Chinese participants were more likely to view receipt of a message as being unsettling than were less human-centered Chinese ($r = 0.27, p < 0.002$). Again, this may reflect the challenges that will face certain persons if we discover that we are not the only intelligent race in the universe.

3.2.5. Religious significance of ETI. The following items measure the extent to which individuals believe that contact with ETI would have religious significance:

1. We would probably gain a lot by the religious teachings of ETs (0.77).
2. ETs could probably offer us spiritual guidance (0.70).
3. ETs could probably help us solve some of our economic problems (0.65).
4. ETs could show us religious truths that we do not yet know (0.60).
5. The message from ETs might actually be a sign from God (0.60).
6. Learning that ETs exist would probably make us a little bit closer to God (0.57).
7. ETs could probably help us solve some of our social problems (0.57).
8. ETs could probably teach us how to live forever (0.54).
9. ETs probably sent the message in part to spread their religious views (0.51).
10. ETs would probably look to us for guidance (0.42).
11. Humans have a moral responsibility to help ETs (0.41).

Only one significant predictor was found for the belief that ETI would provide spiritual guidance or otherwise be religiously significant. For Chinese subjects only, more alienated individuals were more likely to believe in the religious significance of ETI ($r = 0.24, p < 0.005$). As we noted earlier, more alienated individuals from both countries were more likely to see ETI as being malevolent. But for the Chinese participants, there is also an indication that alienated individuals may look to ETI for a sense of meaning that they currently find lacking. Thus, for more alienated Chinese students, while ETI can potentially be dangerous, they may also offer a sense of hope.

3.2.6. Experts should design reply messages. Finally, four items reflect the view that if a reply message is sent from earth, the content should be decided cautiously, under the supervision of experts:

1. A team of experts should be responsible for deciding the content of a reply message (0.73).
2. We should be very careful about what we say in a reply message (0.69).
3. The decision about what to say in a reply message is much too important to be left to amateurs (0.58).
4. The most talented and insightful people on earth should design a reply message, if one is sent (0.57).

For subjects of both nationalities, more anthropocentric individuals were more likely to want to rely on experts for issues concerning a reply message

(American $r = 0.18$, $p < 0.041$; Chinese $r = 0.23$, $p < 0.007$). This may reflect a tendency of anthropocentric individuals to rely more on established authority, while less anthropocentric persons may emphasize more egalitarian approaches.

4. DISCUSSION

4.1. Personal characteristics and beliefs about ETI

4.1.1. *Paranoid and pronoid expectations: unidimensional or discrete factors?* As has been noted before, “Human responses to significant events such as an ETI signal constitute a continuum, rather than a set of discrete behaviors” [8, p. 74]. While this may be an accurate description of the range of possible reactions for people as a *group*, to what extent does this apply to any particular *individual*? There may be a continuous range of responses to the detection of a signal from ETI, but does this necessarily mean that any single individual will be confined to only one type of reaction?

The current study suggests that the answer to this question may vary from one culture to another. As noted above, for American students, the belief that ETI would be malevolent was seldom held by those who thought ETI would be benevolent. Likewise, Americans who thought ETI would be benevolent were very unlikely to anticipate that signal detection would be unsettling ($r = -0.26$, $p < 0.003$). In short, it was unusual for Americans to see ETI as simultaneously “good guys” and “bad guys”.

For Chinese students, however, this dichotomous thinking was not evident. Instead, it was perfectly conceivable for the same person to view ETI as likely to be benevolent *and* to have significant concerns that ETI might have hostile intentions towards humans. Unlike American students, there was no significant relationship between views that ETI would be benevolent and that news of contact would be disturbing ($r = -0.11$, $p < 0.211$). This may suggest that Chinese subjects were more likely to anticipate a complex array of consequences of detecting ETI. In their view, the impact might not be simply positive or negative, but both.

4.1.2. *Alienation.* When individuals interpret an ambiguous situation in the absence of adequate information, their interpretation often says more about the individuals than it does about reality. This is likely to be the case with the detection of a signal from ETI. The scenario used in the current study noted that the radio signal bore a message from ETI, but no details were provided about the actual content of the message. In spite of the optimistic predictions made by some people that messages from ETI will be easy to decode because they will be written in the “language” of science and mathematics, the socially constructed nature of scientific knowledge [19] may make the process of

decryption very difficult and time consuming [11]. Thus, initial reactions to signal detection may well occur in the absence of much concrete knowledge about the ETI transmitting the signal. This provides an ideal context for individuals to “project” their own views of the world onto the elusive senders of the signal.

This process of projection seems to be present with respect to alienation. For both nationalities, the more alienated individuals were more likely to see ETI as hostile — just as the alienated person’s world itself seems hostile. As noted above, one of the statements used to assess alienation was “My whole world feels like it’s falling apart”. For the person agreeing with statements like this, there was also a sense that ETI would have a negative impact on humankind.

However, once again the Chinese subjects showed a tendency to imagine positive implications of a potentially negative situation. Those Chinese students who believed that ETI would be hostile were also more likely to think that signal detection would have great religious significance ($r = 0.17$, $p < 0.049$). In contrast, there was no significant correlation between these beliefs for American subjects ($r = 0.03$, $p < 0.694$).

4.1.3. *Optimism.* Dispositional optimism refers to a person’s tendency to expect positive outcomes across a range of contexts and events. In the current study, it was assessed by items such as “In uncertain times, I usually expect the best”. We found that generalized optimism was predictive of only one belief about ETI, and that only for Americans. In addition to *alienated* Americans believing that ETI would likely be malevolent, as noted above, dispositionally *less optimistic* Americans also thought ETI would have hostile intentions ($r = -0.20$, $p < 0.024$). This suggests that more pessimistic Americans expected ETI to be similar to the world as these subjects typically experience it: negative. This correlation was not significant for Chinese students ($r = -0.09$, $p < 0.287$).

4.1.4. *Anthropocentrism.* The view that humankind is of central importance in the larger scheme of things would take on a new meaning if ETI were discovered. Typically one might think of anthropocentrism as focusing on the central role that humankind plays *on earth*, when compared to other terrestrial life. For example, one item on the scale used to measure anthropocentrism in the current study is “No matter how we define ‘superiority’, it seems that man must be considered superior to all known forms of life”. However, the current study suggests that anthropocentric attitudes can be understood in a broader cosmic context. As we have seen, for both American and Chinese subjects, more anthropocentric individuals were less likely to believe that life exists beyond earth.

If some day we discover an extraterrestrial civilization, particularly if it is technologically more advanced than our own, we can anticipate from the current study that more anthropocentric individuals from both countries will be more likely than others to turn to experts to decide on the contents of any reply messages. Moreover, we would expect that more anthropocentric Chinese individuals would find signal detection more unsettling, and they would be less likely to think the senders of the signal would be benevolent. Indeed, the discovery of life beyond earth, particularly intelligent life, could pose a significant challenge to the world view of strongly anthropocentric individuals.

4.1.5. Religiosity. In one respect, religiosity relates to beliefs about extraterrestrial life in the same way that anthropocentrism does: for both Americans and Chinese, those who were more religious were less likely to think that extraterrestrial life exists. This may reflect the perception that extraterrestrial life is in some way incompatible with religious beliefs. Only for Americans, however, was religiosity related to beliefs about the *nature* of ETI. Those Americans who were more religious were also more likely to view ETI as having hostile intentions. And as might be expected from the other findings suggesting that Americans see the possible benevolence and hostility of ETI as polar opposites, highly religious Americans were also prone to view ETI as being less benevolent.

Although there was no significant relationship between intrinsic religiosity and the anticipated religious significance of signal detection for either nationality, for only Americans the expected religious significance was related to beliefs about (1) the likelihood of extraterrestrial life existing and (2) beliefs about how unsettling signal detection would be. Specifically, those Americans who thought a message would have religious significance were more likely to believe that extraterrestrial life exists ($r = 0.37, p < 0.001$). Moreover, those Americans who thought signal detection would be religiously significant were less likely to view signal detection as unsettling ($r = -0.18, p < 0.041$). It seems that those Americans who viewed message receipt as spiritually significant were both more open to life existing beyond earth, and less apprehensive about making contact.

4.2. Future research directions

4.2.1. Generalizing from the results. One limitation of the current study is its exclusive reliance on data from young adults, making it difficult to apply directly to other age groups. Also, subjects were recruited from only a single university in each of only two countries. Moreover, it is not clear to what extent self-reports about likely responses to news that a signal has been detected would correspond to real responses at some future

date. Finally, although correlations were calculated for the two groups separately, we did not indicate statistical differences *between* American and Chinese responses. Subsequent studies are recommended, in which a wider range of subjects, methodologies and statistical analyses are employed.

4.2.2. Interactions between variables. In the current study, we have reported on the construction of new instruments for assessing beliefs about ETI and post-contact reactions. In addition, we have illustrated ways that imagined reactions might be predicted based on respondents' characteristics. For ease of exposition, we have described relationships between variables in simple terms: the statistical significance of correlations between variables. More complex methods of analysis, such as multiple regression, can *combine* several independent variables to provide an even better prediction of people's attitudes about ETI.

An additional consideration for future studies is that prediction need not rely only on the combination of isolated variables. We agree with the recommendation produced by the Workshops on the Cultural Aspects of SETI [8]: "The preliminary approach that we have adopted in this report identifies separate variables that motivate behavior, but does not specify the ways in which interactions among the variables influence behavior. Studies are needed to learn how these various elements interact" (p. 123). As a case in point, in the current study, five of the six attitudes about ETI or contact could be predicted with even greater accuracy if we also look at the interactions between variables. (For each of these five scales, at least two interactions were significant.) More detailed reports of these results are planned.

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REFERENCES

1. Ashkenazi, M., Not the sons of Adam: religious responses to ETI. *Space Policy*, 1992, **8**, 298–304.
2. Bainbridge, W. S., Attitudes toward interstellar communication: an empirical study. *Journal of the British Interplanetary Society*, 1983, **36**, 298–304.
3. Lavrakas, P. J. and Rosenbaum, D. P., Assessing belief in extraterrestrial life: The BEXTL Scale. *Journal of UFO Studies*, 1978, **1**, 26–30.
4. Rosenbaum, D. P., Maier, R. A. and Lavrakas, P. J., Belief in extraterrestrial life: a challenge to Christian doctrine & fundamentalists? *Journal of UFO Studies*, 1979, **2**, 47–57.
5. Sabadell, M. A. and Salamero, F. J., How do people feel the contact with ETIs? *SPIE Proceedings*, 1996, **2704**, 172–183.
6. Saunders, D. R., Factor analysis of UFO related attitudes. *Perceptual and Motor Skills*, 1968, **27**, 1207–1218.
7. Simon, A., Systematic replication of Saunders' (1968)

- attitude factors. *Perceptual and Motor Skills*, 1979, **48**, 1199–1210.
8. Billingham, J., Heyns, R., Milne, D., Doyle, S., Klein, M., Heilbron, J., Ashkenazi, M., Michaud, M., Lutz, J. and Shostak, S. (Eds.) *Social Implications of the Detection of an Extraterrestrial Civilization: A Report of the Workshops on the Cultural Aspects of SETI*. SETI Press, Mountain View, CA, 1999.
 9. Vakoch, D. A., Constructing messages to extraterrestrials: an exosemiotic approach. *Acta Astronautica*, 1998, **42**, 697–704.
 10. Vakoch, D. A., Signs of life beyond Earth: a semiotic analysis of interstellar messages. *Leonardo*, 1998, **31**, 313–319.
 11. Finney, B. and Bentley, J., A tale of two analogues: learning at a distance from the ancient Greeks and Maya and the problem of deciphering extraterrestrial radio transmissions. *Acta Astronautica*, 1998, **42**, 691–696.
 12. Scheier, M. F., Carver, C. S. and Bridges, M. W., Distinguishing optimism from neuroticism (and trait anxiety, self-mastery, and self-esteem): a reevaluation of the Life Orientation Test. *Journal of Personality and Social Psychology*, 1994, **67**, 1063–1078.
 13. Chandler, E. W. and Dreger, R. M., Anthropocentrism: construct validity and measurement. *Journal of Social Behavior and Personality*, 1993, **8**, 169–188.
 14. Dreger, R. M. and Chandler, E. W., Confirmation of the construct validity and factor structure of the Measure of Anthropocentrism. *Journal of Social Behavior and Personality*, 1993, **8**, 189–202.
 15. Genia, V., A psychometric evaluation of the Allport–Ross I/E Scales in a religiously heterogeneous sample. *Journal for the Scientific Study of Religion*, 1993, **32**, 284–290.
 16. Allport, G. W. and Ross, J. M., Personal religious orientation towards prejudice. *Journal of Personality and Social Psychology*, 1967, **5**, 432–443.
 17. Leong, F. T. L. and Zachar, P., An evaluation of Allport's Religious Orientation Scale across one Australian and two United States samples. *Educational and Psychological Measurement*, 1990, **50**, 359–368.
 18. Travis, R., The MOS Alienation Scale: an alternative to Srole's Anomia Scale. *Social Indicators Research*, 1993, **28**, 71–91.
 19. Hacking, I., *The Social Construction of What?* Harvard University Press, Cambridge, MA, 1999.