2015

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Nadelson and Hardy *Evolution: Education and Outreach* (2015) 8:9
DOI 10.1186/s12052-015-0037-4

Evolution: Education and Outreach
a SpringerOpen Journal

RESEARCH ARTICLE Open Access

# Trust in science and scientists and the acceptance of evolution

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## Abstract

**Background:** Accepting the concept of evolution is important for the advancement of biological science and has many implications for daily life. However, a large portion of the general public does not currently accept biological evolution. Therefore, it is important to understand what factors are associated with a decline in the acceptance of evolution. Of particular interest for us is the relationship of individuals' sense of trust in science in relationship to evolution acceptance.

**Methods:** Using the *Trust in Science and Scientists and Inventory of Student Evolution Acceptance* we surveyed 159 undergraduate students enrolled in an introductory psychology course. Additionally, we also asked the students questions regarding their religious commitment and political orientation. To analyze the data we calculated correlations, regressions, and conducted a path analysis.

**Results:** We found that lower levels of trust in science and scientists, stronger religious commitment, and more conservative political orientations were associated with a decrease in the acceptance of evolution in an undergraduate sample. We also found that the results shifted as the contexts for evolution changed.

**Conclusion:** While religious commitment has been previously studied, when combined with levels of both trust in science and scientists and political orientation we gain new insight into how different factors combine to influence evolution acceptance, particularly as the evolution context changes. By understanding how these factors are linked to acceptance of evolution, we may be able to start developing strategies for increasing the acceptance of evolution that are consistent with a range of worldviews.

**Keywords:** Trust; Religious commitment; Political orientation; Evolution acceptance

## Background

Biological evolution is perhaps one of the most controversial and misunderstood scientific theories (Taylor and Ferrari 2011). Surveys of the general public in the United States reveal somewhere between 19 % and 32 % of the population accept biological evolution as a full explanation for the origin of humans as a species (Gallup 2014; Pew Research Center 2013). Similarly, a little over 30 % of the adult public in the United States accepts evolution (as driven by natural selection) for all organisms (Pew Research Center 2013). Low levels of acceptance of biological evolution can also be found in other countries, although the United States public tends to rank among some of the lowest levels of acceptance (Miller et al. 2006). Indicators for the low level of biological evolution acceptance include limited education, limited income, political orientation, and religious commitment (Barone et al. 2014; Heddy and Nadelson 2013; Nadelson and Sinatra, 2009). The many variables found to be associated with evolution acceptance may be proxies for factors such as trust in science and scientists. We argue that due to the complexity of biological evolution, many people are unlikely to have the knowledge and understanding to effectively comprehend the phenomenon, and must rely on science and scientists to provide explanations for and ramifications of evolution.

Due to the nature of science, such as tentative knowledge (McComas et al. 1998a, b), the tenet of science that mandates that scientific explanations be based on the best available data may cause explanations to shift as new data are gathered, suggesting there may be a different explanation (e.g. the debate over whether drinking coffee good for you or bad for you, see Higdon and Frei, 2006).

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However, some people may view such modifications of explanations by scientists as a lack of competency of scientists to understand phenomena or that science as a way of knowing is flawed, leading such people to develop a lack of trust in scientists and science to effectively explain a wide range of phenomena, including biological evolution. A good example of the lack of an understanding was made public during the debate between Bill Nye and Ken Ham (Browning 2014) where Ham indicated that, "*the word "science" has been hijacked by secularists in teaching evolution*" and "*the word evolution has been hijacked*". The combination of these sentences and many other statements by Ham in the debate reflect profound misconceptions of the nature of science and an acute lack of trust in science and scientists particularly with respect to biological evolution.

Our research explored the relationship between trust in science and scientists and the acceptance of evolution. We hypothesized that those people who do not accept evolution are also likely to have low trust in science and scientists. Our study is the first we are aware of that explicitly examined general trust in science and scientists, political orientation, and religiosity in conjunction with evolution acceptance. Further, we examined the relationship between trust in science and three contexts of evolution: microevolution, macroevolution, and human evolution, to determine if the relationship changed when different facets of evolution acceptance were considered.

### Evolution Acceptance

Understanding the complex process of biological evolution requires a combination of knowledge from the life sciences, probability and statistics, and geosciences (Gould 2002). The multiple mechanisms of evolution such as natural selection, stochastic events, and geographical isolation, involve intellectually challenging concepts such as deep time, probability and situations of uncertainty, speciation, and the nature of science (Gould 2002; Scharmann and Harris 1992). Because of the complexity of biological evolution, people are likely to be challenged to understand the process (Moore and Cotner 2009; Nadelson and Southerland 2010), which may influence their levels of evolution acceptance (Nadelson and Sinatra 2009; Wiles 2014; Wiles and Alters 2011).

Several critical questions need to be considered when examining evolution acceptance such as, "Why is it important for people to accept biological evolution?" and, "What are potential ramifications if people do not accept biological evolution?" Although the actual processes of biological evolution are essentially invisible to us, the outcomes of evolution provide substantial evidence for the processes, are relatively easy to identify, and can be influential on a personal level. Biological evolution provides an effective explanation of why animal testing of human products (e.g. cosmetics and pharmaceuticals) makes sense, how bacteria become resistant to antibiotics (e.g. Methicillin-resistant *Staphylococcus aureus*- MRSA), the potential catastrophic impact of a disease on strains of plants or animals lacking diversity (e.g. potato famine), the transfer of diseases between species (e.g. avian flu and swine flu to humans), and how certain animal hormones can effectively influence the parallel biological systems and mechanisms in humans (e.g. insulin from pigs used by humans). Thus, not accepting biological evolution limits the ability for people to make informed decisions about a wide range of phenomena many of which have personal ramifications. Further, the non-acceptance of biological evolution could potentially offer the possibility of shifting science education to ideas that are popular (e.g. intelligence design) instead of focusing on ideas based on empirical evidence gathered from nature.

The acceptance of evolution has been widely studied (Heady and Nadelson 2013; Nadelson and Sinatra 2010; Nadelson and Southerland, 2010, 2012; Rutledge and Sadler, 2007; Rutledge and Warden, 1999). Variables associated with acceptance of biological evolution have included worldviews (Heddy and Nadelson, 2013; Rissler et al. 2014), understanding of natural selection (Anderson et al. 2002; Nadelson and Sinatra, 2009), feelings of certainty (Ha et al. 2012), understanding of situations of chance (Nadelson 2009), general knowledge of biology (Nadelson and Southerland 2010), the association with the nature of science (Carter and Wiles 2014; McComas et al. 1998a, b; Rudolph and Stewart 1998; Sinatra and Nadelson 2011), and context of evolution such as human evolution or macroevolution (Nadelson and Southerland 2012). We maintain that trust in science or scientists may be a variable that is associated with evolution acceptance that has not been widely assessed. Although Hawley and colleagues (2011) explored trust as related to evolution acceptance, the measures were in the context of biological evolution, and not trust in science or scientists in general.

The association between trust in science and acceptance of biological evolution has become particularly salient given the growing trend of mistrust in science by a wide range of individuals in association with a wide range of science developments and research (Gauchat 2015). Gauchat (2015) reports the growing politicization of science provides support for the concern that "public perceptions of science have become publically charged" (p. 5). The potential for the politicization of science and mistrust in science provides motivation for examining the constructs in relationship to evolution acceptance.

### Trust in Science and Scientists

Trust is a multifaceted construct including affective and cognitive perspectives (Blair and Stout 2001; Dunn and Schweitzer 2005; Mayer et al. 1995; Romano 2003). Trust can be relied upon to reinforce commitment to an

idea or, in the case of lack of trust, disapproval of an idea (Omer et al. 2009). Trust may be highly influential on perceptions of emotionally charged scientific issues (Dunn and Schweitzer 2005; Romano 2003) such as food that includes genetically modified organisms (Broughton and Nadelson 2012), climate change (Dunlap and McCright 2011), vaccines (Keelan et al. 2010), and potentially with biological evolution (Smith, et al. 1995). We maintain that trust in science and scientists is likely to be associated with greater acceptance of each of these concepts. Therefore, we argue there is justification for examining levels of trust in science and scientists in relation to acceptance of biological evolution.

### Implications for Learning and Policy

As with the questions regarding the importance of people accepting evolution, there are also implications for levels of trust in science and scientists. We argue that when people hold low trust in science or scientists they tend to discount scientific processes and evidence (Nadelson et al. 2014). As a result, people who hold a low level of trust in science and scientists are likely to use non-scientific approaches (e.g. supernatural) to explain scientific phenomena (Shermer 2002). Thus, individuals who consider creationism or intelligent design as explanations for the origin of species may also lack trust in science and scientists, as scientists tend to hold very different views than the general public (Pew Research Center 2015). Further, if students lack trust in science and scientists and do not accept biological evolution, they may not seek to understand biological evolution, which may further limit their knowledge of many biological processes and the associated implications. The potential relationship between evolution acceptance and trust in science was the impetus for our research, as we wanted to determine the interaction between these two constructs. Further, we wanted to determine if trust in science was a proxy for other conditions, such as religiosity and the associated differences in worldviews (e.g. political orientation).

## Methods

### Research Questions

Our research was guided by the following research questions:

- What is the association between the level of trust in science and evolution acceptance?
- What is the association between trust in science and different contexts of evolution (i.e. macroevolution, microevolution, and human evolution)?
- What personal characteristics contribute to the association between trust in science and acceptance of evolution?

### Participants

One hundred and fifty-nine participants (84 women, 75 men) enrolled in a large university in the western United States participated in our research in exchange for course credit. Participants ranged from 18 to 31 years of age ($M = 19.39$, $SD = 2.14$). The race/ethnicity of participants was 4.4 % African American, 1.3 % Native American, 2.5 % Asian, 9.4 % Latino/a, 81.1 % European American, and 1.3 % Other. Our sample consisted of 65.4 % freshmen, 19.5 % sophomores, 13.2 % juniors, and 1.9 % seniors. Participants had an average of 1.60 ($SD = 1.06$) years of college education, ranging from 1 to 6 years. Our participants identified associations with a variety of communities (27 % from urban communities, 49.7 % from suburban communities, and 23.3 % from rural communities). Our participants were pursuing a variety of majors (6.9 % biology, 20.8 % business, 6.9 % education, 1.9 % English, 4.4 % engineering, 2.5 % fine arts, .6 % geosciences, 10.7 % health/physical education, .6 % math, 5.7 % nursing, .6 % performing arts, 7.5 % psychology, 8.2 % social science, and .6 % world languages) and reported taking an average of 1.61 ($SD = 1.08$) college level science classes, ranging from 1 to 6 classes. Of those classes, an average of 1.18 ($SD = .65$) classes were biology courses, ranging from 1 to 6.

### Procedure

Participants completed a series of online surveys following the presentation of an informed consent form. Participants were requested to respond to three surveys. The first survey was about their personal characteristics (demographics), second was an acceptance of evolution survey, and third was a trust in science survey. The students took the surveys in the order listed. Participants were debriefed and received course credit upon completion of the surveys.

### Measures

**Trust in Science** We measured trust in science and scientists using the 21-item *Trust in Science and Scientists Inventory* (TSIS), which has been shown to be highly reliable and valid for use with college students (Nadelson, et al. 2014). Students rate each item on a 5-point Likert-type scale ranging from 1 = "Strongly Disagree" to 5 = "Strongly Agree." The inventory consists of a combination of items such as "I trust scientists can find solutions to our major technological problems" and reversed phrase items such as "We cannot trust scientists because they are biased in their perspectives." The *TSIS* was developed for use with undergraduate college students. Nadelson and colleagues (2014) report a Cronbach's alpha of .86 for the TSIS which indicates high reliability.

**Acceptance of Evolution** We assess acceptance of evolution using the 24-item *Inventory of Student Evolution Acceptance* (I-SEA), which has been shown to be highly reliable and valid for use with both high school and college students (Nadelson and Southerland 2012). Students rate each item on a 5-point Likert-type scale ranging from 1 = "Strongly Disagree" to 5 = "Strongly Agree". The inventory is divided into three subscales, microevolution, macroevolution, and human evolution, with a combination of eight forward and reverse phrased items composing each of the subscales. Nadelson and Southerland (2012) reported a Cronbach's alpha of .96 which indicates a high level of reliability. We selected the I-SEA to determine if the relationship between trust in science and acceptance of evolution would shift depending on the context of evolution, as acceptance of evolution is likely to shift with context.

**Religious Commitment** Students rated their religious commitment on a 10-point Likert-type scale ranging from 1 = "Low Commitment," to 10 = "High Commitment". The average score for religious commitment was 4.62 ($SD = 3.29$), which we interpreted to be slightly less than a moderate level of religiosity. Past research has revealed the single item to be highly correlated ($r > .80$) with a 20-item religiosity survey (Nadelson and Sinatra 2009).

**Political Orientation** Similar to the religious commitment scale, we used a 10-point political orientation scale. Students rated their political orientation on a 10-point Likert-type scale ranging from 1 = "Liberal" to 10 = "Conservative". The average score was 5.19 ($SD = 2.48$), which we interpreted as the students as a whole being slightly more conservative than liberal. The item has been successfully used in prior published research (Nadelson et al. 2012).

**Analysis** We used several techniques to analyze our data. First, we examined the correlations between the variables in order to determine if we needed to take into account issues of multicolinearity. We then used a series of regressions to investigate the association between our predictor variables and acceptance of overall evolution in addition to the specific contexts of evolution. Finally, we used structural equation model techniques to determine how well our hypothesized model fit the data.

## Results

### Results Overview

Before we began our analysis we conditioned our data by removing responses from the participants who did not complete all surveys, forward coded reverse phrased items, and removed duplicated answers from the same users. Once conditioned, we determined the Cronbach's alpha reliability of the instruments we used. The reliability, average scores, and standard deviations for our measure of trust in science and scientists, the I-SEA, and the I-SEA subscales are presented in Table 1. Our analysis indicates measures with acceptable levels of reliability and average scores between "Neutral" and "Agree" indicating moderate levels of trust and acceptance of evolution, with variations based on context (e.g. contexts of microevolution were accepted to a higher degree than contexts of human evolution).

We next conducted a correlation analysis of all measures to determine the preliminary relationships between our variables of interest in order to determine if the measures were overly correlated. Our analysis (see Table 2) revealed correlations between the I-SEA overall composite score and the I-SEA subscales. However, there remained unique variance for each of the subscales. While our measures of trust in science and scientists, religious commitment, and political orientation, were strongly correlated, there was unique variance to each, indicating the measures are assessing unique aspects of personal perspective.

Our analysis indicates that we could progress with answering our research questions with the assumption our measures provided useful data. We used a series of regressions to determine the association between trust in science and acceptance of evolution and the different contexts of evolution. Further, we examined how trust in science and scientists and acceptance of evolution related to personal characteristics. We selected regression because we wanted to determine if the relationships changed when multiple variables were considered, and a stepwise regression allowed us to examine relationships to evolution acceptance based on individual and combined variables.

### Trust in Science and Acceptance of Evolution

The analysis for our first research question revealed that trust in science and scientists was associated with overall evolution acceptance ($\beta = .57$, $t(157) = 8.69$, $p < .001$) and that trust in science explained a significant proportion of the variance in overall evolution acceptance ($R^2 = .33$, $F(1,157) = 75.52$, $p < .001$). Our results indicate that about 33 % of the variance in evolution acceptance can

**Table 1** I-SEA measure and subscale reliability, mean, and standard deviation

| Variable | Cronbach's Alpha | Mean (*SD*) |
|---|---|---|
| Trust in science | .85 | 3.35 (*.41*) |
| Overall evolution | .95 | 3.61 (*.67*) |
| Microevolution | .86 | 3.92 (*.61*) |
| Macroevolution | .86 | 3.57 (*.72*) |
| Human evolution | .93 | 3.33 (*.91*) |

**Table 2** Correlations among evolution acceptance, trusts in science, religious commitment, and political orientation

| Measures | Religious commitment | Political orientation. | Trust in science and scientists | Macro-evolution | Micro-evolution | Human evolution | All evolution |
|---|---|---|---|---|---|---|---|
| Religious commitment | – | .34** | -.38** | -.55** | -.42** | -.60** | -.59** |
| Political orientation. | | – | -.25** | -.31** | -.28** | -.33** | -.34** |
| Trust in science and scientists | | | – | .51** | .53** | .50** | .57** |
| Macro-evolution | | | | – | .71** | .80** | .95** |
| Micro-evolution | | | | | – | .58** | .84** |
| Human evolution | | | | | | – | .89** |
| All evolution | | | | | | | – |

**$p < .01$

be explained by the variation in trust in science and scientists, indicating a significant relationship.

### Trust in science and acceptance in evolution contexts

Next, for our second research question we examined the relationship between trust in science and the *I-SEA* subscales. Trust in science was predicative of all three contexts of evolution and accounted for a significant portion of the variance of evolution acceptance (see Table 3).

### Individual characteristics and evolution acceptance

To determine the answer to our third research question we examined the relationship between evolution acceptance and a number of individual characteristics. To determine if individual differences were related to acceptance of evolution we ran a number of appropriate calculations including correlation, chi-square, and *t*-tests.

**Demographic characteristics** Our analysis revealed no relationship between acceptance of evolution and participant age, gender, ethnicity, community of upbringing, year in college, years of college education, major, number of college level classes, or number of college level biology classes (all *p*-values were greater than .05).

**Religiosity, Trust, and Political orientation** To determine if religious commitment and political orientation both individually and in combination with trust in science were predictive of evolution acceptance we conducted a number of regression calculations. Our analysis revealed that having lower religious commitment was associated with a greater evolution acceptance. Additionally, having a more conservative political affiliation was associated with having a lower overall evolution acceptance (see Table 4).

When both trust in science and religious commitment were included in the model, a larger proportion of the variance of evolution acceptance was explained than when either trust or religiosity were considered independently (see Table 4). Similarly, when trust in science and political orientation were included in the model, a larger proportion of the variance of evolution acceptance was accounted for than when the variables were examined independently (see Table 4).

Finally, we included trust in science, religious commitment, and political orientation in the model to predict overall evolution acceptance. While trust in science, religious commitment, and political orientation are correlated we do maintain that there is justification in the literature for considering them as independent measures (Heady and Nadelson, 2012). Thus, when we included the three variables, the model explained about the same proportion of the variance in evolution acceptance compared to when only trust in science and religiosity were included. However, our results suggest that overall

**Table 3** Evolution subscales, prediction by trust in science, and variance accounted for by trust

| Acceptance | $\beta$ | *df* | *t* | $R^2$ | *F* |
|---|---|---|---|---|---|
| All measures | .57 | 157 | 8.59** | .33 | 75.52** |
| Microevolution | .53 | 157 | 7.84** | .28 | 61.45** |
| Macroevolution | .51 | 157 | 7.41** | .26 | 54.95** |
| Human evolution | .50 | 157 | 7.28** | .25 | 52.93** |

**$p < .01$

**Table 4** Relationship to evolution acceptance to religiosity, political orientation, and trust in science

| Variables | Variance explained ($R^2$), | Coefficient(s) ($\beta$) |
|---|---|---|
| Religiosity | .36 | -.60** |
| Political orientation | .12 | -.35** |
| Trust in science and scientists | .33 | .57** |
| Religiosity, Trust in science | .49 | -.45**, .39** |
| Political orientation, Trust in science | .37 | -.22**, .52** |
| Religiosity, Political orientation, Trust in science | .50 | -.42**, –.12*, .37** |

*$p < .05$, **$p < .01$

evolution acceptance is associated with trust in science, religious commitment, and political orientation.

**ISEA Subscales** Similarly to what was observed for overall evolution acceptance, no significant associations between acceptance of microevolution, macroevolution, or human evolution and any of the demographic variables were observed ($p > .05$ for all variables). Likewise, having lower religious commitment was associated with a stronger acceptance of the three contexts of evolution and having a more conservative political orientation was associated with a weaker evolution acceptance in the three contexts (see Table 5).

Religious commitment and trust in science predicted acceptance of all contexts of evolution when both variables were included in the model (see Table 6). Likewise, trust in science and political orientation predicted acceptance of all evolution contexts when both variables were included in the model. However, evolution acceptance was only significantly associated with trust in science and lower religious commitment when including all three variables in the model. Thus, political orientation was no longer associated with acceptance of the various contexts of evolution. Including all three variables into the model explained a similar proportion of the variance in evolution acceptance as when only trust in science and religious commitment were included in the model. Therefore, it appears that trust in science and religious commitment are greater indicators of acceptance of evolution facets than political orientation, although political orientation is a meaningful predictor of evolution acceptance when the other variables are omitted from the model.

### Structural Equation Model

We conducted a final level of data analysis by testing a structural equation model (SEM) (Bentler 1995), using our religious commitment, political orientation, and composite average of trust values as independent variables and the composite average for evolution acceptance as the dependent variable. Our analysis revealed all three of the independent variables were significant at the .05 level (see Fig. 1). However, the fit indices were mixed with an acceptable level for the root mean square residual (RMR = .91) and marginal values for others (MFI = .88), and unacceptable values for the chi square degree of freedom ratio ($\chi^2$/df = 14.87). Given the significance of the relationships between the independent and dependent variables, the likely explanation for the variation in the fit indices is likely sample size restricting the statistical power related to the fit indices calculations (Hooper et al. 2008). Regardless, the structural equation model produced results similar to our regression models, suggesting that religious commitment and trust are greater predictors of evolution acceptance than political orientation. Further we again confirmed that political orientation accounts for some of the variance of evolution acceptance. Our SEM confirms political conservatism is negatively correlated with acceptance ($r = -.12$, $p < .05$), high religious commitment is negatively correlated with acceptance ($r = -.45$, $p < .01$) and trust in science is positively correlated with evolution acceptance ($r = .43$, $p < .01$). Combined, the three independent variables account for 41 % of the variance of evolution acceptance ($r^2 = .41$).

**Table 5** Single predictor variable regression analyses for I-SEA

| Predictor variable | *β* | *df* | *t* | $R^2$ | *F* |
|---|---|---|---|---|---|
| Microevolution | | | | | |
| Religious commitment | -.42 | 156 | −5.75** | .18 | 33.10** |
| Political orientation | -.28 | 157 | −3.70** | .08 | 13.69** |
| Macroevolution | | | | | |
| Religious commitment | -.55 | 156 | −8.27** | .31 | 68.34** |
| Political orientation | -.31 | 157 | −4.11** | .10 | 16.87** |
| Human evolution | | | | | |
| Religious ommitment | -.60 | 156 | −9.24** | .35 | 85.37** |
| Political orientation | -.33 | 157 | −4.43** | .11 | 19.66** |

**$p < .01$

### Overall Summary of Results

Both trust in science and religious commitment were predictive of evolution acceptance as well as the contexts of microevolution, macroevolution, and human evolution. Further, political orientation was significantly associated with acceptance of each context of evolution when listed as the only predictor variable or when included in the model with trust in science and religiosity. Although political orientation was no longer associated with acceptance of the facets of evolution when included in the full model, political orientation appears to be related to evolution acceptance.

## Discussion

Although evolution acceptance has been associated with multiple variables including knowledge of evolution (Nadelson and Sinatra 2010; Nadelson and Southerland 2010) and religiosity (Heedy and Nadelson 2013), we are unaware of research that has examined evolution acceptance with relationship to trust in science and scientists. Thus, our research addressed this gap in the literature.

Consistent with prior research, our research documented the association between evolution acceptance and religiosity. We hypothesized that people with strong religious commitment are less likely to accept biological evolution due to their worldviews which include

**Table 6** TSIS and religious commitment regression analyses for I-SEA

| Acceptance | Trust in science | | Religiosity | | Trust in science and religiosity | |
|---|---|---|---|---|---|---|
| | *β* | *t* | *B* | *t* | $R^2$ | *F* |
| Microevolution | .43 | 6.01** | -.26 | −3.64** | .33 | 38.35** |
| Macroevolution | .34 | 5.02** | -.43 | −6.35** | .40 | 52.08** |
| Human evolution | .31 | 4.82** | -.48 | −7.34** | .44 | 60.40** |

**$p < .01$

alternative explanations of the origin of species. Thus, aligned with the position of Sinatra and Nadelson (2010) we suspect that the unconditional regard for authority (e.g. religious leaders) and reliance on religious doctrines to explaining natural phenomena by those with high levels of religious commitment are antithetical to scientific processes and nature of science. The absolute reliance on religious belief structures may provide justification for disregarding science and scientists, particularly if the work of scientists conflicts with particular religious beliefs, as may be the case with biological evolution.

Our hypothesis that people with strong religious commitment are less likely to accept science is reinforced by the correlation between trust in science and scientists and religious commitment. Our data revealed that religiosity and trust in science shared some variance, suggesting that while there was overlap between these constructs, they are measuring unique variables that should likely be considered both independently and collectively when assessing evolution.

We posit that the negative correlation between the lack of trust in science and scientists and evolution acceptance is evidence for the likely influence of perceptions of science and scientists on evolution acceptance. We hypothesized that trust in science may be strongly related to understanding the nature of science, and that misunderstanding how science works may lead to mistrust in science and scientists that is manifested in rejection of the work of scientists such as the explanations for biological evolution.

The increased level of predictability of evolution acceptance when using the combination of trust in science and religiosity has two implications. First, the level to which people embrace a religious perspective may influence perceptions for the origin of humans. The second is the level to which people are willing to trust science and scientists to develop meaningful and acceptable explanations. Gaining a deeper understanding of the interaction between religiosity and trust in science and the combined influence on engagement in learning about and subsequent acceptance of scientific developments (e.g. climate change, genetically modified foods, vaccines) is an excellent direction for future research.

Our finding of political orientation with evolution acceptance suggests that more politically conservative individuals are less accepting of evolution, which may be due to higher levels of skepticism of the associated science. However, the reduced contribution of political orientation to the prediction of evolution acceptance when religiosity and trust in science are added to the

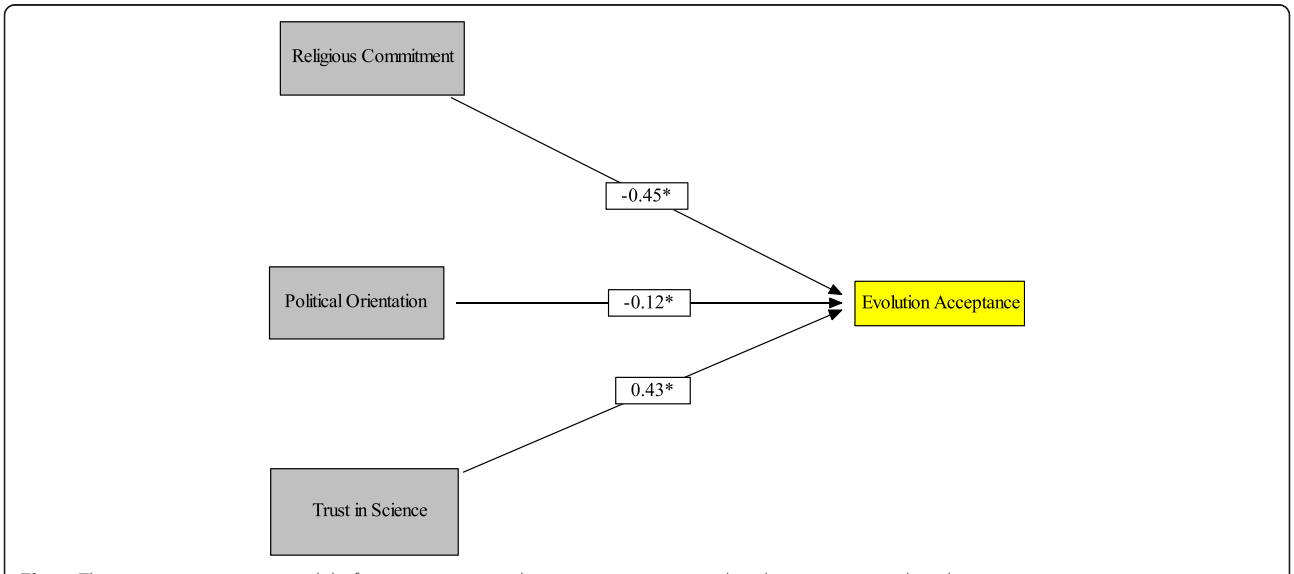


**Fig. 1** The structure equation model of trust in science, religious commitment, political orientation, and evolution acceptance

model suggests that there is likely substantial overlap between the two other predictors and political orientation. It is likely that there are aspects of political orientation embedded within the other variables that may influence the correlation between political orientation and evolution acceptance. The levels of overlap between religiosity, political orientation and trust in science and scientists and how these overlaps manifest in conditions such as evolution acceptance is likely to be a fruitful direction for future research.

There were some variations of predictability of trust in science, religiosity, and political orientation with relation to different contexts of evolution; however, the variations were not substantial. We hypothesize that, while levels of acceptance may vary due to context, the variables predictive of evolution acceptance remained constant. Thus, we contend that the variables influencing evolution acceptance are constant regardless of the context of evolution.

### Implications

One implication of our study is evidence that indicates that worldviews and trust in science are likely to be associated with acceptance of evolution. The nature of worldviews and perceptions of science are such that finding a resolution or common ground for the discussion of evolution as a viable explanation of the origin of species may not be possible without questioning personal perspectives, which is a tenuous territory. Our job as educators is to provide contexts for learning and sharing sources of evidence and explanation, not to change worldviews to assure perspectives align with acceptance of scientific theory. Yet, people are not likely to accept evolution if they hold high levels of religiosity, low trust in science, and a conservative political orientation. Thus, the ability to increase evolution acceptance while validating a diversity of worldviews may be impossible. Respecting a wide range of worldviews while increasing acceptance of biological evolution as the scientific explanation for the origin of species is a substantial challenge that may be difficult to achieve. However, increasing students' trust in science and scientists may be key to increasing their consideration of biological evolution as a plausible explanation for the origin of species.

### Limitations

The first limitation of our study is the nature of our sample which was drawn from a single institution and may have led to constrained perspectives. Our sample was revealed to reflect a group of students with a diversity of backgrounds and perspectives which we contend are likely to be consistent and representative of the general undergraduate student population. Yet, if the students in our sample are considered as a whole, they may differ in perspectives when compared to samples of students from other institutions. Additional research with a wide range of institutions will allow us to determine the generalizability of our findings.

Our second limitation was the nature of our data collection. Although our survey data were consistent with prior research (e.g. Heady and Nadelson, 2013; Nadelson et al., 2014) and collected using reliable instruments, we are not able to explain in detail why people responded as they did. More in-depth interviews of people may allow us to determine why and how variables are associated with certain perspectives.

The third limitation of our study was the use of undergraduate college students for our research. The general adult public or younger learners may provide different perspectives. Thus, the consideration of adults or pre-college students' perceptions is an excellent direction for future research.

The final limitation of our study is the multicolinearity of trust in science, religious commitment, and political orientation which makes it difficult to determine how much each construct is actually associated with acceptance of evolution when the variables are combined. Although our structural equation model allowed for a greater indication of individual variable contribution, there may be other associations at play that we were not able to disentangle through the analysis. Exploring conditions such as the association between and individual's parental or sibling perspectives of trust in science, religious perspectives and political orientation is likely to provide a greater understanding of evolution acceptance.

## Conclusion

We achieved our goal of determining how levels of trust in science and scientists are associated with acceptance of biological evolution. We found that religiosity and political orientation are also predictors of acceptance of biological evolution. The association of worldviews with evolution acceptance poses significant challenges to those educators considering approaches to increasing evolution acceptance. How we respect worldviews while developing a convincing and acceptable argument that leads to increased and wide-spread evolution acceptance as an explanation for the origin of species is an ongoing and substantial challenge for science educators. Addressing issues of trust in science and scientists may be key to increasing acceptance of evolution as a plausible explanation for the origin of species.

#### Competing interests

The authors declare no competing interests, financial or otherwise.

#### Authors' contributions

LSN and KKH collaboratively designed the study, carried out the data collection, performed the statistical analyses, and wrote the manuscript. Both authors read and approved the final manuscript.

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Received: 9 January 2015 Accepted: 2 June 2015
Published online: 16 June 2015

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