

# Can Six Minutes of Culturally Competent Evolution Education Reduce Students' Level of Perceived Conflict Between Evolution and Religion?

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## ABSTRACT

Evolution is foundational to biology but is controversial for many undergraduate students. Although evolution and religion are potentially compatible, students' perceived conflict between their religious beliefs and evolution can negatively affect their acceptance of evolution. In a previous study, we found that illustrating the potential compatibility of religion and evolution decreased the number of students who perceived a conflict between religion and evolution by 53 percent. However, in the previous study, the instruction on the potential compatibility of religion and evolution took a significant amount of instructional time, which could be a barrier for implementation. In this current study, we condensed the instruction illustrating the potential compatibility of religion and evolution to six minutes. By conducting qualitative analyses on data gathered from ten students who perceived a conflict before the evolution module, we found that eight of these students reduced their level of perceived conflict after the evolution module. We identified eight distinct aspects of the evolution instruction that students stated reduced their perceived conflict, including that the instructor did not force student acceptance of evolution, the instructor was respectful of students with multiple viewpoints on evolution, and students experienced a greater exposure to evolution content.

**Key Words:** evolution; religion; perceived conflict; curriculum; attitudes.

## ○ Introduction

Evolution is considered a core concept of biology and has been recommended to be taught at every level of undergraduate biology education (AAAS, 2011; Brownell et al., 2014). However, evolution remains controversial for many undergraduate biology students; some studies show that up to 50 percent of college students can reject evolution (Rice et al., 2010). One of the primary reasons that students reject evolution is that they perceive a conflict between evolution and their religious beliefs (Rissler et al., 2014; Scott, 2014). Despite examples of the

potential compatibility between evolution and religion (Barbour, 1990; Gould, 1999; Collins, 2006; Miller, 2002), there is still a prevalent perception among students that evolution and religion must conflict with one another.

College biology instructors can choose to address this perceived conflict between evolution and religion in class. We use the term **Religious Cultural Competence in Evolution Education** (ReCCEE, pronounced “ree-see”) to describe instructional practices that are designed to help evolution instructors better communicate evolution to religious students who may perceive a conflict between religion and evolution (Barnes & Brownell, 2017). ReCCEE practices are non-content instructional practices that can help bridge the cultural disconnect between instructors and religious students to help students decrease their conflict between religion and evolution. ReCCEE practices can be used in combination with instruction on evolution content. Although the research literature provides some evidence that ReCCEE practices can be

effective for increasing student acceptance of evolution and decreasing student perceived conflict between religion and evolution, there is variability in the extent to which instructors report using these practices. Exploratory work out of our research group has shown that instructors who teach evolution at Christian universities do tend to incorporate these practices into their teaching of evolution (Barnes & Brownell, In press), and those who teach evolution at secular institutions tend to not use ReCCEE practices (Barnes & Brownell, 2016). Yet, religious students at secular institutions appreciate instruction that decreases the perceived conflict between evolution and reli-

gion (Barnes et al., 2017b), and a lack of this instruction can make religious students feel excluded in the evolution classroom (Hermann, 2012; Barnes et al., 2017b).

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A previous study conducted by our research group explored the impact of implementing ReCCEE practices embedded in an evolution module (Barnes et al., 2017a). The ReCCEE practices that were implemented were: instruction on the spectrum of viewpoints on the relationship between evolution and religion (Yasri & Mancy, 2016); a presentation of religious scientist role models (Winslow et al., 2011); and instruction on the bounded nature of science to illustrate that science and religion are different ways of knowing (Southerland & Scharmann, 2013). These practices were all embedded in instruction on evolution in an introductory biology course. We measured students' perceived conflict between evolution and religion before and after the module using open-ended surveys, and found a 53 percent decrease in the number of students who perceived a conflict between evolution and religion. Although we observed a positive impact in reducing students' perceived conflict between evolution and religion, we only reported a binary of whether students perceived a conflict, and it could be possible that this underrepresented the extent to which students' perceived conflict was reduced. Also, we were unable to determine from the short open-ended responses what specific aspects of the evolution module influenced students' perception of conflict. Further, a large portion of instructional time in the evolution module was dedicated to ReCCEE practices addressing the potential compatibility between evolution and religion. However, previous research indicates that most instructors prefer not to allocate much time to ReCCEE practices while teaching evolution (Barnes & Brownell, 2016).

To address some of the limitations of the prior study, we decided to implement six minutes of ReCCEE practices as a short introduction to evolution instruction so that the time spent on the non-content ReCCEE practices was minimized. We used qualitative analysis of student reflections and in-depth, semi-structured interviews to determine the impact of the instruction. The strength of this type of exploratory qualitative study is the richness of student responses that can be obtained through student interviews (Glesne & Peshkin, 1992). Our specific research questions were as follows:

1. To what extent can evolution instruction with a six-minute ReCCEE introduction decrease students' perceived conflict between evolution and religion?
2. What aspects of the evolution instruction, including six minutes of ReCCEE practices, were reported by students to be important for reducing their perceived conflict between evolution and religion?

## ○ Course Characteristics

The study took place in an intensive nine-day summer introductory biology course at a large public university in the Southwestern United States that was about 40 hours of biology content. The course was a summer bridge course designed to prepare incoming, first-year biology students for their introductory biology course in the fall semester (Ashley et al., 2017). The course was developed as a "flipped class" in which students were assigned videos and readings to complete outside of class and worked on problems in primarily small groups inside of class. The course focused on biology content typically taught in introductory biology, including

genetics and heredity, DNA structure and function, and mitosis and meiosis. One day of the course (six hours total of in-class instruction) was dedicated to teaching evolution.

## Characteristics of the Evolution Module

The majority of the module on evolution was focused on content about evolutionary mechanisms such as natural selection and speciation. However, the first six minutes of the evolution module included non-content ReCCEE practices that outline the potential compatibility between evolution and religion. The ReCCEE practices used in this class were similar to what was described in the Barnes et al. (2017a) study. However, the ReCCEE instruction in this study was only six minutes of in-class time: there were no readings, no discussion among peers, and religious scientist role models were presented to the class on a PowerPoint slide rather than as a guest speaker. The differences and similarities between the ReCCEE practices implemented in the two studies are outlined in Table 1. The most notable difference between the ReCCEE practices implemented in these two studies is that the ReCCEE practices in this new study took significantly less time than in Barnes et al. (2017a). For a video recreating the six minutes of ReCCEE practices implemented in this current study, please refer to this link: <https://tinyurl.com/y9xm52oh>

## ○ Methods

This study was done in accordance with an approved IRB (#4775).

There were 34 students enrolled in the introductory biology course. All the students in the course were incoming, first-year undergraduate biology majors. From open-ended student reflections that were administered before the evolution module, we identified 14 of 34 students who perceived a conflict between their religious beliefs and evolution. After the evolution module was completed, we sent recruitment emails to these 14 students. We sent recruitment emails only to students who reported perceiving a conflict with evolution so that we could determine if their level of perceived conflict was reduced over the evolution instruction, and which aspects of the instruction they felt influenced their level of perceived conflict. The recruitment email asked these students if they would be interested in participating in a research study concerning their experiences during the evolution module. (Excerpt from recruitment email: "If you remember, you learned about evolution in the bridge program, and we would like to conduct an interview with you about your experiences so that we can inform better educational practices while teaching evolution.") The students were told that their responses would remain confidential.

Ten students agreed to be interviewed (71% response rate); interviews were conducted by a researcher who was not the instructor of the course. Students who were interviewed for the study were compensated with \$50 at the end of their interview. This amount of compensation was intended to maximize response rate and therefore minimize response bias.

To assess the impact of the evolution module with six minutes of ReCCEE practices on students' perceived conflict between evolution and religion, we collected data in two ways:

**1. Student interviews.** A 30- to 45-minute semi-structured interview was conducted with students who perceived a conflict with evolution at the beginning of the evolution module. The interview

**Table 1. The differences and similarities between the six minutes of ReCCEE practices used in the current study and ReCCEE practices used in Barnes et al. (2017a).**

Component of Instruction	Six minutes of ReCCEE practices in the current study	About two hours of ReCCEE practices in Barnes et al. (2017a)
<b>Presentation of a spectrum of viewpoints on evolution and religion</b>	<ul style="list-style-type: none"> <li>• Presentation of viewpoints on the relationship between religion and evolution from atheistic evolution to special creationism on a PowerPoint slide</li> </ul>	<ul style="list-style-type: none"> <li>• Presentation of viewpoints on the relationship between religion and evolution from atheistic evolution to special creationism on a PowerPoint slide</li> <li>• Presentation of different religious denominations and their views on evolution on a PowerPoint slide</li> </ul>
<b>Presentation of religious scientist role models</b>	<ul style="list-style-type: none"> <li>• Presentation of two religious scientist role models on a PowerPoint slide</li> </ul>	<ul style="list-style-type: none"> <li>• One religious biologist video-conferenced with students for half of a class period and discussed his reconciliation of religion and evolution</li> </ul>
<b>Explanation of the bounded nature of science</b>	<ul style="list-style-type: none"> <li>• Presentation on the bounded nature of science using the Non-Overlapping Magisteria (Gould, 1997) on a PowerPoint slide</li> </ul>	<ul style="list-style-type: none"> <li>• Students read Science, Evolution, and Creationism to understand the nature of science (NAS, 2008)</li> <li>• Students watched videos of instructor describing the nature of science</li> </ul>

questions explored students' level of perceived conflict before and after the evolution module, the aspects of the evolution module that impacted their perceived conflict, and their religiosity. Examples of questions used in the interviews include:

- How did you feel about evolution before you started the Bridge program?
- To what extent were your personal beliefs in conflict with evolution after the Bridge program?
- Why did your beliefs change or why didn't your beliefs change?
- Did anything that the instructor said while teaching evolution influence how you felt about evolution and your religious beliefs?
- How did you feel about evolution after the evolution lesson in the Bridge program? Why?

Although other sources of data were used to corroborate our findings, student interviews served as the main source of data for this study because student interviews provided the most thorough and in-depth descriptions of students' experiences (Glesne & Peshkin, 1992).

**2. Student class reflections.** On the night before and the night after the evolution module, all students were asked to respond to the following prompt: "Do you see a conflict between evolution and your personal beliefs? Please write Yes, Unsure, or No as the first word of your response. Then explain why you gave the answer you did. Be thorough. Why do you feel there is a conflict or why don't you feel there is a conflict or why are you unsure?" Students' reflections before the evolution module were used to identify which students perceived a conflict between religion and evolution at the beginning of the evolution module. Further, we used students' reflection responses at the end of the evolution module, in combination with interviews, to evaluate changes in students' perceptions of conflict over the evolution module. If we identified any discrepancies within the interviews, or if student responses in the interviews were too vague to be interpreted, we emailed students to

clarify aspects of their interview to ensure we were interpreting their responses correctly.

### **Students' Level of Perceived Conflict between Religious Beliefs and Evolution**

We determined each student's level of perceived conflict between religion and evolution both before and after the evolution module by developing a rubric to rate their perceived conflict as "No conflict," "Little conflict," "Some conflict," or "A lot of conflict" (Table 2). This rubric goes beyond the binary rubric used in our previous study of "Conflict" or "No conflict" and provides a more fine-grained analysis of students' perceived conflict over the evolution module.

To determine students' level of perceived conflict between their religious beliefs and evolution, we used content analysis to classify students' responses from class reflections and interviews (Krippendorff, 2012). The criteria for determining how much conflict a student perceived was shaped by using constant comparative methods (Glesne & Peshkin, 1992), in which students' responses in one category were compared to one another to ensure that their narratives were similar enough to be categorized together. To increase certainty that these categories adequately discriminated different levels of perceived conflict among students, we collaboratively compared student data within and between each category. Through this process we came to a final result in which students who experienced similar levels of conflict were categorized together. The researchers (M.E.B. and J.M.T.) worked collaboratively on categorizing student responses and refining the category descriptions until they reached consensus.

### **Aspects of Evolution Instruction that Reduced Students' Perceived Conflict Between Religious Beliefs and Evolution**

To determine what aspects of instruction reduced students' perceived level of conflict between evolution and religion, we used grounded

**Table 2. Categories for students' perceived conflict between religion and evolution.**

Level of Perceived Conflict	Description
3: A lot of conflict	The student perceives that evolution conflicts with most aspects of their personal/religious beliefs. They believe that there can be little to no reconciliation between evolution and their personal/religious beliefs. For example, a student may believe in young Earth creationism, and that evolution conflicts with that belief. Alternatively, a student may have initially only known about special creationism and did not even consider evolution a viewpoint until the program.
2: Some conflict	Though the student has somewhat reconciled their personal/religious beliefs with evolution, they still struggle to decrease conflict between their beliefs and certain aspects of evolution. For example, the student may believe that some aspects of evolution, such as natural selection and adaptation, are compatible with their beliefs, but other aspects such as human evolution are still incompatible with their personal/religious beliefs.
1: Little conflict	The student has mostly reconciled their personal/religious beliefs with evolution. Though the student does not directly state that there is a conflict, some of their statements indicate that they still perceive some sort of conflict between their beliefs and evolution.
0: No conflict	The student perceives no conflict between their personal/religious beliefs and evolution. They believe that their beliefs are compatible with evolution and do not contradict this perception with any other statements.

**Table 3. Aspects of evolution instruction that reduced students' level of perceived conflict between religion and evolution.**

	Description
1. <i>Did not force student acceptance of evolution</i>	The student perceived that the instructor let students form their own opinions about evolution.
2. <i>Respect for multiple viewpoints</i>	The student perceived that the instructor remained respectful of students who had different views about evolution.
3. <i>Exposure to evolution content</i>	The student learned facts about and evidence for evolution.
4. <i>Presented religious scientist role models</i>	The student learned that there are religious scientists who have reconciled their religious beliefs and evolution.
5. <i>Acknowledgement of students' potential conflict between religion and evolution</i>	The student cited that the instructor acknowledged that some students might see a conflict between religion and evolution and that a conflict could exist between religion and evolution.
6. <i>Presented the bounded nature of science</i>	The student learned that science and religion can be conceptualized as two separate realms that do not conflict with one another if they do not attempt to address the same questions.
7. <i>Described multiple viewpoints</i>	The student learned that there are a variety of viewpoints on the relationship between religion and evolution.
8. <i>Safe classroom community</i>	The student felt as though they could safely voice their opinion of evolution in the classroom, and did not feel pressured to share their ideas with the class.

theory to identify themes that emerged from student interviews (Table 3). Grounded theory is used when themes emerge from the data that are not predetermined by the researchers (Glaser & Strauss, 2009). After a preliminary set of themes was established, M.E.B. and J.M.T. used constant comparative methods to confirm that the themes sufficiently represented the interviews.

### Student Religiosity

Students' level of religiosity was determined by how important the students believed their religion was to their identity and/or their level of participation in religious activities, such as attendance of church

and frequency of prayer. This definition of religiosity is supported by prior research on the psychology of religion (Cohen et al., 2008). These data were gathered from student interviews, student reflections, and/or through email correspondences with students.

## ○ Results

### Interview Participants

Eight out of ten students reported that they belonged to a Christian religious denomination, one student self-identified as agnostic, and

one student did not identify with a religious denomination but said their religious belief was an important part of their life. Eight out of ten participants were female, and all participants were first-year biology majors.

### Most Students Who Perceived a Conflict before the Module Decreased Their Level of Perceived Conflict after the Module

Eight out of the ten students who perceived a conflict before the evolution module decreased their level of perceived conflict after the evolution module, and two students showed no change in their perceived conflict (Figure 1). Notably, no students showed an increase in perceived conflict between evolution and religion. Students started at different levels of perceived conflict, and we could capture the change toward decreased perceived conflict by analyzing the class reflections and the interviews using the rubric outlined in Table 2. Notably, if we had only used a binary scale of “Conflict” or “No conflict,” as we had used in a prior study (Barnes et al., 2017a), we would have missed the change toward less conflict for six of the students.

Students who had higher levels of religiosity began with a higher level of conflict, yet even for the most religious students, we found that six out of seven decreased their perceived conflict between evolution and religion after the evolution module.

In the following section, we include student quotes taken from the interviews to show this change in perceived conflict between evolution and religion before and after evolution instruction. All student names are pseudonyms.

Students such as Gabrielle and Esmeralda showed decreased conflict between evolution and religion while maintaining their religious beliefs. However, after the evolution module they still perceived some level of conflict between evolution and religion. For instance, though Gabrielle is more open to learning about evolution after the evolution

module, she still perceives some conflict between evolution and her religious beliefs, especially regarding human evolution:

**Gabrielle: A lot of conflict → Some conflict**

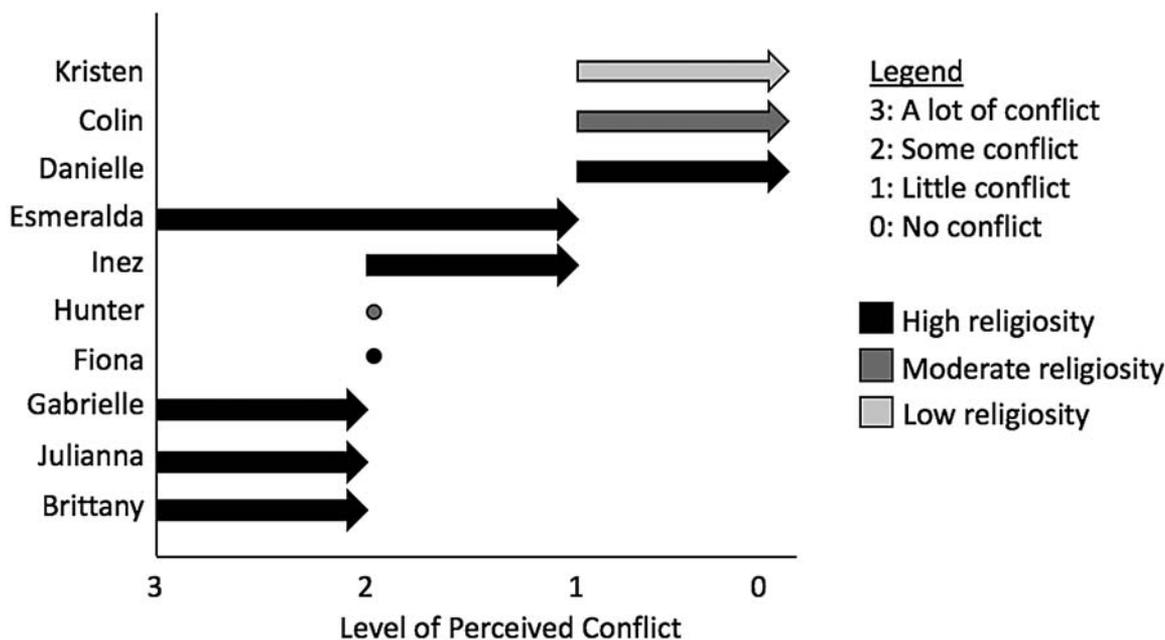
It [evolution] wasn't as big a conflict [after the module] as it was in the beginning because I then started to think . . . I had always been super against evolution, but then I was like, I want to go dive in deeper in this and really study it and understand it . . . there is quite a bit of evidence . . . like fossils . . . there are things that make sense, like [adaptation] makes sense, but because of my beliefs . . . I don't really believe humans evolved from anything. Just that God created them.

Julianna also illustrates how her perceived conflict with evolution decreased after the evolution module, but her responses indicated that she still doubted the full extent of human evolution:

**Julianna: A lot of conflict → Some conflict**

[After evolution instruction] it just made me think more, made me open my mind to see that evolution might be a possibility to me to some extent . . . at first, I just really thought that Adam and Eve and species really didn't evolve . . . but now, after [instruction] I was like, “Okay, maybe to some extent we did evolve.”

Other students experienced a greater reduction in perceived conflict and did not indicate any rejection of important aspects of evolution after the evolution module, but some of their statements indicated that they may still perceive a small amount of conflict with evolution in other ways. For instance, although Esmeralda said that she was able to reconcile evolution and her belief in God, and even said in her post-class reflection that she perceived no conflict between evolution and her religious beliefs, some of her interview responses suggested that she may still struggle to



**Figure 1.** The change in students’ level of perceived conflict between their religious beliefs and evolution. Students who are highly religious are marked in black, whereas students who are moderately religious are marked in dark grey. Students who expressed low levels of religiosity are marked in light grey.

reconcile her beliefs and evolution in some contexts. For example, in her interview she expressed that she avoids thoughts about her religious beliefs while learning evolution because she worries that her religious beliefs may conflict with her understanding of evolution:

**Esmeralda: A lot of conflict → Little conflict**

Esmeralda: I still believe in God. [The program] didn't make me not believe in God anymore. It just made me think of evolution in a more positive way.

Interviewer: In your post-class reflection you said that you do not perceive a conflict between your personal beliefs and evolution. Can you explain your response?

Esmeralda: In my post-class reflection, when the instructor asked if there is still a conflict [between my religious beliefs and evolution] I said, "No," because . . . I just honestly didn't even think about religion. I just thought about it scientifically so [religion] didn't really matter.

Interviewer: Why did you just think about [evolution] . . . ?

Esmeralda: You understand [evolution] easier, I think, because if you think about your religion while they're explaining evolution to you, you're just thinking, "No, God did that."

Other students, such as Kristen, started the evolution module with only a little perceived conflict, but by the end showed no indication that she perceived any conflict between her religious beliefs and evolution:

**Kristen: Little conflict → No conflict**

I think I was confused [before the evolution module]. I was in the middle . . . [Evolution] made more sense but then again, people were saying stuff that could make sense about the God/Creation theory . . . but now I pretty strongly believe in evolution . . . I think that evolution is just a natural process and it's happening every day.

Although most students were able to reduce their perceived conflict between religion and evolution after instruction, none of them started the evolution module perceiving a lot of conflict and ended the evolution module perceiving no conflict. These students almost always made incremental steps toward reducing their perceived conflict between their religious beliefs and evolution.

## Students Reported Aspects of the Evolution Instruction that Reduced Their Perceived Conflict Between Religion and Evolution.

From the interviews, we identified eight distinct aspects of the evolution instruction that students report reduced their perceived conflict between evolution and religion (Table 3). Below we describe each of these aspects, with a supporting student quote. See Table 4 to see which aspects were mentioned by each student. Each aspect is listed from most frequently cited by students to less frequently cited.

**1. Instructor was not forceful about making students accept evolution.** The majority of students said that they appreciated that the instructor allowed for them to form their own opinions about evolution, and they felt as though the instructor was not forcing them to accept evolution. Although the instructor never explicitly said to students that they can choose their own opinions about evolution, the students nonetheless perceived that she was not forcing them to accept evolution. Although it was the instructor's implicit

goal to help students accept evolution, she also did not explicitly tell students that they must accept evolution.

**Gabrielle, A lot of conflict → Some conflict**

Again, [during the course] was when I really was lightening up about evolution because this was I think the first time someone had told me, believe what you want to believe. That's what really stuck to me. It was like this teacher isn't going to force evolution upon me.

**2. Instructor was respectful of students' multiple viewpoints on evolution.** The majority of students noted that the instructor respected that students may hold different viewpoints regarding their religious beliefs and evolution, and that this was helpful in reducing conflict between their religious beliefs and learning evolution. The students were referring to when the instructor stated that she would be teaching evolution based on what is known from science, but that she would remain respectful of students who had different views regarding evolution.

**Esmeralda: A lot of conflict → Little conflict**

Some people take their religion really seriously. For someone to say, "Don't believe in that, believe in this," it's just not right. The instructor didn't do that. She said that she respects everyone's beliefs.

**3. Increased exposure to evolution content.** The majority of students reported that their increased exposure to evolution content influenced their perceived conflict between their religious beliefs and evolution. Some of these first-year biology students had little to no prior knowledge regarding evolution before the module, but students said they had a lower level of perceived conflict after the presentation of scientific evidence. The students were referring to the portion of instruction related to the mechanism of natural selection, the processes of speciation, and the evidence for evolution.

**Colin: Little conflict → No conflict**

When [the instructor] talked about . . . fossils and how they found DNA from all these species that have evolved and stuff, looking back at it, that was probably a main reason that kind of convinced me to feel like this did occur. Because we have some evidence to back it up, something a few years ago, or hundreds of thousands of years ago existed. We have the stuff to prove it, I guess, in a way.

Notably, increased exposure to evolution content was not referring to a part of the six-minute ReCCEE instruction on the potential compatibility between evolution and religion that was directly aimed at decreasing students' perceived conflict.

**4. Instructor presented examples of religious scientist role models.** Some students highlighted that the instructor presented examples of religious scientist role models who have reconciled their religious beliefs with evolution. The students were referring to the portion of instruction where the instructor presented Francis Collins and Theodosius Dobzhansky as famous scientists who have endorsed evolution and also maintained their religious beliefs.

**Gabrielle, A lot of conflict → Some conflict**

I think [my perceived conflict changed] when the instructor was talking about that there have been scientists who have studied evolution and been involved with evolution that still believe in religion. It was just like they were able

**Table 4. Aspects of instruction that students said influenced their level of perceived conflict between religion and evolution.**

Participant	Change in perceived conflict	Did not force student acceptance of evolution	Respect for multiple viewpoints	Exposure to evolution content	Presented religious scientist role models	Acknowledgement of potential conflict between religion and evolution	Presented the bounded nature of science	Described multiple viewpoints	Safe classroom community
Colin	Little conflict → No conflict	✓		✓			✓		
Danielle	Some conflict → No conflict	✓	✓	✓	✓				
Esmeralda	A lot of conflict → Little conflict	✓	✓	✓	✓	✓	✓		
Inez	Some conflict → Little conflict	✓	✓	✓			✓		
Gabrielle	A lot of conflict → Some conflict	✓	✓		✓				
Julianna	A lot of conflict → Some conflict	✓	✓	✓					
Brittany	A lot of conflict → Some conflict	✓			✓	✓		✓	✓
Kristen	Little conflict → No conflict		✓	✓		✓			
Hunter	Some conflict → Some conflict								
Fiona	Some conflict → Some conflict								
		7 out of 10 students	6 out of 10 students	6 out of 10 students	4 out of 10 students	3 out of 10 students	3 out of 10 students	1 out of 10 students	1 out of 10 students

to go through it and still have their relationship and faith in God, but learn and understand evolution.

**5. Instructor acknowledged students' potential conflict between evolution and religion.** Some students said they appreciated when the instructor would acknowledge that students may perceive a conflict between evolution and religion, and that there is a potential conflict between evolution and religion, depending on the specific religious beliefs the students hold. The students were referring to when the instructor addressed the potential conflict between evolution and religion.

**Esmeralda: A lot of conflict → Little Conflict**

I think what was good, what the instructor said, was how she addressed the students who maybe think evolution conflicts with their personal beliefs. I respected how she did that.

**6. Instructor presented the bounded nature of science.** Some students said that they appreciated when the instructor presented religion and science as two separate realms that do not have to conflict with one another if they do not attempt to answer the same types of questions. These students were referring to when the instructor discussed that science and religion can be seen as answering different types of questions about the world; if science is limited to answering questions about the natural world using natural explanations, and religion is limited to answering questions about the existence of the supernatural, the purpose of life, and ethics, then science and religion do not have to conflict with one another.

**Esmeralda, A lot of conflict → Little conflict:**

[The instructor] kind of separated the two [religion and science]. She said, "Don't think about your religion for one second and just think about it scientifically." I did. It kind of clicked. Now I understood why [evolution] doesn't really go against my religion.

**7. Instructor outlined that there are multiple viewpoints about the relationship between religion and evolution.** One student said that the instructor provided examples of different viewpoints regarding the relationship between evolution and religion, and that this made her feel more comfortable learning evolution. The student was referring to when the instructor described special creationism, theistic evolution, agnostic evolution, and atheistic evolution. The instructor also described how special creationism is in direct conflict with scientific evidence, whereas theistic evolution, agnostic evolution, and atheistic evolution are not in direct conflict with scientific evidence.

**Brittany: A lot of conflict → Some conflict**

I felt glad that the instructor understood, she knew, she was showing viewpoints from every perspective. It wasn't just her being biased over one viewpoint. She had a perspective over all the viewpoints. It was comforting to know that she cares about all of the viewpoints, not just one.

**8. Safe classroom community.** One student said that she felt she could safely voice her opinions of evolution to the class and did not feel any pressure to share her ideas with the class. This safe classroom environment helped her to feel like she could share without being judged.

**Brittany: A lot of conflict → Some conflict**

It made me feel safe . . . I felt safer . . . It helped me feel that we could be open and say what we actually thought about evolution without having to go into class and voice it out in front of [a bunch of] people verbally, [we could also choose to] reply to the teacher one-on-one.

## ○ Discussion

In this study, we found that evolution instruction with six minutes of ReCCEE practices about the potential compatibility of evolution and religion can positively impact students who perceive a conflict between their religious beliefs and evolution. This study further expands on the Barnes et al. (2017a) study by providing a higher resolution of students' level of perceived conflict between their religious beliefs and evolution, and illuminating the specific aspects of the evolution instruction that these students thought were important for reducing their perceived conflict with evolution.

The aspects of the evolution module that were most frequently mentioned by students as decreasing their perceived conflict between evolution and religion were: (1) the instructor did not force student acceptance of evolution; (2) the instructor was respectful of multiple viewpoints; and (3) students' increased exposure to evolution content. The third finding is in contradiction to some research, which shows that increased understanding of evolution is only weakly correlated with student acceptance of evolution (Glaze et al., 2014; Nadelson & Sinatra, 2010). However, the introductory biology students in this study had little to no exposure to evolution before this course. Perhaps increased exposure to evolution when students have very limited knowledge could help decrease their perceived conflict between religion and evolution, and increase their acceptance of evolution. Given the design of this study, it impossible to disentangle the impact of the evolution content in the module from the six minutes of ReCCEE practices in the module. Another hypothesis may be that increased exposure to evolution content is effective for decreasing perceived conflict with evolution only in the presence of ReCCEE practices. Future research should compare the influence of evolution content instruction in the presence and in the absence of ReCCEE practices on students' perceived conflict between evolution and religion.

We found that students' level of perceived conflict between religion and evolution may be best described along a spectrum rather than a binary of "Conflict" or "No conflict." Many students showed positive shifts in their perceived conflict between evolution and religion, but still maintained some level of conflict. Previously used binary scales for perceived conflict may not be the best means of measuring student perceptions of conflict between their religious viewpoints and evolution, and we may need more fine-grained scales to provide higher resolution of this conflict. A higher resolution of perceived conflict can potentially lead to the discovery of novel strategies for reducing students' conflict, perhaps even characterizing different strategies that are more effective for students with different levels of conflict.

We found that two of the ten students in this study did not reduce their level of perceived conflict with evolution after the course, but their interviews indicated that they were positively impacted by the instruction. Though these students did not necessarily change their level of perceived conflict, they indicated that

they still appreciated certain aspects of the evolution instruction, including the instruction on the different views of the relationship between evolution and religion. For example, Fiona talked about how she appreciated when the instructor acknowledged the potential conflict between evolution and religion:

**Fiona: Some conflict → Some conflict**

I feel like when the instructor addressed it [the potential conflict between evolution and religion] in the beginning, it sets you up for what the discussion is going to be. The fact that she said, “I am aware that it is a conflict.” And then she backed it up by saying, “I’m not telling you [you are going to be forced to believe].” It didn’t shut me out. I wasn’t like, “Oh this is evolution. I don’t want to hear about it.” She addresses that. She knows and she’s not telling us what to believe. She’s just making us aware.

We do not expect to be able to reduce the perceived conflict between evolution and religion for every student who comes into the evolution class. However, perhaps these particular students who did not show a reduced level of perceived conflict may have needed more exposure to ReCCEE practices, or more time to process it themselves, to change their perception of a conflict.

## ○ Limitations

These findings are limited to one course, one instructor, and a specific population of students. This instruction may not have the same effect in a different context. Future research should look at the impact of this instruction among other populations of students with different instructors. Further, we can only report the results of the six minutes of ReCCEE practices embedded within the evolution module; we do not know the relative influence of the evolution content instruction or the six-minute ReCCEE practices. Future research exploring the impact of each practice in isolation would be an important next step for disentangling which practices, or which combination of practices, are important for reducing students’ perceived conflict. Future research should also explore direct comparisons between six minutes of ReCCEE practices and more extensive implementation of ReCCEE practices to examine if the more extensive instruction reduces students’ perceived conflict to a greater extent, or if this six-minute ReCCEE instruction is sufficient to reduce most students’ perceived conflict.

## ○ Conclusion

In this study, we found that six minutes of Religious Culturally Competent Evolution Education (ReCCEE) practices in combination with instruction on evolution content reduced students’ perceived conflict between religion and evolution. Notably, we found that students reported eight distinct aspects of the evolution instruction as helpful in reducing their perceived conflict (Table 3). This exploratory study shows that a short implementation of ReCCEE practices in conjunction with content instruction on evolution may be able to help reduce students’ perceived conflict. This research also begins to illuminate the specific aspects of instruction that students

recognize are important for reducing perceived conflict between evolution and their religious beliefs.

## ○ Acknowledgments

We would like to acknowledge the Center for Evolution and Medicine at Arizona State University for its support during this project, and a National Science Foundation GRFP award (M.E.B.). Additionally, we would like to thank the Biology Education Research lab for their helpful comments and feedback on this manuscript.

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